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Final
Remedial Investigation Report
of the
Cauterskill Road Site
Catskill, New York

September 1999

Prepared for:

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
50 Wolf Road
Albany, New York 12233-5027

ecology and environment engineering, p.c.

BUFFALO CORPORATE CENTER 368 Pleasant View Drive, Lancaster, New York 14086
Tel: 716/684-8060, Fax: 716/684-0844

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List of Acronyms

AMSL	above mean sea level
ASC	Ecology and Environment Analytical Services Center
AVS	acid volatile sulfide
BCF	bioconcentration factor
BGS	below ground surface
BW	body weight
CFU	central field unit
COPC	chemicals of potential concern
DEE	Division of Environmental Enforcement
E & E	Ecology and Environment Engineering, P.C.
EPA	United States Environmental Protection Agency
EPC	exposure point concentration
FR	area use factor
FS	feasibility study
FSA	Farm Service Agency
FSP	field sampling plan
ft/min	feet per minute
FWIA	Fish and Wildlife Impact Analysis
ha	hectare
HASP	site-specific health and safety plan
HQ	hazard quotient
ID	identification
IDW	investigation-derived waste
IR	ingestion rate
JCL	Joseph C. Lu Engineering and Land Surveying, P.C.
LEL	low-effect level
LOAEL	lowest observed adverse effect level

mS/m	millisiemens/meter
MS/MSD	matrix spike/matrix spike duplicate
ND	non-detect
NOAEL	no observed adverse effect level
NTU	nephelometric turbidity units
NWI	National Wetland Inventory
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OD	outer diameter
OVA	organic vapor analyzer
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
ppt	parts per thousand
PVC	polyvinyl chloride
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
RI	remedial investigation
RPD	relative percent difference
RQD	rock quality designation
SB	site background
SCS	Soil Conservation Service
SEL	severe-effect level
SEM	simultaneously extracted metals
SOP	standard operating procedure
SVOC	semivolatile organic compound
TAGM	Technical and Administrative Guidance Manual
TAL	target analyte list
TCL	target compound list
TCLP	toxicity characteristic leaching procedures
TICs	tentatively identified compounds

List of Acronyms (Cont.)

TOC	total organic carbon
TOIC	top of inner casing
TRV	Toxicity Reference Value
UCL	upper confidence limit
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VOC	Volatile organic compounds

Executive Summary

Ecology and Environment Engineering, P.C. (E & E), under contract to the New York State Department of Environmental Conservation (NYSDEC) (Work Assignment No. D003493-12) performed a Phase I and Phase II Remedial Investigation (RI) between December 1998 and July 1999 at the Cauterskill Road site (NYSDEC Site No. 4-20-024) in Catskill, New York. The purpose of these investigations was to determine the nature, extent, and source of contamination (if any) present at the site and to evaluate the extent to which the contamination poses a threat to human health and the environment.

The site is located at 5040 and 5048 Cauterskill Road in the Town of Catskill, Greene County, New York. It is a private residence situated in a rural area adjacent to the northbound lanes of the New York State Thruway (Route 87). Wastes from the Catskill Chrome Plating Company (NYSDEC Site No. 4-22-023) were reportedly disposed of at the Cauterskill road site from the mid 1980s to December 1992. Several investigations were performed at the site prior to the RI. These investigations included: sampling of groundwater from residential wells; sampling of on-site surface soils; and sampling of surface water from the adjacent tributary to Kaaterskill Creek. Based on the results of these investigations, and testimonies from former Catskill Chrome employees, the site was classified as a Class 2 hazardous waste site.

RI Field Activities

In September 1998, an initial site reconnaissance was performed by E & E and NYSDEC. A work plan was developed by E & E and approved by NYSDEC in November 1998. The Phase I RI field work began in December 1998 and was completed in March 1999. The fieldwork included the following activities:

- Site Reconnaissance;
- Records search;
- Geophysical survey;

- Surface soil, subsurface, groundwater, surface water and sediment, and exposed waste investigation and sampling;
- Development of a site base map; and
- Fish and wildlife impact analysis.

Based on the results of the Phase I RI, additional sampling was performed on July 1, 1999 according to the scoping and costing letter dated June 21, 1999. The Phase II RI fieldwork included the following activities:

- Surface water sampling; and
- Sediment sampling.

Nature and Extent of Contamination

Results of sample analyses from the various sample media collected during the RI indicated the following:

- Surface soils contained six polycyclic aromatic hydrocarbons (PAHs) (benzo[a]anthracene, benzo[a] pyrene, benzo[b]fluoranthene, benzo[j]fluoranthene, chrysene, and dibenzo[a,h]anthracene), one phthalate (di-n-butylphthalate), one polychlorinated biphenyl (PCB) (Aroclor 1260), and nine metals (cadmium, chromium, copper, iron, lead, magnesium, mercury, nickel, and zinc) in excess of screening criteria;
- Subsurface soils contained one volatile (toluene), the same six PAHs as detected in surface soil samples, one pesticide (heptachlor epoxide), and 14 metals (aluminum, cadmium, calcium, chromium, copper, iron, magnesium, mercury, nickel, potassium, selenium, silver, sodium, and thallium) in excess of screening criteria;
- Groundwater from the monitoring wells contained only three metals (iron, sodium, and thallium) in excess of screening criteria. These metals were uniformly detected both upgradient and downgradient of the disposal areas and are not considered to be site related;
- Groundwater from residential wells also only contained three metals (iron, mercury, and sodium) in excess of screening criteria. Once again, these metals are not considered to be site related;
- Surface water from the tributary to Katterskill Creek contained one phthalate (bis[2-ethylhexyl]phthalate) and four inorganics (aluminum, iron, silver, and cyanide) in excess of screening

criteria. The metals exceeded screening criteria in both upstream and downstream samples, therefore, they are not considered site related; however, the cyanide may be site related based on results from a site seep;

- Sediment from the tributary to Kaaterskill Creek contained four PAHs (benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene, and ideno[1,2,3-cd]pyrene) in an upstream sample and the south site pond and seven PAHs downstream of the site, one pesticide (heptachlor epoxide) in the north site pond, and ten metals (antimony, arsenic, cadmium, chromium, copper, iron, lead, manganese, nickel, and zinc) in both upstream and downstream samples;

- Waste (white powder) from the disposal area did not exceed TCLP metals and cyanide reactivity;

- The faulting and folding of the underlying bedrock, which is very near to the surface, has resulted in highly permeable bedding plane and vertical fractures which act as conduits for groundwater contamination migration. Since many fractures are unpredictable, the exact migration pathways are unknown. In addition, due to the presence of the fault line beneath the bed of the tributary, this high hydraulic conductivity zone has resulted in causing the tributary to be a losing stream. Therefore, if contaminants have migrated to the groundwater they do not necessarily discharge to the tributary, but instead migrate into the fault line and move deeper further to the north; and

- The downstream extent of contamination was not determined due to the presence of low levels of cyanide in surface water collected from the farthest downstream point. Other contaminants detected in this downstream sample were also detected upstream of the site, and are therefore considered non-site related.

In general, the nature and extent of contamination has been reasonably defined by the data collected during the RI. The buried disposal area was defined by the geophysical survey and test pit excavations to be a 50-foot wide band along the west embankment of the tributary to Kaaterskill Creek to the north, east, and south of the site barns; the surficial disposal area on the west side of the dirt road in the southeast corner of the site is a secondary source area for contamination; surface soil contamination is limited to the site; subsurface soils have been impacted by the disposal materials; groundwater contamination is not evident; and only minor amounts of contamination have migrated off site through the tributary to Kaaterskill Creek.

Fish and Wildlife Impact Analysis

A fish and wildlife impact analysis was conducted for the Cauterskill Road site and was presented in the draft RI report (E & E 1999). The analysis concluded that aquatic habitat and wildlife resources at the site were potentially at risk from exposure to toxic levels of site-related chemicals. The chemicals of potential ecological concern at the site included six metals (cadmium, chromium, copper, lead, nickel, and zinc) related to disposal of plating wastes at the site, and possibly selected PAHs and PCBs. Terrestrial habitats at the site are suitable for a variety of wildlife species. Aquatic habitat in the site vicinity is limited and appears to support benthic invertebrates and amphibians, but not fish. As per NYSDEC guidance, a toxic effect analysis was undertaken to evaluate the risks that site contaminants pose to these resources.

The risks of contaminant effects on aquatic life appear to be negligible. The results of sediment toxicity tests demonstrated that there are no adverse effects of stream sediment on growth and survival of sensitive species of benthic macroinvertebrates. Levels of various contaminants in sediment were elevated, but the contaminants appear to occur in forms that are not bioavailable or toxic to aquatic organisms. The stream itself provides minimal habitat for aquatic life adjacent to the site, where concentrations of contaminants are highest. The contaminant levels decrease further downstream, where stream habitat quality also improves. Therefore, no additional investigation or remedial action appears to be necessary to address risks to aquatic life.

Terrestrial wildlife, plants, and invertebrates could be impacted by soil contamination at the site, particularly PCBs and certain metals such as cadmium, chromium, lead, and zinc. These impacts were identified using wildlife risk-assessment methods and by screening soil contaminant levels against available benchmarks for plants and soil invertebrates. Although risks are predicted for wildlife, plants, and soil invertebrates, no site-specific biological data are available to verify the risks. Because of the relatively small size of the contaminated areas at the site, and the conservative assumptions used for the risk assessment, it does not seem likely that toxic effects on terrestrial species are widespread or could severely impact communities or populations of organisms resident in the area. No endangered, threatened, or rare species are known to occur at the site and the site itself is not a significant ecological resource. Given the limited value of wildlife resources likely to be impacted, it is not clear that additional study of contaminant uptake and toxicity to terrestrial species is warranted. Remediation of the most contaminated portions of the site would likely eliminate the ecological risks identified in this report.

Recommendations

Due to the presence of exposed product (white powder in fiber-board drums) and the presence of elevated cyanide in a seep from the site, interim remedial measures (IRMs) for the removal of exposed wastes along the embankment should be performed.

1 Introduction

E & E
Ecology and Environment Engineering, P.C.

NYSDEC
New York State Department of Environmental Conservation

RI/FS
remedial investigation/ feasibility study

1.1 Purpose of the Remedial Investigation

Ecology and Environment Engineering, P.C., (E & E), under the State Superfund Contract, New York State Department of Environmental Conservation (NYSDEC) (Work Assignment No. D003493-12), was tasked to perform a remedial investigation/ feasibility Study (RI/FS) at the Cauterskill Road Site (No. 4-20-024) in the Town of Catskill, Greene County, New York (see Figure 1-1).

The purpose of this investigation was to:

- Characterize physical and environmental conditions at the site;
- Determine the nature, extent, and source of contamination present at the site;
- Determine past, present, and anticipated pathways of contaminant release;
- Present maps illustrating contaminant concentrations, potential migration pathways, and data summaries;
- Compare analytical data against federal and state regulatory standards; and
- Identify potential remedial alternatives to mitigate contamination problems that pose threats to public health and the environment as determined by the fieldwork and risk assessment.

1.2 Site Background

1.2.1 Site Description and Surrounding Land Uses

The Cauterskill Road Site is a private residence, currently owned by Patricia Helmadach, located at 5040 and 5048 Cauterskill Road in the Town of Catskill, Greene County, New York (see Figures 1-1 and 1-2). It is located on the east side of Cauterskill Road (County Highway 47) north of State Route 23A, approximately 2 miles southwest of the Village of Catskill. This Class 2 site includes all areas of the property used for the storage/disposal of off-spec plating solutions and untreated plating sludges prior to 1993.

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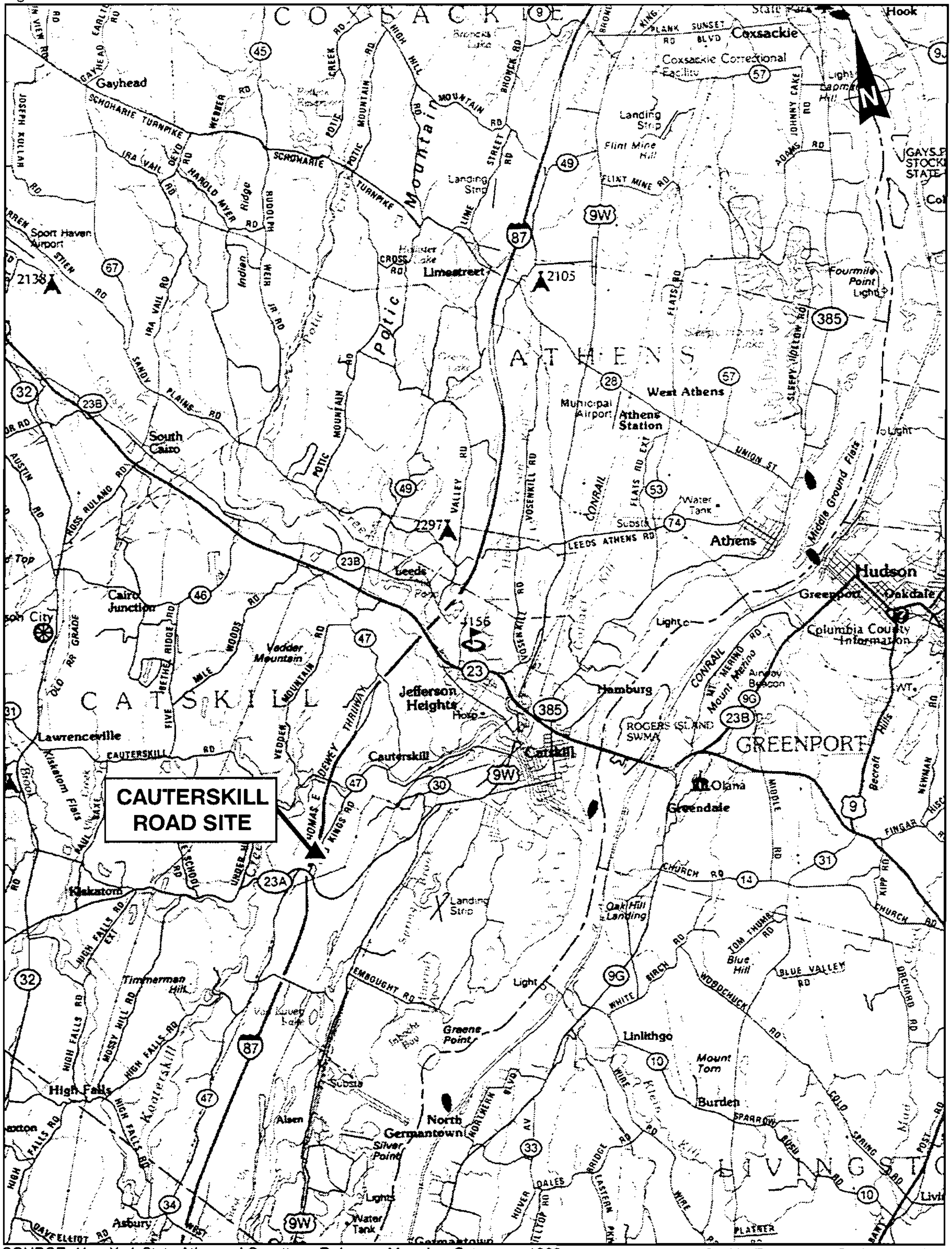
Fig1-1.CDR-4/5/99-GRA



SOURCE: *New York State Atlas and Gazetteer*, DeLorme Mapping Company, 1988.

APPROXIMATE SCALE

0 1 2 Miles

Figure 1-1 CAUTERSKILL ROAD SITE LOCATION

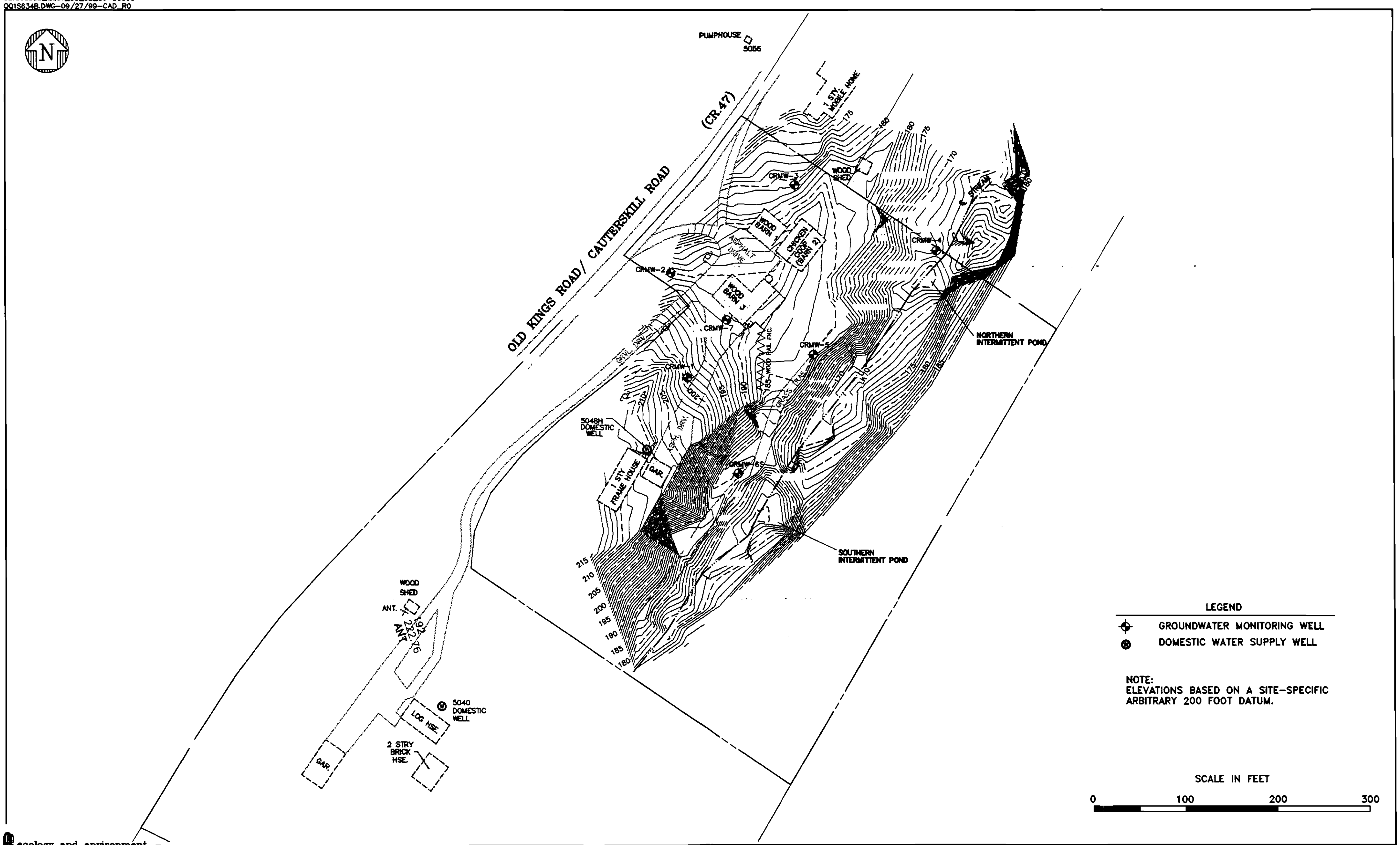


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Figure 1–2 SITE PLAN
CAUTERSKILL ROAD SITE
CATSKILL, NEW YORK

The plating wastes originated from the former Catskill Chrome Plating Company (NYSDEC Site No. 4-22-023) located at 370 West Bridge Street in the southwest corner of the Village of Catskill. Although the original 13.3-acre parcel has been subdivided into two parcels (5.4 acres to the north [5040 Cauterskill Road] and 7.9 acres to the south [5048 Cauterskill Road]), wastes are only believed to have been stored/disposed of on 0.5 acre of the northern parcel. Some portions of the property are covered with various fill materials including asphalt, metal debris, tires, domestic trash, and empty steel drums. Drums of waste and off-spec material are also believed to be buried at the site. During the site reconnaissance (see Section 3.2), exposed wastes, metallic machinery, and other debris were noted along the embankment adjacent to the intermittent tributary between the base of the slope next to the 5040 residence and a dirt road along the tributary (see Figure 1-2).

NYS
New York State

AMSL
above mean sea level

The site is in a rural area of Catskill, just east of the northbound lanes of the New York State (NYS) Thruway (Route 87). Private residences are located immediately to the north of the site, and the Town of Catskill Highway Department is located immediately to the south along Cauterskill Road. The land to the east of the property is undeveloped and owned by Peckham Materials Corporation. Elevations on the site property range from approximately 170 feet above mean sea level (AMSL) to 280 feet AMSL (USGS 1980). The southern parcel is partially wooded and contains a log house, a two-story brick house, a shed, and a garage. The northern parcel is also partially wooded and contains a one-story frame house, garage, two wood barns, and a chicken coop (see Figure 1-2). Grassy areas are located on both sides of the barns and chicken coop. A north/south trending ravine, approximately 15 feet deep, traverses through the center of both parcels. The ravine contains an intermittent tributary to Katterskill Creek. Katterskill Creek is located approximately 0.7 mile north of the site property. North/south-striking rock outcrops are present along the western, central, and eastern portions of the site, resulting in steep slopes along these rock faces.

1.2.2 Site History

The Cauterskill Road site was the location of the personal residence of Henry Helmedach Jr. and his wife Evelyn Helmedach, the former owners of the Catskill Chrome Plating Company. The plating company, located at 370 West Bridge Street, was in operation from 1948 until January 1993. Wastes from the facility were reportedly disposed of at the Cauterskill Road site from the mid 1980s until December 1992. These wastes consisted of an undetermined amount of off-spec plating solutions; untreated plating sludges containing cyanide, chromium, cadmium, copper, nickel, and zinc, and tanks of acid and rinse water. In 1994, their son Paul Helmedach pleaded guilty to disposing of these wastes in over 0.5

acre of the site. The site is currently owned by Patricia Helmedach.

1.2.3 Previous Site Investigations

Several investigations into the site's environmental conditions have previously been conducted. These included the testing of residential wells by the New York State Department of Health (NYSDOH); and soil and water sampling for NYSDEC by one of its contractors.

NYSDOH
New York State Department of Health

DEE
Division of Environmental Enforcement

CFU
central field unit

Drinking water samples were collected from several residences on Cauterskill Road by NYSDOH as early as May 9, 1989 and submitted for metals and VOC analyses. The only compound reportedly detected above regulatory limits was sodium.

In March 1993, Roy F. Weston collected several soil samples from the site and submitted them for metals analyses. High levels of several metals were detected, including cyanide.

An investigation of the site by the law enforcement division of NYSDEC culminated with an application for a search warrant submitted April 22, 1993. The investigation included interviews with several former employees of Paul Helmedach, all of which confirmed the dumping of wastes from the plating company at the residence. Allegedly, drums of material were either emptied over the embankment of the tributary to Kaaterskill Creek that runs along the eastern side of the property, or buried at the site. Dumped wastes identified by these former employees included spent plating solutions, unidentified acids, old chrome stripping solution, and old potash. The investigation also discovered that when activities at West Bridge Street terminated in December 1992, some of the operations were moved to the garage next to Helmedach residence. In January 1993, when equipment was being moved to the garage, a large (approximately 4,000 pounds) pile of hardened cyanide waste was dumped in a clearing behind the barns at the site. Interviewees also stated that waste from a Schenectady electroplater was dumped at the property. Analysis of aerial photographs taken of the property, and an independent investigation performed around the same time by the office of the Attorney General of the State of New York, confirm some of these activities.

In April 1993, execution of the search warrant resulted in the sampling of containers, soil, surface water, and sediment, performed by the Division of Environmental Enforcement (DEE) Bureau of Technical Services Central Office and Central Field Unit (CFU), accompanied NYSDEC personnel. This also confirmed the dumping of rubbish along the embankment of the stream.

In December 1993, NYSDEC collected two surface water samples, one upstream and one downstream of the site, and analyzed for cadmium, copper, nickel, zinc, and cyanide. Only low levels of zinc were detected. Additionally, two surface soil samples, one from a depression at the north end of the site and one from a stained area near a tractor trailer at south end of the site were collected and analyzed for the same suite of metals. Concentrations of all these metals was determined to be high in both samples.

On January 20, 1994, NYSDOH collected samples of drinking water from the Helmedach and surrounding residences and submitted them for VOC, ketone, inorganics, and cyanide analysis. Only sodium was determined to be present at elevated levels.

On February 10, 1997, a NYSDEC site investigation was conducted to confirm the presence of high levels of cyanide, cadmium, and chromium in soil. Additionally, surface water samples were collected from the tributary to Kaaterskill Creek. Based on the results of this investigation, the site was classified as a Class 2 hazardous waste site.

On February 21, 1997, NYSDOH conferred the classification Class 2 to the site.

In November 1999, E & E submitted an RI/FS work plan to NYSDEC, and Phase I RI field investigations were conducted in December 1998, and January and March 1999. During this time period, NYSDEC performed a removal action of chemicals reported to be stored at the site. Based on the results of the Phase I RI, a one-day Phase II RI field sampling event was conducted in July 1999 to further characterize the intermittent tributary running through the site. This report describes the findings of both the Phase I and II RI.

2 Remedial Investigation Field Activities

JCL
Joseph C. Lu Engineering and Land Surveying, P.C.

FSP
Field Sampling Plan

QAPP
Quality Assurance Project Plan

HASP
Health and Safety Plan

2.1 Introduction

RI field investigations at the Cauterskill Road Site consisted of several activities conducted to identify the physical characteristics of the study area. These activities included: a site reconnaissance; records search; geophysical survey; surface soil, subsurface soil, groundwater, surface water and sediment, and exposed waste investigations and sampling; development of a site base map; and a fish and wildlife impact analysis. Field activities were conducted during four different field efforts. The first field effort was conducted between December 9 and 15, 1998. During this effort, a geophysical/surface soil sampling grid was installed, the geophysical survey was performed, and one waste sample and all surface soil and sediment samples CRSD-1 through -9 were collected. Ambient air temperatures were above freezing, and the ground was not yet frozen for the season. The second field effort was conducted between January 5 and January 29, 1999. During this effort, test pit excavation and sampling, soil boring and sampling, monitoring well installation, development, sampling, and aquifer permeability testing, surface water sampling, and the remainder of the waste sampling were conducted. During nearly all of January's field activities, ambient air temperatures were below freezing with significant snow and ice cover. Surface water sampling was conducted on January 26, 1999 during a brief thaw period. The third field effort was conducted on March 4 and 5, 1999. This effort included the fish and wildlife impact analysis and collection of another round of groundwater elevation measurements. The last field effort was conducted on July 1, 1999. This effort included additional surface water/sediment sampling from the tributary to Kaaterskill Creek.

All field activities were conducted by an E & E and Joseph C. Lu Engineering and Land Surveying, P.C. (JCL) field team consisting of two geologists in accordance with the Field Sampling Plan (FSP), Quality Assurance Project Plan (QAPP), and site-specific Health and Safety Plan (HASP) included in the November 1998 work plan and the July 21, 1999 scoping letter. In accordance with the HASP, a health and safety officer was maintained on site throughout the field program to ensure that personnel were protected from both physical and chemical health hazards.

OVA
organic vapor analyzer

VOCs
volatile organic compounds

Appropriate protective clothing were worn by site workers while performing intrusive activities for protection against contamination and to prevent cross contamination between sample locations. An organic vapor analyzer (OVA) and hydrogen cyanide monitor were used to assess the concentration of volatile organic compounds (VOCs) and hydrogen cyanide gas, respectively, in the workers breathing zone, excavation trenches, boreholes, and from soil and water samples. VOC concentrations above background were screened for methane content using a carbon filter (i.e., methane passes through the carbon while most other hazardous VOCs are adsorbed). In addition to these instruments, an oxygen/explosimeter and mini-ram aerosol monitor were also used during intrusive activities to monitor explosive conditions and dust inhalation, respectively. A walkover of the site was also performed with a radiation alert monitor to screen for abnormally high radiation emission.

The methodologies and specific goals of each of the aforementioned activities are described below in Sections 2.2 through 2.12.

2.2 Site Reconnaissance

Prior to work plan development, a site reconnaissance was performed on September 23, 1998 by E & E and NYSDEC personnel to identify the following:

- Visible signs of contamination;
- Types and tentative locations of sample media; and
- Drill rig access.

A complete walkover of the site was performed, and photographs were taken to document existing site conditions (see Appendix A). Based on the site reconnaissance, two disposal areas were evident: buried wastes, machinery, and other debris (wood, glass, asphalt, domestic refuse) along the west bank of the tributary to Kaaterskill Creek, east of the Barns; and exposed empty 55-gallon drums, machinery, tires, and other debris along the base of the slope east of the 5048 residence, on the west side of the dirt road along the tributary to Kaaterskill Creek. Disposal appeared to be only on the northern 5.4-acre parcel.

E & E also met with Village of Catskill Water and Sewer Department personnel to identify whether public water or sewer service is provided to residences on Cauterskill Road. It was determined that all of Cauterskill Road residences use private wells and septic systems.

2.3 Record Search

Review of available records was performed in September and December 1998, and January 1999. The records obtained include: the 1986 property deed; an application for search warrant of the property; the site remedial status report; the inactive hazardous waste disposal report; tax maps; aerial photos, data from previous on-site sampling and surrounding residential well sampling; and various other information from local agencies. Table 2-1 summarizes the agencies contacted and the information obtained. This data was used to assist in developing a further understanding of the site and to select sample locations.

2.4 Geophysical Survey

A geophysical survey was performed at the Cauterskill Road site by an E & E geotechnical team on December 14, 1998. The survey was performed using a Geonics Ltd. Model EM31-MK2 ground conductivity meter and an EG & G Geometrics Model G-856 proton precession magnetometer. The ground conductivity meter was used to identify changes in soil/rock conductivity resulting from natural geohydrologic or unnatural conditions (i.e., man-made) such as buried drums, wastes and debris, or possibly a contaminant plume. The magnetometer was used to identify changes in the earth's magnetic field due to the presence of buried ferromagnetic objects (i.e., drums, tanks, etc.).

A survey grid was established at the site on December 9, 1998. The grid encompassed approximately 100,000 square feet (see Figure 2-1). The grid consisted of pin flags at grid nodes and lines spaced at 25-foot intervals. Wood lath stakes were placed in the corners of the grid. The X and Y axes were oriented S65E and N25E, respectively, using a 13° west magnetic declination correction (USGS 1980).

mS/m
millisiemens/meter

ppt
parts per thousand

Magnetic and ground conductivity measurements (both quadrature-phase and in-phase components) were collected at each survey station. Magnetic readings were recorded in units of gammas. The quadrature-phase component, which is linearly related to ground conductivity, is measured in units of millisiemens/meter (mS/m) or millimhos/meter (i.e., 1 siemen = 1 mho). The in-phase component, which represents the ratio between the primary magnetic field generated by the EM31 and the secondary magnetic field generated in the earth, is measured in units of parts per thousand (ppt). Quadrature-phase and in-phase readings were collected with the instrument oriented in two directions (north/south and east/west). Since instrument readings are affected by the relative position of the instrument with respect to the orientation of an elongated buried object which may cause an anomaly, collection of separate readings at two instrument orientations ensures that the object will be detected.

Table 2-1 Agencies Contacted and Summary of Information Obtained, Cauterskill Road Site

Contact	Information Obtained
Agency: Farm Service Agency, Columbia Green Office Address: 1024 Rt. 66, Ghent, NY 12075 Contact: Ketchum, Harry Title: Clerk Telephone Number: 518-828-4385	1967 and 1980 aerial photographs of site.
Agency: Green County Soil and Water Conservation Address: HC3, Box 907, Cairo, NY 12413 Contact: Demerest, Jason Title: Clerk Telephone Number: 518-622-3620 Fax Number: 518-622-0344	Soil survey of Green County, and aerial photographs.
Agency: Green County Tax Office Address: 288-292 Main Street, Catskill, NY 12414 Contact: Stein, William D. Title: Tax Map Technician Telephone Number: 518-943-6977 Fax Number: 518-943-6721	Tax map; Listing of property owners.
Agency: NYSDEC Address: 50 Wolf Road, Building 4, Room 105, Albany, NY 12233-7010 Contact: Carpenter, Kevin Title: Project Manager Telephone Number: 518-457-3555 Fax Number: 518-485-1820	Application for search warrant of Cauterskill Road property; Department of Health sampling reports; 1993 aerial photograph of the site; Site Remedial Status Report; Inactive Hazardous Waste Disposal Report.
Agency: NYSDOT, Mapping Unit Address: 1220 Washington Ave., Building 4, Room 105, Albany, NY 12232 Contact: Johnson, Bill Title: Mapping Unit Manager Telephone Number: 518-457-3555 Fax Number: 518-485-1820	Aerial photographs: 1962 1968 1972 1974 1993

Table 2-1 Agencies Contacted and Summary of Information Obtained, Cauterskill Road Site

Contact	Information Obtained
Agency: Town of Catskill Address: 439 Main Street, Catskill, NY 12414 Contact: DeVeccio, John Title: Building Inspector Telephone Number: 518-943-2381	No records for Cauterskill Road site.
Agency: Town of Catskill Address: 439 Main Street, Catskill, NY 12414 Contact: Deyo, Jean Title: Town clerk Telephone Number: 518-943-2141	No records of private wells.
Agency: USDA Farm Service Agency Address: 1024 Rt. 66, Ghent, NY 12075 Contact: Carachet, Cecilia Title: Aerial Photography clerk Telephone Number: 518-828-4385 Fax Number: 518-828-0166	List of available aerial photographs of the site.
Agency: Village Water/Sewer Superintendent Address: West Bridge Street, Catskill, NY 12414 Contact: Tice, Bill Title: Superintendent Telephone Number: 518-943-5505	Village does not provide Town with sewer service. Homes on Cauterskill Road have septic systems.
Agency: Water Department, Village of Catskill Address: West Bridge Street, Catskill, NY 12414 Contact: June, Lyle Title: Foreman Telephone Number: 518-943-5505	Village does not provide Town with municipal water. Cauterskill Road water supply is private wells.

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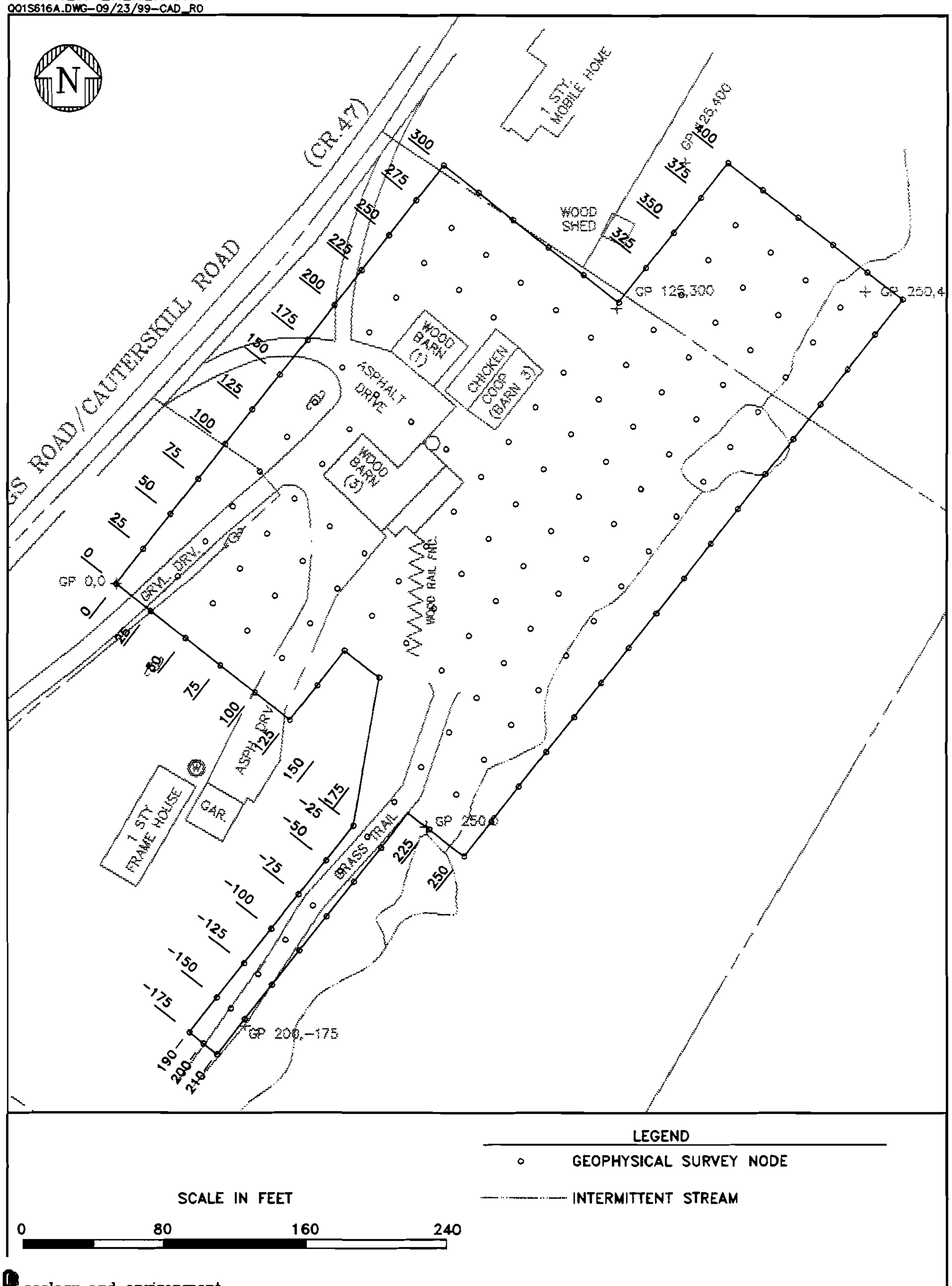

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Figure 2–1
GEOPHYSICAL SURVEY LOCATION MAP
CAUTERSKILL ROAD, CATSKILL, NEW YORK

BGS
below ground surface

ID
sample identification

Measurements were also made in both the vertical and horizontal dipole mode. The vertical mode allows for greater instrument penetration (i.e., down to 18 feet below ground surface [BGS]), as opposed to lesser instrument sensitivity and penetration in the horizontal mode (i.e., less than 9 feet BGS). Therefore, a total of eight different EM31 readings (vertical dipole oriented north/south: conductivity [V1C] and in-phase [V1I]; horizontal dipole oriented north /south: conductivity [H1C] and in-phase [H1I]; vertical dipole oriented east/west: conductivity [V2C] and inphase [V2I]; and horizontal dipole oriented east/west: conductivity [H2C] and in-phase [H2I]) were collected at each survey station.

All instrument readings were electronically stored by the instruments. The data were later downloaded using software provided with the instruments, and processed using Surfer Version 6.0 (Golden Software 1995). Section 5.2 of this report provides geophysical interpretations.

2.5 Surface Soil Investigation

Forty-two surface soil samples (CRSS-1 through CRSS-42) were collected at the Cauterskill Road site on December 10 and 11, 1998 by the E & E and JCL field team. At the time of surface soil sample collection, ambient temperatures were above freezing and the ground was not yet frozen for the season. The samples were collected from a depth of 0 to 2 inches BGS at randomly selected nodes along a grid with 25-foot spacings as indicated in the work plan (see Figure 2-2). Although the work plan states that 41 samples were to be collected, one sample (CRSS-42) was added, at the request of the NYSDEC project manager, from the floor inside Barn 3 (see Figure 2-2). Table 2-2 summarizes the surface soil sample identification (ID) number, date, analyses, location, and lithology of each sample.

The primary contaminants of concern in surface soils at this site are metals. The evaluation of metals is complicated by the natural presence of metal in soil. Therefore, to ensure that the evaluation of metals in soils at the site is meaningful, an average background soil concentration was established through collection of five off-site background surface soil samples (CRSS-BG-1 through CRSS-BG-5). These were collected from the site property along hill slopes south and east (east side of the tributary to Kaaterskill Creek) of the disposal areas (see Figure 2-2). These sample locations are topographically upgradient of the site; thus it is highly unlikely they ever received solid or liquid effluent from the disposal areas.

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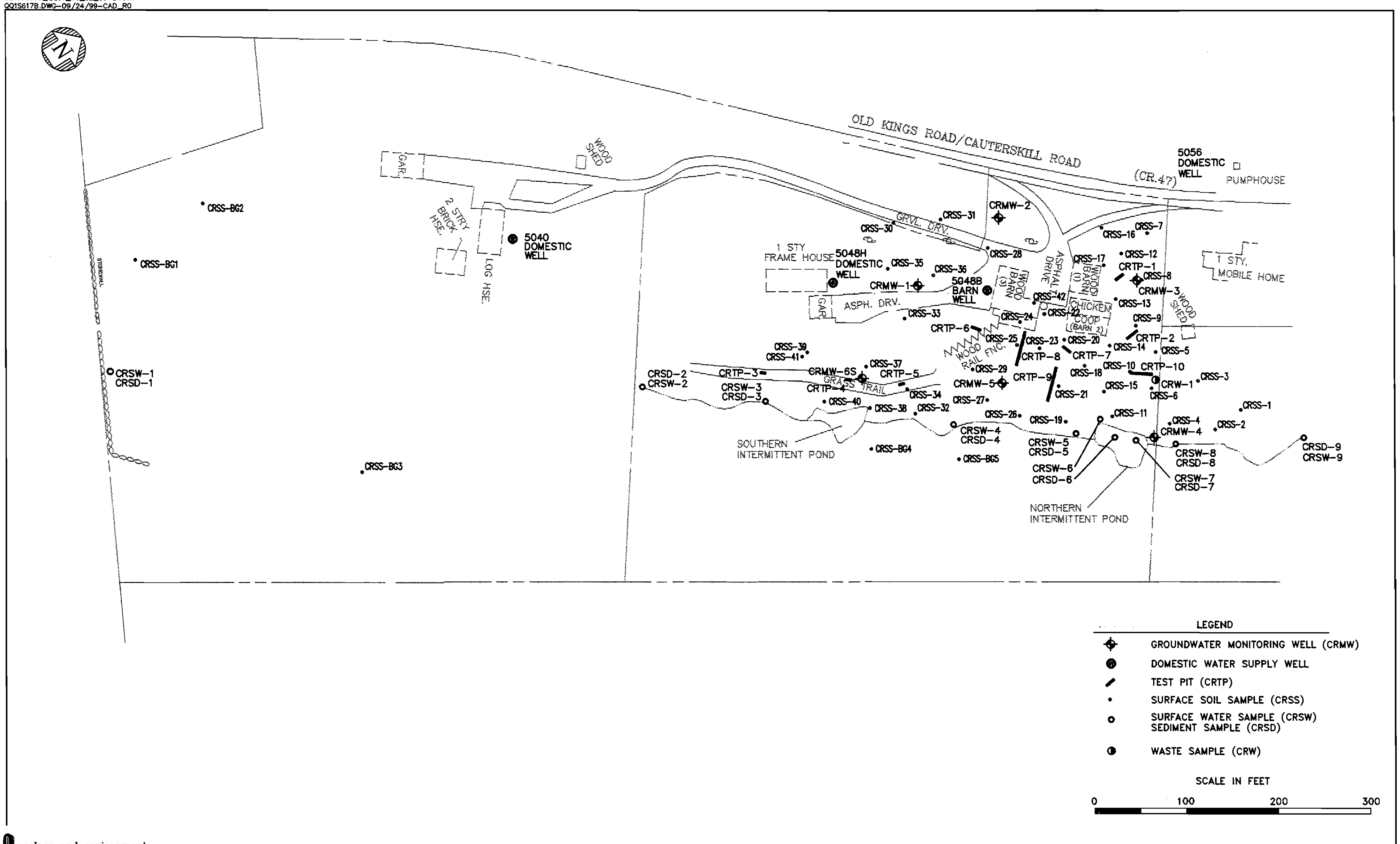

ecology and environment

Figure 2-2a PHASE I RI SAMPLE LOCATIONS
CAUTERSKILL ROAD
CATSKILL, NEW YORK

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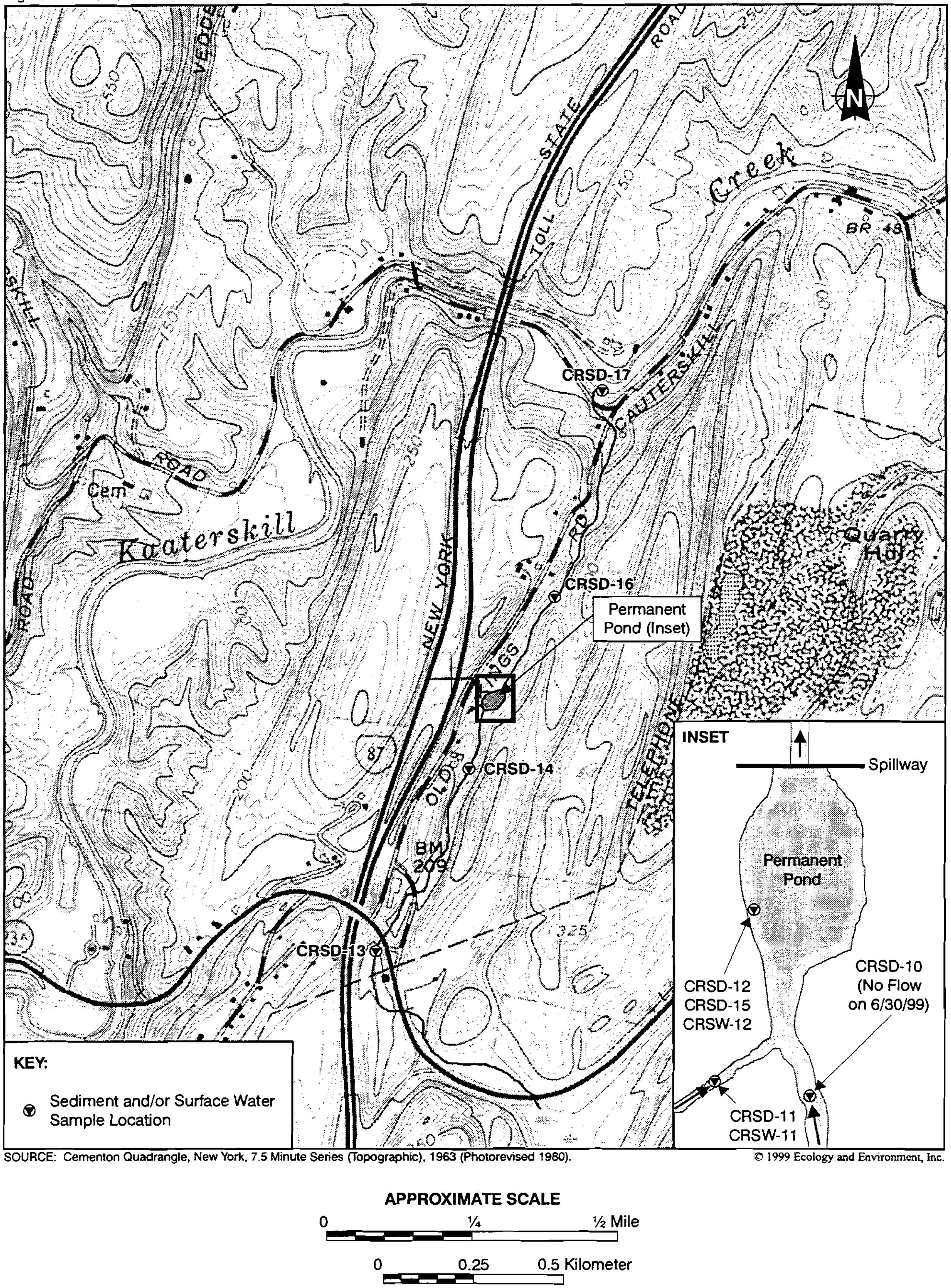
Fig2-2b.CDR-9/22/99-GRA



SOURCE: Cementon Quadrangle, New York, 7.5 Minute Series (Topographic), 1963 (Photorevised 1980).

Figure 2-2b PHASE II RI SAMPLING LOCATIONS ON TRIBUTARY TO KAATERSKILL CREEK

Table 2-2 Surface Soil Sample Summary, Cauterskill Road Site

Sample Number	Sample Date	Analyses	Description
Surface Soils - Background			
CRSS-BG-1	12/10/98	TCL VOCs, TCL SVOCs, TCL Pest/PCBs, TAL Metals, CN, and Cr^{+6}	Location: On slope of hill on west side of creek, south of site, just north of a stone wall; 0-2" depth. Lithology: Dark brown organic loam.
CRSS-BG-2	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: Top of hill on west side of creek, south of site; 0-2" depth. Lithology: Dark brown gravelly sand and silt.
CRSS-BG-2/D	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Field duplicate of sample CRSS-BG-2.
CRSS-BG-3	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: West facing slope on east side of creek, SE of the site; 0-2" depth. Lithology: Dark brown/black loam.
CRSS-BG-4	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: West facing slope on east side of creek, SE of the site; 0-2" depth. Lithology: Dark brown/black organic soil.
CRSS-BG-5	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: West facing slope on east side of creek, east of the site; 0-2" depth. Lithology: Dark brown organic soil.
Surface Soils - On Site			
CRSS-1	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: Wooded area downgradient of site on creek floodplain; geophysical grid location (175,400); 0-2" depth. Lithology: Brown gravelly loam.
CRSS-2	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: Wooded area downgradient of site on creek floodplain; geophysical grid location (200,375); 0-2" depth. Lithology: Dark brown gravelly loam.

Table 2-2 Surface Soil Sample Summary, Cauterskill Road Site

Sample Number	Sample Date	Analyses	Description
CRSS-3	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: Wooded area downgradient of site on creek floodplain; geophysical grid location (150,350); 0-2" depth. Lithology: Brown gravelly loam.
CRSS-4	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: Wooded area downgradient of site on creek floodplain; geophysical grid location (200,325); 0-2" depth. Lithology: Dark brown clayey loam.
CRSS-4/D	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Field duplicate of sample CRSS-4.
CRSS-5	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: North end of site near tree-line; geophysical grid location (125,300); 0-2" depth. Lithology: Dark brown gravely loam.
CRSS-6	12/10/98	TCL VOCs, TCL SVOCs, TCL Pest/PCBs, TAL Metals, CN, and Cr^{+6}	Location: North end of site at toe of fill area; geophysical grid location (162.5,300); 0-2" depth. Lithology: Silty sand beneath leaves and waste metal.
CRSS-6/D	12/10/98	TCL VOCs, TCL SVOCs, TCL Pest/PCBs, TAL Metals, CN, and Cr^{+6}	Field duplicate of sample CRSS-6.
CRSS-7	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: Grassy area near tree line on west side of site; geophysical grid location (0,275); 0-2" depth. Lithology: Dark brown sandy, silty loam.
CRSS-8	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: Brushy area north of Barn 1; geophysical grid location (50,275); 0-2" depth. Lithology: Dark brown gravelly loam beneath brush
CRSS-9	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: Grassy area north of chicken coop; geophysical grid location (100,275); 0-2" depth. Lithology: Dark brown loam.

Table 2-2 Surface Soil Sample Summary, Cauterskill Road Site

Sample Number	Sample Date	Analyses	Description
CRSS-10	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: Grassy area NE of chicken coop; geophysical grid location (150,275); 0-2" depth. Lithology: Dark brown sand and gravel, loose, no vegetation.
CRSS-11	12/10/98	TCL VOCs, TCL SVOCs, TCL Pest/PCBs, TAL Metals, CN, and Cr^{+6}	Location: NE corner of site at toe of fill area; geophysical grid location (200,262.5); 0-2" depth. Lithology: Shaley silt, sand , and clay .
CRSS-12	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: Grassy area NW of Barn 1; geophysical grid location (25,250); 0-2" depth. Lithology: Dark brown gravelly loam beneath grass.
CRSS-13	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: Brushy area near NE corner of the chicken coop (Barn 2); geophysical grid location (75,250); 0-2" depth. Lithology: Dark brown gravely loam.
CRSS-14	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: Grassy area near NE corner of chicken coop; geophysical grid location (125,250); 0-2" depth. Lithology: Brown loose gravel, silt beneath grass.
CRSS-14/D	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Field duplicate of sample CRSS-14.
CRSS-15	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: Grassy area near NE corner of site; geophysical grid location (175,250); 0-2" depth. Lithology: Dark brown gravely loam and brown clay.
CRSS-16	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: Near brush line on west side of site; geophysical grid location (0,225); 0-2" depth. Lithology: Dark brown silty and sandy loam.
CRSS-17	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: Near NW corner of Barn 1; geophysical grid location (40,233); 0-2" depth. Lithology: Dark brown gravelly loam.
CRSS-18	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: Grassy area east of chicken coop; geophysical grid location (150,225); 0-2" depth. Lithology: Gravel and tan clay.

Table 2-2 Surface Soil Sample Summary, Cauterskill Road Site

Sample Number	Sample Date	Analyses	Description
CRSS-19	12/10/98	TCL VOCs, TCL SVOCs, TCL Pest/PCBs, TAL Metals, CN, and Cr^{+6}	Location: Toe of fill area on east side of site; geophysical grid location (212.5,212.5); 0-2" depth. Lithology: Shaley sand, silt, clay, asphalt.
CRSS-20	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: Near SE corner of chicken coop; geophysical grid location (125,200); 0-2" depth. Lithology: Compacted gravel.
CRSS-21	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: Brush line on east side of site; geophysical grid location (175,200); 0-2" depth. Lithology: Soft loose, medium/fine gravel, no vegetation.
CRSS-22	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: Adjacent to east side of silo; geophysical grid location (100, 175); 0-2" depth. Lithology: Mounded soft, loose loam with glass fragments.
CRSS-23	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: NE of Barn 3; geophysical grid location (137.5,175); 0-2" depth. Lithology: Soft, loose gravel and silt, dead grass.
CRSS-24	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: Under overhang on east side of Barn 3; geophysical grid location (112.5, 150); 0-2" depth Lithology: Soft sandy loam.
CRSS-25	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: Small drainage ditch on east side of Barn 3; geophysical grid location (137.5,150); 0-2" depth. Lithology: Brown loose gravel/silt
CRSS-25/D	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Field duplicate of sample CRSS-25.
CRSS-26	12/10/98	TCL VOCs, TCL SVOCs, TCL Pest/PCBs, TAL Metals, CN, and Cr^{+6}	Location: Toe of fill area on east side of site; geophysical grid location (212.5,162.5); 0-2" depth. Lithology: Tan brown clayey/silty soil beneath leaves and metal.
CRSS-27	12/10/98	TCL VOCs, TCL SVOCs, TCL Pest/PCBs, TAL Metals, CN, and Cr^{+6}	Location: Slope of fill area on east side of site; geophysical grid location (200,125); 0-2" depth. Lithology: Gravelly, sandy, silty clay.

Table 2-2 Surface Soil Sample Summary, Cauterskill Road Site

Sample Number	Sample Date	Analyses	Description
CRSS-28	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: East side of driveway to 5040 residence, near brick pillar; geophysical grid location (37.5,87.5); 0-2" depth. Lithology: Dark brown gravelly loam.
CRSS-29	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: Grassy area east of wooden fence, SE of Barn 3; geophysical grid location (170,100); 0-2" depth. Lithology: Brown sandy loam, no vegetation.
CRSS-30	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: West side of driveway to 5040 residence; geophysical grid location (15,50); 0-2" depth. Lithology: Dark brown gravelly loam under grass.
CRSS-31	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: Brushy area west of driveway to 5048 residence; geophysical grid location (75,50); 0-2" depth. Lithology: Dark brown sandy loam beneath brush.
CRSS-32	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: Slope of fill area north of manmade dam on creek; geophysical grid location (225,50); 0-2" depth. Lithology: Dark brown sandy loam beneath brush.
CRSS-33	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: East side of driveway to 5048 residence; geophysical grid location (125,25); 0-2" depth. Lithology: Dark brown sand and gravel beneath grass.
CRSS-34	12/10/98	TCL VOCs, TCL SVOCs, TCL Pest/PCBs, TAL Metals, CN, and Cr^{+6}	Location: On dirt road adjacent to manmade dam on creek; geophysical grid location (200,37.5); near wastes; 0-2" depth. Lithology: Silty clayey loam; moist; only moss is growing; iron staining from metal washers.
CRSS-35	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: East side of driveway to 5040 residence; geophysical grid location (25,0); 0-2" depth. Lithology: Dark brown fine sand/silt loam beneath moss.
CRSS-36	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: Brushy area on west side of driveway to 5048 residence; geophysical grid location (75,0); 0-2" depth. Lithology: Dark brown sandy/gravelly topsoil; high brush.

Table 2-2 Surface Soil Sample Summary, Cauterskill Road Site

Sample Number	Sample Date	Analyses	Description
CRSS-37	12/10/98	TCL VOCs, TCL SVOCs, TCL Pest/PCBs, TAL Metals, CN, and Cr^{+6}	Location: West side of dirt road in SE corner of site; geophysical grid location (182,-10); below drum; 0-2" depth. Lithology: Silty sand; dry.
CRSS-38	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: Near NW corner of southern site pond; geophysical grid location (225,0); 0-2" depth. Lithology: Dark brown, gravelly sand and silt.
CRSS-39	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: Drum/tire disposal area on west side of dirt road in SE corner of site; 0-2" depth. Lithology: Organic, dark brown material.
CRSS-40	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: Drum/tire disposal area on west side of dirt road in SE corner of site; 0-2" depth. Lithology: Dark brown gravelly sand and silt.
CRSS-40/D	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Field duplicate of sample CRSS40.
CRSS-41	12/10/98	TCL VOCs, TCL SVOCs, TCL Pest/PCBs, TAL Metals, CN, and Cr^{+6}	Location: Drum/tire disposal area on west side of dirt road in SE corner of site; 0-2" depth. Lithology: Dark brown sandy loam; organic odor.
CRSS-42	12/10/98	Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: Inside Barn 3 beneath former chemical staging area; 0-2" depth. Lithology: Light brown silt.

Key:

Cd = Cadmium.
CN = Total cyanide.
Cr = Chromium.
Cr^{+6} = Hexavalent chromium.
Cu = Copper.
TAL = Target analyte list.
Ni = Nickel.
NE = Northeast.
NW = Northwest.
Pb = Lead.
PCB = Polychlorinated biphenyl.
Pest = Pesticide.
SE = Southeast.
SVOC = Semivolatile organic compound.
SW = Southwest.
TCL = Target compound list.
VOC = Volatile organic compound.
Zn = Zinc.

MS/MSDs
matrix spike/matrix spike duplicates

ASC
Analytical Services Center

In addition to the field samples, QA/QC samples, including duplicate samples, trip blanks, and matrix spike/matrix spike duplicates (MS/MSDs) were also collected. All samples were submitted to E & E's Analytical Services Center (ASC), and Friend Laboratory, Inc. for analysis. Results of QA/QC samples are discussed in Section 4, and surface soil results are discussed in Section 5.3.

2.6 Subsurface Soil Investigation

Subsurface soil sampling was conducted during two investigative activities at the site; test pit excavations and monitoring well installations. Each activity is described below.

2.6.1 Test Pit Excavations

Ten test pits (CRTP-1 through CRTP-10) were excavated and backfilled between January 5 and January 8, 1999 by SJB Services, Inc. under the supervision of the E & E and JCL field team. The purpose of the test pit excavations and sampling was to determine the composition of the subsurface and delineate the fill areas through visual observations and chemical analyses. Test pit locations were selected based on physical site features and geophysical survey results (see Figure 2-2). Test pits were excavated with a Kobelco TLK 760 Extend-a-Hoe per the methodology described in the work plan (E & E 1998).

At least one soil sample was collected from all but one pit: test pit 1 did not present any unusual soil conditions; therefore, a sample was not collected from this pit. Due to the extended length of test pits 8 and 9 (i.e., 36 feet and 43 feet, respectively), two samples were collected from each of these pits, at the direction of the NYSDEC site manager.

All test pit subsurface soil samples were collected directly from the backhoe bucket using a dedicated stainless-steel spoon. Table 2-3 provides a summary of physical test pit excavation data including the date of excavation, depth, length, air monitoring readings, and soil description. Table 2-4 provides a summary of test pit subsurface soil sampling including sample date, depth, analyses, and physical description.

In addition to the field samples, QA/QC samples, including duplicate samples, trip blanks, and MS/MSDs, were also collected. All samples were submitted to E & E's ASC for analysis. Results of QA/QC samples are discussed in Section 4, and test pit soils results are discussed in Section 5.4.1.

Analytical results of test pit soil samples are presented in Section 5.4.1.

Table 2-3 Summary of Test Pit Excavations, Cauterskill Road Site

Test Pit Number	Excavation Date	Maximum Depth of Test Pit (ft bgs)	Approximate Length of Test Pit (ft)	Maximum OVA[a] Reading (ppm)	Maximum HCN Gas Meter Reading (ppm)	Description
CRTP-1	1/5/99	2.5 (center) 1.0 (west end)	10	1.5 (total)	0	0-1': topsoil-organic (tree and shrub roots); medium to dark brown sandy, gravelly loam; bucket refusal at 2.5' in center and at 1' at west end.
CRTP-2	1/5/99	3	14	0	0	0-0.5': dark to medium brown sandy gravelly loam; bucket refusal at 0.5'; 1-3': medium brown sand, silt, clay, and gravel; trench excavated to width of 10' with bucket refusal between 1'-3'.
CRTP-3	1/5/99	8	10	0	0	0-2': dark brown organic sandy, silty, gravelly loam; 2-8': light brown/tan gravelly silt and sand.
CRTP-4	1/5/99	4	10	32 (total)	0	0-3': medium/dark brown crushed rock (4-6") with sand and silt; angular boulders at 1.5'-2.5'; 3-4': medium brown silt and sand; bucket refusal at 4'.
CRTP-5	1/6/99	4	6.5	1.5 (CH_4)	0	0-1': crushed rock; 1-4': crushed rock and dark brown coarse sand and silt; bucket refusal at 4'.
CRTP-6	1/7/99	4	10	0	0	0-0.9': dark brown topsoil (sandy, silty, gravelly); 0.9-4': medium brown, orange and gray mottled clay till with angular gravel fragments up to 1cm; bucket refusal at 4'.

Table 2-3 Summary of Test Pit Excavations, Cauterskill Road Site

Test Pit Number	Excavation Date	Maximum Depth of Test Pit (ft bgs)	Approximate Length of Test Pit (ft)	Maximum OVA[a] Reading (ppm)	Maximum HCN Gas Meter Reading (ppm)	Description
CRTP-7	1/7/99	3	7	10 (total)	0	0-6": very hard (frozen and compacted) material; 0-3': encountered plastic top of a 5-gallon bucket, bricks, miscellaneous debris (plastic, wood, cans, pipes, glass, wires, cinder blocks) in mixture of sand, silt, clay, and asphalt; bucket refusal at 3'.
CRTP-8	1/7/99	3.3 (west end) 4.5 (center) 2 (east end)	36	0	0	West end 0-2': dark brown sandy loam; 2-4.5': medium brown till (orange and gray mottled gravelly clay with large [1-2'] rounded boulders). East end 0-1': gray-brown gravelly clay; 1-2': dark brown sandy loam.

Table 2-3 Summary of Test Pit Excavations, Cauterskill Road Site

Test Pit Number	Excavation Date	Maximum Depth of Test Pit (ft bgs)	Approximate Length of Test Pit (ft)	Maximum OVA[a] Reading (ppm)	Maximum HCN Gas Meter Reading (ppm)	Description
CRTP-9	1/7/99	12 (east end) 3.5 (west end)	43	12 (CH_4) 6 (unknown)	0	East end: Encountered pool liner, metal stool, metal cylindrical container, chrome vehicle horns, wood, pipes, asphalt, PVC, bricks, spray paint can, and cinder blocks within a medium brown sandy silty matrix; bucket refusal at 12'. Center: Encountered Mazda Sundowner sport pick-up truck, rags, wire, wood straps, pipes, porcelain sink, crushed drum, metal debris, plastic, and three metals tubs/vats (2.5'x2.5' with auto parts; 1.5'x5.5' with black sludge; and 3'x2.5') in medium brown sandy, silty, gravelly matrix; bucket refusal at 9'. West end: waste materials tapered to 1.25' thick; bucket refusal at 3.5'.

Table 2-3 Summary of Test Pit Excavations, Cauterskill Road Site

Test Pit Number	Excavation Date	Maximum Depth of Test Pit (ft bgs)	Approximate Length of Test Pit (ft)	Maximum OVA[a] Reading (ppm)	Maximum HCN Gas Meter Reading (ppm)	Description
CRTP-10	1/8/99	8	25	0	0	North end: half buried tractor at north end; plastic, roofing material, blacktop, sewer pipes, wood, wires, metal strapping, large metallic equipment in a sandy gravelly clayey matrix; trash and debris across the entire length of trench.

[a] Total OVA reading without using a carbon filter. When a carbon filter is used the OVA measures CH_4.

Key:

bgs	= Below ground surface.	OVA	= Organic vapor analyzer.
CH_4	= Methane.	ppm	= Parts per million.
ft	= Feet.	PVC	= Polyvinyl chloride.

Table 2-4 Test Pit Subsurface Soil Sample Summary, Cauterskill Road Site

Sample Number	Sample Date	Test Pit Number	Sample Depth (ft bgs)	Analyses	Description
CRTP-2	1/5/99	TP02	3	TCL VOCs, TCL SVOCs, TCL PCB/Pest, TAL Metals, CN, Cr^{+6}	Medium brown sand, silt, clay, and gravel.
CRTP-3	1/5/99	TP03	2	TCL VOCs, TCL SVOCs, TCL PCB/Pest, TAL Metals, CN, Cr^{+6}	Light brown/tan gravelly silt and sand.
CRTP-3/D	1/5/99	TP03	2	TCL VOCs, TCL SVOCs, TCL PCB/Pest, TAL Metals, CN, Cr^{+6}	Field duplicate of sample CR-TP03.
CRTP-4	1/5/99	TP04	2	TCL VOCs, TCL SVOCs, TCL PCB/Pest, TAL Metals, CN, Cr^{+6}	Medium dark brown crushed rock with sand and silt.
CRTP-5	1/6/99	TP05	4	TCL VOCs, TCL SVOCs, TCL PCB/Pest, TAL Metals, CN, Cr^{+6}	Crushed rock and dark brown coarse sand and silt.
CRTP-6	1/7/99	TP06	4	TCL VOCs, TCL SVOCs, TCL PCB/Pest, TAL Metals, CN, Cr^{+6}	Medium brown, orange and gray mottled clay till with angular gravel fragments up to 1 centimeter.
CRTP-7	1/7/99	TP07	2	TCL VOCs, TCL SVOCs, TCL PCB/Pest, TAL Metals, CN, Cr^{+6}	Mixture of sand, silt, clay, and asphalt.
CRTP-8-1	1/7/99	TP08	2	TCL VOCs, TCL SVOCs, TCL PCB/Pest, TAL Metals, CN, Cr^{+6}	Dark brown sandy loam; collected from west end.
CRTP-8-2	1/7/99	TP08	1.5	TCL VOCs, TCL SVOCs, TCL PCB/Pest, TAL Metals, CN, Cr^{+6}	Dark brown sandy loam; collected from east end.
CRTP-9-1	1/7/99	TP09	4.5	TCL VOCs, TCL SVOCs, TCL PCB/Pest, TAL Metals, CN, Cr^{+6}	Gray-blue sandy granular material; collected from east end.
CRTP-9-2	1/8/99	TP09	—	TCL VOCs, TCL SVOCs, TCL PCB/Pest, TAL Metals, CN, Cr^{+6}	Composite sample of sludge from three tubs/vats.

Table 2-4 Test Pit Subsurface Soil Sample Summary, Cauterskill Road Site

Sample Number	Sample Date	Test Pit Number	Sample Depth (ft bgs)	Analyses	Description
CRTP-10	1/8/99	TP10	8	TCL VOCs, TCL SVOCs, TCL PCB/Pest, TAL Metals, CN, Cr^{+6}	Sandy, gravelly, clayey matrix.

Key:

bgs	=	Below ground surface.
CN	=	Total cyanide.
Cr^{+6}	=	Hexavalent chromium.
ft	=	Feet.
PCB	=	Polychlorinated biphenyl.
Pest	=	Pesticide.
SVOC	=	Semivolatile organic compound.
TAL	=	Target analyte list.
TCL	=	Target compound list.
VOC	=	Volatile organic compound.

2.6.2 Monitoring Well Borehole Sampling

Six monitoring wells were drilled and installed between January 8 and 25, 1999 by SJB Services, Inc., under the supervision of the E & E and JCL field team (see Figure 2-2). The boreholes were advanced through the overburden using 4.25-inch hollow stem augers with continuous split-spoon sampling in accordance with the November 1998 work plan. Both truck-mounted and track-mounted CME 75 drill rigs were used on site. Monitoring well boring logs are presented in Appendix B, and Table 2-5 summarizes the standard penetration test data recorded during split-spoon sampling activities. One subsurface soil sample was planned to be taken from each borehole; however, due to the shallow nature of the bedrock (i.e., 1.25 to 6 feet BGS), and poor sample recovery, only two subsurface soil samples were collected. Table 2-6 provides a summary of the samples collected, including the sample number, date, depth, instrument reading, analyses, and soil description.

In addition to the field samples, QA/QC samples, including a trip blank and rinsate blank, were also collected. All samples were submitted to E & E's ASC for analysis. Results of QA/QC sample is discussed in Section 4, and subsurface soil results are discussed in Section 5.4.2.

2.7 Groundwater Investigation

2.7.1 Monitoring Well Installation

OD
outside diameter

RQD
rock quality designation

As stated in Section 2.6.3, one groundwater monitoring well was installed in each of the six boreholes drilled at the site (see Figure 2-2). All of the wells were completed in the underlying bedrock due to shallow and dry overburden conditions. The overburden was sealed off with 4-inch outside diameter (OD) carbon steel casing set 1 to 4 feet below top of rock. The rock socket was drilled with the hollow stem augers. Bedrock drilling continued no sooner than 24 hours after the steel casing was grouted in place. Bedrock drilling was initially performed in CRMW-1 and CRMW-2 using HX rock coring (3-15/16 inch OD) methods per the work plan (E & E 1998). However, due to significant water loss to the formation in both wells (i.e., 1,850 gallons during coring of 16.4 feet of rock in CRMW-1, and 700 gallons during coring of 11.5 feet of rock in CRMW-2), bedrock drilling methodology was changed to air rotary. A summary of drilling parameters including well number, date started and completed, total depth, number of split-spoon samples, drilling type, air monitoring readings, and well type is presented in Table 2-7; and well boring logs are presented in Appendix B. A summary of the rock quality designation (RQD) from the HX cores is provided in Table 2-8. RQD is a quantitative index developed by Deere 1963 to log cores. It provides a preliminary estimate of the variation of the in situ rock mass properties from those of the sound portion of the rock core.

Table 2-5 Summary of Standard Penetration Tests from Monitoring Well Boreholes, Cauterskill Road Site

Borehole Number	Split Spoon Number	Depth Interval (ft bgs)	Number of Blows Per Foot	Soil Components	Relative Density[a]
CRMW-1	1	0-1	4	Brown silty loam	Loose
		1-2	4		Loose
	2	2-3	14	Brown clay and silt with some gravel	Medium
		3-4	>50		Refusal
CRMW-2	1	0-1	9	Dark brown fine sand and silt with a trace of clay	Loose
		1-1.5	>50		Refusal
CRMW-3	1	0-1	44	Dark brown fine silt, sand, and trace of clay with lime-stone rock fragments	Dense
		1-2	>50		Refusal
CRMW-4	1	0-1	8	Topsoil and limestone frag-ments	Loose
		1-2	5		Loose
	2	2-3	8	Topsoil and limestone frag-ments	Loose
		3-4	13		Medium
	3	4-5	8	Dark brown silt and mottled (yellow/orange) clay with some sand and gravel, and rock fragments	Loose
		5-6	>50		Refusal
CRMW-5	1	0-1	6	Light brown clay with some silt, sand, and gravel	Loose
		1-2	5		Loose
	2	2-3	5	Medium brown medium sand with trace of silt	Loose
		3-4	5	Light brown clay with some silt, sand, and gravel	Loose

Table 2-5 Summary of Standard Penetration Tests from Monitoring Well Boreholes, Cauterskill Road Site

Borehole Number	Split Spoon Number	Depth Interval (ft bgs)	Number of Blows Per Foot	Soil Components	Relative Density[a]
	3	4-5	5	Medium sand and rock fragments	Loose
		5-6	>50		Refusal
CRMW-6	1	0-1	16	Medium/dark brown silt and gravel with some sand and clay	Medium
		1-2	8		Loose
	2	2-3	6	No recovery	Loose
		3-4	15	No recovery	Medium
	3	4-5	>50	Dark brown silt and gravel with some sand and clay	Refusal

[a] Blows per foot	Relative density
0-10	Loose
11-30	Medium
31-50	Dense
>50	Very dense

Key:

bgs = Below ground surface.
ft = Feet.

All rock cores were placed in wooden core boxes in the on-site field trailer at the completion of the investigation.

IDW
investigation-derived waste

All drill cuttings, both soil and rock chips, were placed in 55-gallon drums. The drums were labeled and staged under the overhang on the east side of Barn 3. An inventory of all investigation-derived waste (IDW) is presented in Appendix C.

While air drilling, care was taken to note changes in dust levels and the depth intervals of moist to wet rock chips in order to determine the presence or absence of groundwater. In most cases, except for CRMW-4, there was very little indication of the presence of groundwater during drilling. Therefore, after each core run (or approximately every 10 feet), the borehole was checked for groundwater using a water level indicator. Again, in most cases (except for CRMW-4), little or no groundwater was measured. However, in cases where a slight detection of water in the borehole was made at the end of the day, a 10-foot water column was present in the borehole the next day. Since the depth of the water-bearing fractures was unknown, 15- to 25-foot screens were installed based on the location of potential fracture zones, instead of

Table 2-6 Monitoring Well Borehole Subsurface Soil Sample Summary, Cauterskill Road Site

Sample Number	Sample Date	Borehole Number	Sample Depth (ft bgs)	OVA/HCN Meter Reading (ppm)	Analyses	Description
CRMW-5SB	1/13/99	CRMW-5	2-6	0.5/0	TCL VOCs, TCL SVOCs, TCL Pest/PCB, TAL Metals, Cr^{+6}	Location: East of Barn 3, near edge of fill area. Sample: Medium brown medium sand, trace silt; light brown clay some gravel, some sand, trace silt; limestone fragments at bottom, lens of medium sand (3" thick)
CRMW-6SB	1/12/99	CRMW-6	4-5	30/0	TCL VOCs,	Location: Along dirt road at base of hill between the creek and 5048 residence. Sample: Dark brown gravel (limestone rock fragments) and silt, some sand, trace clay; solvent/gasoline odor.

[a] Total OVA reading without using a carbon filter. When a carbon filter is used the OVA measures CH_4.

Key:

bgs	=	Below ground surface.
CH_4	=	Methane.
Cr^{+6}	=	Hexavalent chromium.
ft	=	Feet.
HCN	=	Hydrogen cyanide.
OVA	=	Organic vapor analyzer.
PCB	=	Polychlorinated biphenyl.
Pest	=	Pesticide.
ppm	=	Parts per million.
SVOC	=	Semivolatile organic compound.
TAL	=	Target analyte list.
TCL	=	Target compound list.
VOC	=	Volatile organic compound.

Table 2-7 Drilling Summary, Cauterskill Road Site

				Overburden		Bedrock					
				HSA 4¼ inch ID					Maximum Reading		
Well Boring Number	Date Started	Date Completed	Total Depth (ft bgs)	Number of Split Spoon Samples	Interval (ft bgs)	Rock Socket Interval (ft bgs)	HX Rock Coring 3¾ inch OD (ft bgs)	Rotary 3⅞ inch OD (ft bgs)	OVA (ppm)	HCN Gas (ppm)	Well Type
CRMW-1	1/7/99	1/20/99	37.5	2	0-3.8	3-8-4.8	4.9-21.3	21.3-37.5	7	0	Bedrock
CRMW-2	1/8/99	1/20/99	37.0	1	0-1.25	1.25-5.25	5-16.5	16.5-37.0	980	0	Bedrock
CRMW-3	1/11/99	1/22/99	55.5	1	0-0.75	0.75-4.25	—	4.75-55.5	30	0	Bedrock
CRMW-4	1/11/99	1/25/99	50.0	3	0-5.5	5.5-9.5	—	9.5-50.0	2.5	0	Bedrock
CRMW-5	1/13/99	1/25/99	32.5	3	0-6.0	6.0-8.5	—	8.5-32.5	70	0	Bedrock
CRMW-6	1/12/99	1/22/99	58.0	3	0-5.0	5.0-9.0	—	9.0-58.0	250	0	Bedrock

Key:

bgs = Below ground surface.
ft = Feet.
HCN = Hydrogen cyanide.
HSA = Hollow-stem auger.
ID = Inside diameter.
OD = Outside diameter.
OVA = Organic vapor analyzer.
ppm = Parts per million.

Table 2-8 Summary of Rock Quality Designation from Monitoring Well Boreholes, Cauterskill Road Site

Well Number	Depth Interval (ft bgs)	RQD (Percent)	RQD Description
CRMW-1	4.9-9.6	77	Good
	9.6-14.7	98	Excellent
	14.7-20.0	100	Excellent
	20.0-21.1	100	Excellent
	21.1-21.3	0	Very Poor
CRMW-2	5.5-14	89.3	Good
	14-16.5	97	Excellent

Key:

bgs = Below ground surface.
ft = Feet.
RQD = Rock quality designation.

the 10-foot screens designated in the work plan, so that potential water-bearing fractures would not be sealed off.

PVC
polyvinyl chloride

TOIC
top of inner casing

All wells were completed with 2-inch ID polyvinyl chloride (PVC) casing and 0.010-inch machine slotted screen. In addition, a shallow 1-inch PVC well (CRMW-6S) was nested in the same borehole as the deeper 2-inch well CRMW-6D. The purpose of the shallow well was to determine if the water-bearing fracture encountered at a depth of 24.5 feet was interconnected with deeper water-bearing fractures. A sand filter pack was placed around each well screen from the bottom of the borehole to 2-feet above the top of the screen. Although the work plan called for the installation of 10-foot screens, well screens varied from 15 feet to 25 feet in length. Longer screens were installed because the actual locations of water-bearing fractures could not be determined during the air rotary drilling. The sand was followed by a 2-foot thick bentonite chip seal, then bentonite/cement grout to the surface. Table 2-9 provides a summary of monitoring well construction data including top of inner casing (TOIC) and ground elevations, total boring depth, depth to bedrock, depth to bottom of carbon steel casing, PVC casing and screen size, PVC casing length, PVC screen interval, and bentonite seal interval.

2.7.2 Monitoring Well Development

Monitoring well development was performed on all of the newly installed wells between January 22 and 27, 1999 by the E & E and JCL field team. The development was performed no sooner than

Table 2-9 Groundwater Monitoring Well Construction Summary, Cauterskill Road Site

Well Number	TOIC Elevation[a] (ft)	Ground Elevation[a] (ft)	Boring Total Depth (ft bgs)	Depth to Bedrock (ft bgs)	Depth to Bottom of 4" OD Steel Surface Casing (ft bgs)	PVC Well Casing & Screen ID Size (in)	PVC Casing Length (ft)	PVC Screen Interval (ft bgs)	Sand Pack Interval (ft bgs)	Bentonite Seal Interval (ft bgs)
CRMW-1	201.18	198.79	37.5	3.8	4.8	2	24.89	22.5-37.5	18.15-37.5	15.95-18.15
CRMW-2	193.05	190.1	37	1.25	5.25	2	25.04	22-37	19.5-37	16.3-19.5
CRMW-3	182.46	180.75	55.5	0.75	4.75	2	32.21	30.5-55.5	27.1-55.5	25.1-27.1
CRMW-4	170.52	168.9	50	5.5	9.5	2	32.22	30-50	24.9-50	23.4-24.9
CRMW-5	186.31	184.89	32.5	6.0	8.5	2	18.92	17.5-32.5	15.4-32.5	13.4-15.4
CRMW-6S	182.42	180.49	25.5	5.0	9.0	1	17.43	15.5-25.5	13.5-29	11.5-13.5
CRMW-6D	182.26	180.49	58	5.0	9.0	2	34.77	33-58	31-58	29-31

[a] Based on a site-specific 200-foot datum.

Key:

bgs	=	Below ground surface.
ft	=	Feet.
ID	=	Inside diameter.
in	=	Inches.
OD	=	Outer diameter.
PVC	=	Polyvinyl chloride.
TOIC	=	Top of inner casing.

NTU
nephelometric turbidity units

24 hours following grout placement using dedicated polyethylene bailers and new nylon bailer cord as described in the work plan (E & E 1998). Temperature, pH, conductivity, and turbidity readings were recorded to monitor the progress of the development process. While pH, temperature, and conductivity stabilized, turbidity never decreased to less than 50 nephelometric turbidity units (NTU) (the preferred turbidity quality for groundwater sampling) after significant effort. However, if the water column was allowed to settle for a few hours, turbidity dropped well below 50 NTUs. Appendix B contains the well development records for each well.

All development water was placed in 55-gallon drums. The drums were labeled and staged under the overhang on the east side of Barn 3. An inventory of all IDW is presented in Appendix C.

2.7.3 Groundwater Sampling

Groundwater samples were collected from the six newly installed monitoring wells and four residential wells (see Figure 2-2) on January 27 and 28, 1999 by the E & E and JCL field team. The residential wells included three on-site wells (two at 5048 Cauterskill Road and one at 5040 Cauterskill Road) and one off-site well at 5056 Cauterskill Road.

2.7.3.1 Monitoring Well Sampling

Prior to sampling of the monitoring wells, static water levels were measured in each well. The volume of water in each well was then calculated, and at least three volumes of water standing in the well casing were removed, or the well was bailed dry. The same dedicated polyethylene bailers and nylon cord used for development were also used for sampling. Temperature, pH, conductivity, and turbidity measurements were recorded throughout the well purging process, and immediately prior to sampling. As with development water, all purge water was placed in 55-gallon drums. The drums were labeled and staged under the overhang on the east side of Barn 3. An inventory of all IDW is presented in Appendix C. Once the wells recharged, turbidity was tested again. In all cases, turbidity dropped below 50 NTUs at the time of sampling (in most cases, the recovery time period between purging and sampling was 3.5 to 5.5 hours; however, two wells [CRMW-4 and CRMW-5] were allowed to recharge 15 hours prior to sampling). Table 2-10 presents sample numbers, dates, well descriptions, analyses, and field chemistry readings at the time of sampling.

In addition to the field samples, QA/QC samples including trip blanks were also collected. All samples were submitted to E & E's ASC for analysis. Results of QA/QC samples are discussed in Section 4, and well results are discussed in Section 5.5.1.

Table 2-10 Groundwater Sample Summary, Cauterskill Road Site

Sample/Well Number	Sample Date	Well Description	Analyses	Field Chemistry Measurements			
				pH (s.u.)	Conductivity (μmohs/cm)	Temperature (°F)	Turbidity (NTU)
CRMW-1	1/27/99	Monitoring Well	TCL VOCs, TCL SVOCs, Pest/PCBs, TAL Metals, CN, Cr^{+6}	7.23	811	44.1	17
CRMW-2	1/27/99	Monitoring Well	TCL VOCs, TCL SVOCs, Pest/PCBs, TAL Metals, CN, Cr^{+6}	7.46	509	50.6	22.2
CRMW-3	1/27/99	Monitoring Well	TCL VOCs, TCL SVOCs, Pest/PCBs, TAL Metals, CN, Cr^{+6}	6.92	866	44.4	6.26
CRMW-4	1/28/99	Monitoring Well	TCL VOCs, TCL SVOCs, Pest/PCBs, TAL Metals, CN, Cr^{+6}	6.79	687	40.3	40.3
CRMW-5	1/28/99	Monitoring Well	TCL VOCs, TCL SVOCs, Pest/PCBs, TAL Metals, CN, Cr^{+6}	6.78	1140	45.1	4.41
CRMW-6D	1/27/99	Monitoring Well	TCL VOCs, TCL SVOCs, Pest/PCBs, TAL Metals, CN, Cr^{+6}	7.12	887	48.8	42.1
CRGW-5048H/D	1/28/99	Residential Well at House	TCL VOCs, TCL SVOCs, Pest/PCBs, TAL metals, CN, Cr^{+6}	7.06	716	47.4	0.82
CRGW-5048H	1/28/99	Residential Well at House	TCL VOCs, TCL SVOCs, Pest/PCBs, TAL Metals, CN, Cr^{+6}	7.06	716	47.4	0.82
CRGW-5048B	1/27/99	Residential Well at Barn	TCL VOCs, TCL SVOCs, Pest/PCBs, TAL Metals, CN, Cr^{+6}	7.26	1038	44.2	10.1

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Table 2-10 Groundwater Sample Summary, Cauterskill Road Site

Sample/Well Number	Sample Date	Well Description	Analyses	Field Chemistry Measurements pH (s.u.)	Conductivity (µmohs/cm)	Temperature (°F)	Turbidity (NTU)
CRGW-5040	1/28/99	Residential Well	TCL VOCs, TCL SVOCs, Pest/PCBs, TAL Metals, CN, Cr^{+6}	7.18	1434	47.7	2.23
CRGW-5056	1/28/99	Residential Well	TCL VOCs, TCL SVOCs, Pest/PCBs, TAL Metals, CN, Cr^{+6}	7.06	1320	40.9	4.14

Key:

CN	=	Total cyanide.
Cr^{+6}	=	Hexavalent chromium.
°F	=	Degrees Fahrenheit.
NTU	=	Nephelometric turbidity units.
PCB	=	Polychlorinated biphenyl.
Pest	=	Pesticide.
SVOC	=	Semivolatile organic compound.
s.u.	=	Standard units.
TAL	=	Target analyte list.
TCL	=	Target compound list.
VOC	=	Volatile organic compound.
µmohs/cm	=	MicroMohs per centimeter.

2.7.3.2 Residential Well Sampling

Prior to sampling of most of the residential wells, the sampling port (spigot) was allowed to run for approximately 5 to 10 minutes before directly filling the sample bottles. The sampling port at the 5048 Cauterskill Road well (5048H) was an outside spigot on the house foundation; the sampling port for the 5040 Cauterskill Road (log cabin) well was from a spigot in the basement of the log cabin; and the sampling port at the 5056 Cauterskill Road well was an outside spigot on the house foundation. All sample locations were free of any water treatment systems. Since the well located on the south side of Barn 3 (5048B) was no longer in use, and the pump was not functioning, 1.2 well volumes of water (285 gallons) were removed from this well using a Grundfos Rediflow II 2-inch stainless steel submersible pump supplied by NYSDEC. The water was discharged to the ground surface. Following purging, this well was sampled with a dedicated polyethylene bailer and new nylon bailer cord. This 6-inch well was measured to be 179 feet BGS, with a static water level of 19.33 feet below the top of casing. The top of casing was buried approximately 6-inches BGS and was not water tight (therefore, surface runoff has entered the well). As part of the field activities, a water-tight cap was placed on the well, and a curb box was placed around the casing to facilitate future access.

In addition to the field samples, QA/QC samples, including duplicate samples, trip blanks, and MS/MSDs, were also collected. All samples were submitted to E & E's ASC for analysis with the exception of the hexavalent chromium portion which was sent to SCI Laboratories, Inc., located in Latham, New York. Results of QA/QC samples are discussed in Section 4, and well results are discussed in Section 5.5.2.

2.7.4 Hydraulic Conductivity Testing

Following groundwater sampling activities, aquifer testing was performed on January 28 and 29, 1999 by the E & E and JCL field team. The tests consisted of slug tests on the six newly installed monitoring wells to determine the hydraulic conductivity of the bedrock aquifer in the immediate vicinity of each well. This was accomplished by performing a rising head test on one of the wells (CRMW-5) and falling head tests on the remainder of the wells using the methodology described in the work plan (E & E 1998). The rising head test was performed by removing a 1-liter slug of water by rapidly withdrawing a previously submerged dedicated polyethylene bailer; and the falling head tests were performed by adding a slug of distilled water to each well through a large funnel mounted on top of the well. The amount of water added was determined by calculating the volume of available casing above the water table. Field data was recorded on a Hermit 2000 data logger; and data reduction/interpretation was completed using Aqtesolv

Version 2.13 software (Duffield 1998). Hydraulic conductivity results are presented in Section 3.3.2.

2.8 Surface Water and Sediment Investigation

Surface water and sediment samples were collected from nine locations along the tributary to Kaaterskill Creek (on the western side of the site) by the E & E and JCL field team during the Phase I RI (see Figure 2-2a). This sampling was performed during two different sampling events because no surface water was initially present at the site. The sediment samples were collected on December 11, 1998, and the surface water samples were collected on January 26, 1999. All surface waters planned for Phase I were collected at the same approximate locations as sediment samples, except CRSW-6. This surface water sample was collected approximately 30 feet southwest of CRSD-6 at a seep at the toe of the fill area (see Figure 2-2). Due to laboratory problems, CRSD-9 was resampled on January 28, 1999 ; and due to a sampling oversight, all of the sediments were resampled on March 9, 1999 for total organic carbon. Two additional surface water samples and nine sediment samples were collected on June 30, 1999 as part of the Phase II RI sampling (see Figure 2-2b). One planned surface water sample was not collected because the location was dry.

In addition to the field samples, QA/QC samples including duplicate samples, trip blanks, and MS/MSDs were also collected. All surface water and sediment samples were submitted to E & E's ASC for analysis with the exception of the hexavalent chromium portion of the surface water samples, which were sent to SCI Laboratory, Inc., in Latham, New York. Results of QA/QC samples are discussed in Section 4, and surface water and sediment sample results are discussed in Sections 5.6.1 and 5.6.2, respectively. Sampling procedures are described below.

2.8.1 Surface Water Sampling

All surface water samples were collected by directly immersing the appropriate sample containers as outlined in the Work Plan (E & E 1998). Temperature, pH, conductivity, and turbidity measurements were recorded for each sample (see Table 2-11). A summary of surface water sampling including sample date, analyses, and physical description, are presented in Table 2-12.

2.8.2 Sediment Sampling

All sediment samples were collected by transferring the top 6-inches of material using dedicated stainless steel spoons from each location to the appropriate sample containers as outlined in the work plan (E & E 1998). A summary of sediment sampling, including sample date, analyses, and physical description, are presented in Table 2-12.

Table 2-11 Summary of Surface Water Field Chemistry Measurements, Cauterskill Road Site

Sample/Well Number	Sample Date	Field Chemistry Measurements			
		pH (s.u.)	Conductivity (μmohs/cm)	Temperature (°F)	Turbidity (NTU)
CRSW-1	1/26/99	7.56	692	41.6	2.69
CRSW-2	1/26/99	7.54	669	39.6	5.84
CRSW-3	1/26/99	7.72	651	38.0	2.36
CRSW-4	1/26/99	7.83	665	37.9	2.35
CRSW-5	1/26/99	7.50	687	40.2	5.00
CRSW-6	1/26/99	7.07	650	37.5	3.00
CRSW-7	1/26/99	7.43	440	36.3	9.01
CRSW-8	1/26/99	7.33	442	37.7	4.74
CRSW-9	1/26/99	7.06	434	35.0	12.2
CRSW-10	Not sampled (dry)	—	—	—	—
CRSW-11	6/30/99	7.65	NA	NA	NA
CRSW-12	6/30/99	7.57	NA	NA	NA

Key:

°F = Degrees Fahrenheit.
NA = Not available.
NTU = Nephelometric turbidity units.
s.u. = Standard units.
μmohs/cm = MicroMohs per centimeter.

2.9 Exposed Waste Investigation

Two samples of exposed waste were collected on December 11, 1998 and January 20, 1999 by the E & E and JCL field team. materials originated from plastic-lined fiberboard drums exposed along the toe of the fill area on the west bank of the tributary to Kaaterskill Creek. The fiberboard has since decayed, leaving only the metal lid rings and inside plastic-lined product.

The first sample (CRW-1) is a white powdery material, still in its original burial place; and the second sample (CRW-2) is a white granular (sugar-like) material, which has since been placed in a polyethylene overpack drum. Table 2-13 provides a summary of waste samples including sample date, analyses, and sample description. The overpack drum has been staged with the other IDW drums.

Table 2-12 Surface Water and Sediment Sample Summary, Cauterskill Road Site

Sample Number	Sample Date	Matrix	Analyses	Description
Surface Water				
CRSW-1	1/26/99	Surface Water	TCL VOCs, TCL SVOCs, TCL Pest/PCBs, hardness, pH, TAL Metals, CN, Cr^{+6}	Location: Upstream of site, in depression in SW corner of ponded area, just north of the stone wall. Sample: Clear ponded water.
CRSW-2	1/26/99	Surface Water	Hardness, pH, TAL Metals, Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: Upstream of the southern site pond. Sample: Clear flowing water.
CRSW-3	1/26/99	Surface Water	TCL VOCs, TCL SVOCs, TCL Pest/PCBs, hardness, pH, TAL Metals, CN, Cr^{+6}	Location: In southern site pond. Sample: Clear ponded water.
CRSW-4	1/26/99	Surface Water	Hardness, pH, Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: Downstream of southern site pond, adjacent to fill area. Sample: Clear flowing water.
CRSW-5	1/26/99	Surface Water	Hardness, pH, Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: Upstream of northern site pond, adjacent to fill area. Sample: Clear flowing water.
CRSW-6	1/26/99	Surface Water	TCL VOCs, TCL SVOCs, TCL Pest/PCBs, hardness, pH, TAL Metals, CN, Cr^{+6}	Location: From seep from fill area approximately 30 feet SW of CRSD-6. Sample: Clear flowing water (seep).
CRSW-6/D	1/26/99	Surface Water	TCL VOCs, TCL SVOCs, TCL Pest/PCBs, hardness, pH, TAL Metals, CN, Cr^{+6}	Field duplicate of sample CRSW-6
CRSW-7	1/26/99	Surface Water	Hardness, pH, Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: In northern site pond. Sample: Clear ponded water.
CRSW-8	1/26/99	Surface Water	Hardness, pH, Cd, Cr, Cu, Ni, Pb, Zn, and CN	Location: Downstream of northern site pond. Sample: Clear flowing water.
CRSW-9	1/26/99	Surface Water	TCL VOCs, TCL SVOCs, TCL Pest/PCBs, hardness, pH, TAL Metals, CN, Cr^{+6}	Location: Downstream of CRSW-8 in ponded area. Sample: Clear ponded water.

Table 2-12 Surface Water and Sediment Sample Summary, Cauterskill Road Site

Sample Number	Sample Date	Matrix	Analyses	Description
CRSW-10	Not sampled (dry)	Surface Water	—	Location: Downstream of CRSW-9, before confluence with tributary to west, upstream of permanent pond. Sample: Dry
CRSW-11	6/30/99	Surface Water	PAHs, Pest/PCBs, TAL metals, CN, CR^{+6}	Location: West tributary, upstream of confluence with site tributary, upstream of permanent pond. Sample: Clear flowing water
CRSW-12	6/30/99	Surface Water	PAHs, Pest/PCBs, TAL metals, CN, CR^{+6}	Location: West bank of permanent pond, downstream of site and below confluence with west tributary. Sample: Slightly turbid ponded water.
Sediment				
CRSD-1	12/11/98	Sediment	TOC, TCL, VOCs, TCL SVOCs, TCL Pest/PCBs, TAL Metals, CN, and CR^{+6}	Location: Upstream of site, in depression in SW corner of ponded area, just north of the stone wall; 0-6" depth.
CRSD-1R	3/9/99		TOC	Sample: Dark brown, sandy, silty clay.
CRSD-2	12/11/98	Sediment	TOC, Cd, Cu, Cr, Ni, Pb, Zn, CN, and CR^{+6}	Location: Upstream of the southern site pond; 0-6" depth.
CRSD-2R	3/9/99		TOC, CR^{+6}	Sample: Dark brown, gravely sand, and silt.
CRSD-3	12/11/98	Sediment	TOC, TCL, VOCs, TCL SVOCs, TCL Pest/PCBs, TAL Metals, CN, and CR^{+6}	Location: In southern site pond; 0-6" depth. Sample: Brown silty loam.
CRSD-3R	3/9/99		TOC	
CRSD-4	12/11/98	Sediment	TOC, Cd, Cu, Cr, Ni, Pb, Zn, CN, and CR^{+6}	Location: Downstream of southern site pond, adjacent to fill area; 0-6" depth.
CRSD-4R	3/9/99		TOC, CR^{+6}	Sample: Medium brown loamy silt and clay.

Table 2-12 Surface Water and Sediment Sample Summary, Cauterskill Road Site

Sample Number	Sample Date	Matrix	Analyses	Description
CRSD-5	12/11/98	Sediment	TOC, Cd, Cu, Cr, Ni, Pb, Zn, CN, and CR^{+6}	Location: Upstream of northern site pond, adjacent to fill area; 0-6" depth.
CRSD-5R	3/9/99		TOC, CR^{+6}	Sample: Medium brown silty clayey loam.
CRSD-5R/D	3/9/99		TOC, CR^{+6}	Field duplicate of CRSD-5R.
CRSD-6	12/11/98	Sediment	TOC, TCL, VOCs, TCL SVOCs, TCL Pest/PCBs, TAL Metals, CN, and CR^{+6}	Location: In northern site pond at geophysical grid location (225,300); 0-6" depth. Sample: Medium brown silty clayey loam.
CRSD-7	12/11/98	Sediment	TOC, Cd, Cu, Cr, Ni, Pb, Zn, CN, and CR^{+6}	Location: In northern site pond at geophysical grid location (225,300); 0-6" depth.
CRSD-7R	3/9/99		TOC, CR^{+6}	Sample: Dark brown, sandy, silty clay.
CRSD-8	12/11/98	Sediment	TOC, Cd, Cu, Cr, Ni, Pb, Zn, CN, and CR^{+6}	Location: Downstream of northern site; 0-6" depth.
CRSD-8R	3/9/99		TOC, CR^{+6}	Sample: Medium brown silty clayey loam.
CRSD-9	12/11/98	Sediment	TOC, TCL, VOCs, TCL SVOCs, TCL Pest/PCBs, TAL Metals, CN, and CR^{+6}	Location: Downstream of CRSD-8 in ponded area; 0-6" depth. Sample: Wet silty clayey loam.
CRSD-9R	1/28/99		TOC, TCL, VOCs, TCL SVOCs, TCL Pest/PCBs, TAL Metals, CN, and CR	
CRSD-9R2	3/9/99		TOC, CR^{+6}	
CRSD-10	6/30/99	Sediment	TOC, PAHs, Pest/PCBs, TAL Metals, CN, and CR^{+6}	Location: Downstream of CRSW-9, before confluence with tributary to west, upstream of permanent pond. Sample: Moist soil-like material.

Table 2-12 Surface Water and Sediment Sample Summary, Cauterskill Road Site

Sample Number	Sample Date	Matrix	Analyses	Description
CRSD-11	6/30/99		TOC, PAHs, Pest/PCBs, TAL Metals, CN, and CR^{+6}	Location: West tributary, upstream of confluence with site tributary, upstream of permanent pond. Sample: Mucky fine-grained texture.
CRSD-12	6/30/99	Sediment	TOC, PAHs, Pest/PCBs, TAL Metals, CN, and Cr^{+6}	Location: West bank of permanent pond, downstream of site, and below confluence with west tributary. Sample: Very mucky fine-grained sediment.
CRSD-12D	6/30/99	Sediment	TOC, PAHs, Pest/PCBs, TAL Metals, CN, and Cr^{+6}	
CRSD-13	6/30/99	Sediment	TOC, PAHs, Pest/PCBs, TAL Metals, CN, and Cr^{+6}, Hyalella azteca 10 day bioassay[a], AVS/SEM[b]	Location: Upstream of site, south of Route 23A. Sample: Mucky fine-grained sediment.
CRSD-14	6/30/99	Sediment	TOC, PAHs, Pest/PCBs, TAL Metals, CN, and Cr^{+6}, Hyalella azteca 10 day bioassay[a], AVS/SEM[b]	Location: Adjacent to site. Taken at location of sample CRSD-6. Channel of tributary was dry at time of sampling (6/30/99). Sample: Moist soil-like material.
CRSD-15	6/30/99	Sediment	TOC, PAHs, Pest/PCBs, TAL Metals, CN, and Cr^{+6}, Hyalella azteca 10 day bioassay[a], AVS/SEM[b]	Location: Permanent pond. Sample: Mucky fine-grained material.
CRSD-16	6/30/99	Sediment	TOC, PAHs, Pest/PCBs, TAL Metals, CN, and Cr^{+6}, Hyalella azteca 10 day bioassay[a], AVS/SEM[b]	Location: Approximately 1/4 mile downstream from permanent pond. Sample: Mucky fine-grained material.
CRSD-17	6/30/99	Sediment	TOC, PAHs, Pest/PCBs, TAL Metals, CN, and Cr^{+6}, Hyalella azteca 10 day bioassay[a], AVS/SEM[b]	Location: At confluence of tributary with Kaaterskill Creek. Sample: Sandy coarse-grained sediment.
CRSD-17D				Field duplicate of CRSD-17.

Table 2-12 Surface Water and Sediment Sample Summary, Cauterskill Road Site

Sample Number	Sample Date	Matrix	Analyses	Description

[a] Survival and growth endpoints.
[b] Cd, Cu, Ni, Pb, and Zn

Key:

AVS	=	Acid volatile sulfide.	N	=	Nickel	SVOC	=	Semivolatile organic compound.
Cd	=	Cadmium.	Pest	=	Pesticide.	SW	=	Southwest.
CN	=	Total cyanide.	PAH	=	Polycyclic aromatic hydrocarbon.	TAL	=	Target analyte list.
Cr	=	Chromium.	PCB	=	Polychlorinated biphenyl	VOC	=	Volatile organic compound.
Cr+6	=	Hexavalent chromium.	SEM	=	Simultaneously extracted metals.	Zn	=	Zinc.
Cu	=	Copper.	TCL	=	Target compound list.			
Pb	=	Lead.	TOC	=	Total organic carbon.			

Table 2-13 Exposed Waste Sample Summary, Cauterskill Road Site

Sample Number	Sample Date	Analyses	Description
CRW-1	12/11/98	TCLP Metals and Reactivity (CN)	Location: West bank of tributary to Kaaterskill Creek. Sample: White powder-like material from plastic-lined fiber-board drum.
CRW-1/D	12/11/98		Field duplicate of CRW-1.
CRW-2	1/20/99	TCLP Metals and Reactivity (CN)	Location: Formerly exposed waste at west bank of tributary to Kaaterskill Creek. Waste has been removed and overpacked Sample: White granular (sugar-like) material from plastic-lined fiberboard drum.

Key:

CN = Total cyanide.
TCLP = Toxicity characteristic leaching procedure.

The samples were collected by transferring the material to the appropriate sample containers using dedicated stainless-steel spoons.

In addition to the field samples, QA/QC samples including duplicate samples and MS/MSDs, were also collected. All of the waste samples were submitted to E & E's ASC for analysis. Results of QA/QC samples are discussed in Section 4, and waste sample results are discussed in Section 5.7.

2.10 Base Map Development/Site Survey

A detailed topographic base map of the Cauterskill Road site and immediate vicinity was developed by a JCL survey crew. The fieldwork for this survey was performed between January 27 and 29, 1999 (see Figure 1-2). The base map was prepared by performing a ground survey and utilizing the existing Greene County, Town of Catskill, District No. 192689, Section No. 171.00 property map dated March 1, 1998. Horizontal control was established using a local magnetic azimuth, and vertical control was established using an assumed elevation of 200 feet assigned to Bench Mark #1 (PK nail in one of the power poles on the site property). All relevant features on site and in adjacent areas (e.g., buildings, power poles, existing wells, etc.) were plotted on a scale of 1 inch = 60 feet. Topographic contours were also established across the areas of concern (i.e fill areas) at 1-foot intervals along with surveying of all pertinent sample locations.

2.11 Fish and Wildlife Assessment Work

FWIA
Fish and Wildlife Impact Analysis

As part of a Fish and Wildlife Impact Analysis (FWIA), a 1-day field investigation was performed on March 8, 1999 by an E & E biologist. Prior to this field investigation, a preliminary cover-type map was developed from the United States Geological Survey topographic map (USGS 1963), aerial photographs of the site and surrounding area, Greene County Soil Survey, and newly established base map. The field investigation was performed to confirm and expand the cover-type map, identify fish and wildlife resources, and observe any potential man-made stress on the environment. A FWIA was conducted for the site and included in the draft RI report (1999). The FWIA concluded that valuable fish and wildlife resources at the site were potentially at risk from exposure to site-related chemicals. Consequently, it was concluded that a toxic effect analysis should be conducted for the site. Additional sediment samples were collected from the tributary to support the analysis. The toxic effect analysis is presented in Section 6 of this report.

3 Physical Characteristics of Study Area

3.1 Physiography and Topography

The study area is located in southeast Greene County, west of the Hudson River and approximately 30 miles south of Albany. The two major physiographic provinces that make up Greene County are the Catskill section of the Appalachian Plateau and the Hudson Valley section of the Ridge and Valley Province (USDA SCS 1985). The Catskill Section is characterized by a mountainous terrain that terminates at the base of a ridge known as the northeastern escarpment or the Mural Front, west of the site. The elevation of the Catskills are generally highest in the east, along the Mural Front, and decrease in elevation to the west and northwest. The highest summit, Hunter Mountain, rises to an elevation of 4025 feet. The Hudson Valley Province lies to the east of the escarpment and is comprised of three physiographic subdivisions (USDA SCS 1993). The first is a terrace, composed of flat sand and clay beds, that borders the Hudson River. It ranges in elevation from 100 to approximately 150 feet and is entrenched by the river to a depth of approximately 100 feet. The second consists of a 1-mile wide area of low hills that runs parallel to the terrace, known as the Kalkburg. Consisting of Late Silurian and Devonian sedimentary rocks, the hills are situated to the west of the Hudson River, range in elevation from 300 to 500 feet, and in most places abut the terrace at a sharp contact. The third is a higher range of hills that lie to the west of the Kalkburg, known as the Hoogeburg. These hills range from 800 to 1,000 feet in elevation. The Cauterskill Road site is on the western edge of the Kalkburg.

3.2 Geology

3.2.1 Regional Geology

Greene County is almost entirely covered by glacial sediments with minor amounts of alluvial deposits along present day streams. Glacial deposits throughout the county range in composition and morphology from thin layers of till, to stratified outwash plains, to irregular morainal surfaces. In places, these sediments are more than 200-feet thick (USDA SCS 1985). The Village of Catskill is underlain by lacustrine clays and silts that were deposited in glacial

Lake Albany between 20,000 and 13,000 years ago. During this time the terminal moraine of the Wisconsin ice sheet dammed the mouth of the Hudson Valley, creating a large lake that stretched 320 km from New York City to Glens Falls, and was estimated to be approximately 120 m deep near Albany (Isachsen et al. 1991). It is unclear when and where the lake drained, but its presence is clearly illustrated by the lacustrine deposits that remain in the valley.

Bedrock in the Hudson Valley consists of extensively folded and faulted Silurian through Middle Devonian age sedimentary rocks, that form a 2- to 3-km-wide miniature valley and ridge province (Marshak 1986). The oldest unit exposed near the study area is the Middle Ordovician Austin Glen Formation, which is composed of graywacke (clay-rich sandstone) and shale. The deep water muds and sands that would eventually lithify to form these rocks were deposited approximately 475 million years ago in a sea that existed between early North America and an island arc approaching from east (Isachsen et al 1991). These sediments are thicker and coarser to the east indicating they eroded from the island arc and were deposited westward in the sea. They sit unconformably on much older Lower Cambrian to Lower Ordovician sedimentary rocks. This unconformity, or missing section of the rock record, represents a period of erosion that occurred prior to the deposition of the Austin Glen Formation (Isachsen et al 1991). Due to this unconformity, little if any Early to Middle Ordovician rocks are present in the Hudson Valley, and their total thickness in this region unknown. However, it is estimated that they may be up to 1,500 meter thick (Isachsen et al 1991).

The beds of the Austin Glen Formation were significantly folded prior to the deposition of the overlying Silurian Rondout Formation. The contact between these two formations is known as the Taconic unconformity and is a result of the Taconic orogeny, a mountain building event that took place approximately 450 million years ago. During the Taconic Orogeny, the westward moving island arc collided with North America causing the deformation of these rocks. The Rondout was then deposited atop these deformed rocks between 438 and 408 million years ago. Above the Rondout sits the Lower Devonian Helderberg and Tristates Groups, which together are composed of 10 formations. Each of these formations is a product of sea level fluctuations that occurred between 408 and 387 million years ago, and are primarily composed of carbonate sequences interlayered with shale. Above the Tristates Group is the lower Middle Devonian Onondaga Limestone, which is the youngest carbonate in the Hudson Valley.

Two more periods of mountain building, known as the Acadian and Alleghanian Orogenies, took place between 410 to 380, and 330 to 250 million years ago, respectively. These events, combined with previous periods of deformation, have created numerous folds and faults of a variety of orientations and scales, creating a very complex subsurface geology in the Hudson Valley region.

3.2.2 Site Geology

Overburden

The site exhibits moderate to high relief with elevations ranging from approximately 170 feet AMSL to 280 feet AMSL (USGS 1980). Several outcrops run through the site with contrasting dip angles indicating folding and faulting. This results in slopes and cliffs at opposing angles from west to east across the site.

The nature of the overburden was characterized during the RI field investigation through test pit excavations and monitoring well drilling and split-spoon sampling. The overburden thickness ranged from 1.0 feet to 12 feet in test pit excavations and 0.75 feet to 6 feet in monitoring well boreholes (see Figure 3-1).

The natural soils encountered generally consisted of brown to dark brown clay and silt, or sand and silt, with some gravel at most localities. The soils exhibited a loose to medium relative density based on blow counts recorded during split-spoon sampling (see Table 2-5). This coincides with that reported in the literature (Fisher et al 1970) (i.e., the area is underlain by a thin veneer of rock debris and glacial till of varying compositions).

Bedrock

Bedrock consisted of dark gray, fractured Onondaga limestone with black chert nodules and calcite mineralization. The Oriskany sandstone that lies beneath the Onondaga formation was not observed at the site. Rock cores were obtained from two of the monitoring well boreholes (CRMW-1 and CRMW-2) from 4.9 to 21.3 feet BGS and 5.5 to 16.5 feet BGS, respectively. The completion of the drilling for these wells and CRMW-3 through CRMW-6 was performed using a combination of air rotary/air hammering techniques. Drilling methods outlined in the work plan (E & E 1998) were changed due to significant drill water loss to formation fractures while coring. The rock chips generated during air rotary/air hammering were all consistent in color and composition to depths of up to 58 feet BGS. The cores exhibited a good to excellent RQD (see Table 2-8), indicating competent, massively bedded cherty limestone. Beds are dipping 28° to 45°, and fractures are generally parallel to bedding planes. Some fractures exhibited

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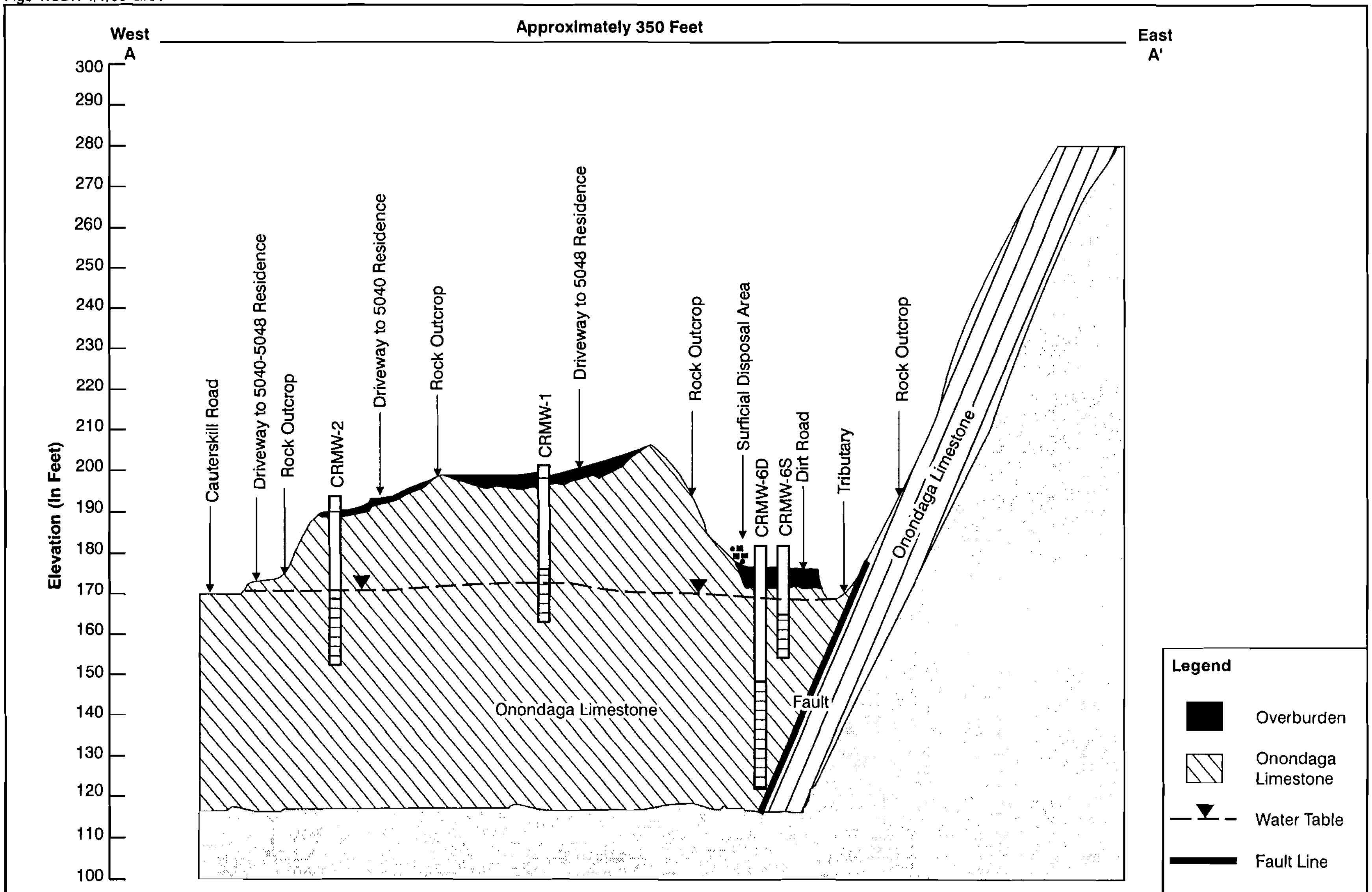
Fig3-1.CDR-4/1/99-GRA



SOURCE: Ecology and Environment, Inc. 1999

Figure 3-1 GENERALIZED SITE CROSS SECTION CAUTERSKILL ROAD SITE

secondary calcite mineralization and iron staining. A few vertical fractures, 45° and 90° to bedding, were encountered.

Several strike and dip measurements were recorded from on site and site boundary outcrops. A summary of these measurements is presented in Table 3-1, and a generalized cross section of the site is illustrated in Figure 3-1. Based on this information, a fault line oriented approximately north/south is located along the creek bed. This coincides with the fault reported on the preliminary Brittle Structures Map of New York (Isachsen and McKendree 1977). Bedding to the west of the fault dips moderately to the east between 28° to 45°, and bedding to the east of the fault dips west at high angles between 64° and 84°.

3.3 Hydrology

3.3.1 Regional Hydrology

Kaaterskill and Catskill creeks converge less than one mile north of the site, and are the primary drainages for two of the four major drainage basin systems in Greene County. After being joined by the Kaaterskill, Catskill Creek flows southeast and empties into the Hudson River immediately south of the Town of Catskill. The Hudson, which drains a third major drainage system, flows southward along the eastern border of the county (USDA SCS 1985).

3.3.2 Site Hydrology

Surface drainage at the Cauterskill Road site flows east and north into a tributary to Kaaterskill Creek. This tributary is also joined further to the north of the site by a drainageway which originates to the west of the New York State Thruway. Together, these tributaries flow into Katterskill Creek approximately 0.7 mile north of the site. Too little overburden is present at the site to facilitate the presence of a significant overburden water-bearing zone. Bedrock groundwater at the site follows in a similar northeastward direction at an average horizontal gradient of 2.3 feet per 100 feet (see Figure 3-2). Table 3-2 summarizes water level measurements recorded after the wells were developed.

Surface drainage and groundwater beneath the site flows east toward the creek bed, where it then flows north along the fault line. Flow in the creek bed is intermittent but depositional features of high flow are evident. During the initial site visit in September 1998, the initial fieldwork activities in December 1998, and most of the field activities in January 1999, the tributary and associated ponded areas were dry. However, after a few days with temperatures above freezing and steady rain in mid-January, the north pond

Table 3-1 Summary of Strike and Dip Measurements Cauterskill Road Site

Measurement Number	Location	Strike (Degrees)	Dip (Degrees)
1	East side of Cauterskill Road, at middle of southern site driveway	N18E	40E
2	East side of Cauterskill Road, at foot of southern site driveway	N26E	35E
3	East side of Cauterskill Road, approximately 50 feet south of Measurement No. 2	N36E	43E
4	East side of Cauterskill Road, approximately 70 feet south of Measurement No. 3	N24E	38E
5	East side of Cauterskill Road, approximately 130 feet south of Measurement No. 4	N38E	27E
6	East side of Cauterskill Road, approximately 220 feet south of Measurement No. 5	N27E	30E
7	Approximately 25 feet northeast of CRMW-3	N38E	38E
8	Near southeast corner of the Kost residence	N15E	23E
9	Approximately 25 feet east of geophysical survey grid node (250,400)	N65W	2NE
10	Approximately 25 feet northeast of geophysical survey grid node (250,300)	N40W	95W
11	Top of east ridge, east of the south end of the chicken coop	N25E	84W
12	East ridge, east of the Kost residence	N28E	64W
13	Rock face on east side of 5048 residence driveway	N28E	29E
14	Rock face approximately 15 feet southeast of the brick pillar on the east side of the driveway to the 5040 residence	N11E	30E

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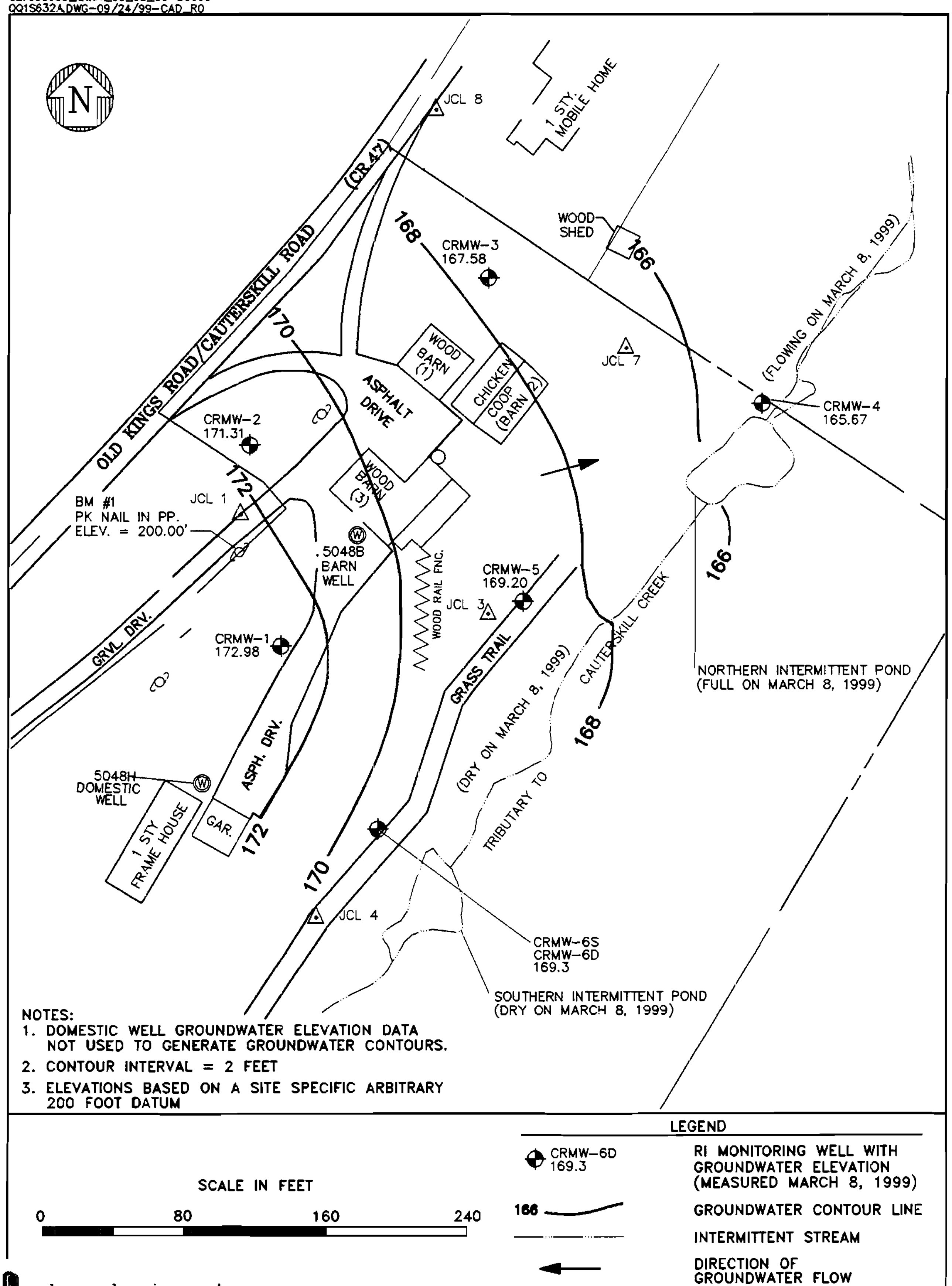

ecology and environment

Figure 3-2
GROUNDWATER CONTOUR MAP
CAUTERSKILL ROAD, CATSKILL, NEW YORK

Table 3-2 Summary of Groundwater Levels, Cauterskill Road Site

Well Number	Ground Elevation[a] (ft)	TOIC Elevation[a] (ft)	Average Depth to Groundwater (ft bgs)	Average Standing Water Column (ft)	Depth to Groundwater (ft below TOIC) 1/22/99	1/25/99	1/26/99	1/27/99	1/28/99	1/29/99	3/8/99
CRMW-1	198.79	201.18	25.74	11.76	28.14			27.98	28.20		28.20
CRMW-2	190.1	193.05	19.92	17.08	21.75		21.26	22.36	28.07	22.05	21.74
CRMW-3	180.75	182.46	14.33	41.17		12.68	19.35	15.24	18.05		14.88
CRMW-4	168.9	170.52	2.63	47.37			4.16		3.74		4.85
CRMW-5	184.89	186.31	21.22	11.28			17.15	25.58	27.10	26.24	17.11
CRMW-6S	180.49	182.42	12.20	13.30					15.15		13.11
CRMW-6D	180.49	182.26	12.32	45.68		10.80	16.32	14.85	15.50		12.97

[a] Based on a site-specific 200-foot datum.

Key:

bgs = Below ground surface.
ft = Feet.
TOIC = Top of inner casing.

filled with water overnight to a depth of 2.5 feet. Water was observed upwelling from the base of a rock outcrop on the east side of the pond. The pond remained filled and the tributary flowed downstream of the pond for the remainder of the field program (January 29, 1999) and was observed to be flowing in early March 1999. During this two-week time period in late January, the tributary exhibited intermittent flow between the highway department building and the north site pond. In some instances, the south site pond would be dry one day, have over 3 feet of water on another day, and be totally dry a day later. The fluctuations between no flow and excessive high energy flow was directly related to freezing and thawing resulting in surface water runoff and groundwater recharge through the fractured bedrock from upgradient locations. Since the tributary only flows during periods of surface water/groundwater recharge events, it is considered to be a losing stream (i.e., water from the tributary is being lost to the underlying fractured bedrock) because it cannot sustain flow during dryer periods. As stated above, the fault line acts as a groundwater sink causing groundwater from the site to flow to the northeast, and groundwater from the ridge east of the site to flow northwest, then ultimately north towards Kaaterskill Creek.

Groundwater flow through the uplifted and faulted bedrock is through bedding plane fractures and vertical fractures. The dry fractures (i.e., those above the water table) exhibited very high hydraulic conductivities based on the amount of water lost to the formation during drilling (i.e., 1,850 gallons over 16.4 feet of rock coring in CRMW-1, and 700 gallons over 11.5 feet of rock coring in CRMW-2). However, the saturated fractures exhibited much lower hydraulic conductivities based on slug test results, except for CRMW-1. Hydraulic conductivity measured in CRMW-1 was 9.5 x 10^{-3} feet/minute (ft/min), CRMW-3 was 2.5 x 10^{-6} ft/min, CRMW-4 was 1.9 x 10^{-6} ft/min, CRMW-5 was 5.2 x 10^{-4} ft/min, and CRMW-6 was 3.1 x 10^{-5} ft/min (see Appendix E).

ft/min
feet/minute

The hydraulic conductivity measured in CRMW-1 is typical of Karst limestone, and the hydraulic conductivities in the other wells are typical of a limestone/dolomite (Freeze and Cherry 1979). The hydraulic conductivity of CRMW-5 was the second-most permeable well, falling close to the distinction between typical values for Karst limestone and limestone.

4 Quality Assurance/ Quality Control (QA/QC) Procedures

EPA
United States
Environmental Protection
Agency

This section describes the sampling procedures utilized for each environmental medium collected and analyzed for this project. The QAPP presented in the work plan was followed for all RI activities. The procedures described in the QAPP are consistent with the most current updates of the United States Environmental Protection Agency (EPA) sampling procedures as described in SW-846.

4.1 Field QC Samples

Field QC samples provide a means to check ways that sample quality can be compromised in the field or through shipping, and also document overall sampling precision. The following sections describe field QC samples collected during the RI.

Trip Blanks

Trip blanks check for the possible introduction of VOCs from the time the samples are collected to the time they are analyzed. Trip blanks were prepared in the field trailer by filling 40-mL glass vials with organic-free deionized water. They were handled like field samples; however, they were not opened in the field. One trip blank sample accompanied each shipment containing samples to be analyzed for VOCs. Due to the simultaneous collection and shipment of samples in the same cooler from both the Catskill Chrome and Cauterskill Road sites, trip blanks from January 5 and 12, 1999 were shared between samples from both sites. Table 4-1 lists trip blanks and associated samples, and Table 4-2 summarizes the analytical data generated from trip blank analyses. Appendix D contains appropriate trip blank analytical data from both sites.

Duplicate Samples

Consistency in both sample collection and sample analysis is checked through analysis of duplicate samples. Duplicate samples consist of aliquots of sample media placed in separate sample containers and labeled as separate samples. Duplicate samples were collected at a rate of approximately one per 10 field samples. Table 4-3 lists the duplicate samples and the original samples

Table 4-1 Summary of Trip Blanks and Associated Samples

Trip Blank Sample Number	Sample Date	Associated Samples
CRTB1211	12/11/99	CRSS-6, CRSS-6/D, CRSS-11, CRSS-19, CRSS-26, CRSS-27, CRSS-34, CRSS-37, CRSS-41, CRSS-BG-1, CRSD-1, CRSD-3, CRSD-6, CRSD-6/D, and CRSD-9
CC-BH14-AWT	1/5/99	CRTP-2, CRTP-3, CRTP-3/D, and CRTP-4
CRTB1699	1/6/99	CRTP-5
CRTB1799	1/7/99	CRTP-6, CRTP-7, CRTP-8-1, CRTP-8-2, and CRTP-9-1
CRTP1899	1/8/99	CRTP-9-2 and CRTP-10
CC-TP13-AWT	1/12/99	CRMW-6SB
CRTB11399	1/13/99	CRMW-5SB, and CRDW01
CRTB12099	1/20/99	CRRIN-SS and CRDW02
CRTB12699	1/26/99	CRSW-1 through CRSW-9, and CRSW-6/D
CRTB12799	1/27/99	CRMW-1, CRMW-2, CRMW-3, CRMW-6D, and CRGW-5048B
CRTB12899	1/28/99	CRMW-4, CRMW-5, CRGW-5040, CRGW-5048H, CRGW-5048H/D, CRGW-5056

which they duplicated. Duplicate sample analytical data are presented in the data summary tables presented in Section 5.

Rinsate Samples

Rinsate samples are collected to check on the effectiveness of the decontamination process on sampling equipment. Since dedicated sampling equipment was used to collect most of the RI samples, rinsates were generally not necessary. However, subsurface soil sampling from monitoring well boreholes was conducted using decontaminated split-spoon samplers. Therefore, a rinsate sample consisting of organic-free deionized water poured over the interior of the split-spoon sampler was collected. Rinsate samples were collected at a rate of one per 20 field samples. Since only two subsurface soils from monitoring well boreholes were collected, only one rinsate (CRRIN-SS) was necessary. The resulting rinsate sample analytical data is presented in Table 4-4.

Drill Water Samples

Drill water samples are collected to check whether water added to the borehole during drilling or used for decontamination of drilling equipment contains analytes which can affect the quality of the groundwater or split-spoon soil samples. The drill water samples were collected by pumping the water from the rig tank(s) to the appropriate sample containers. The source of the drill water is the

Table 4-2 Summary of Trip Blank Sample Analyses

Compound	CRTB-1211	CC-BH14-AWT[a]	CRTB-1699	CRTB-1799	CRTB-1899	CC-TP13-AWT[a]	CRTB-11399	CRTB-12099	CRTB-12699	CRTB-12799	CRTB-12899
TCL Volatiles (µg/L)											
Chloroform	ND	ND	ND	ND	ND	ND	1 J	ND	ND	ND	ND
Methylene chloride	ND	ND	2 J	1 J	1 J	ND	ND	1 JB	ND	ND	1 J

[a] VOC samples from Cauterskill Road RI were shipped in the same cooler as samples from the Catskill Chrome site; therefore, only the trip blank designated for the Catskill Chrome samples was also used for the Cauterskill Road samples.

Key:

B = Detected less than 10 times the value in the associated blank sample.
J = Reported value was from reading less than Contract Required Detection Limit but greater than or equal to the instrument detection limit (same as B qualifier on Form 1 of the laboratory data pack for metals). Therefore, the value is estimated.
ND = Compound not detected.
TCL = Target compound list.
µg/L = micrograms per liter.

Table 4-3 Summary of Duplicate Samples

Sample Matrix	Original Sample Number	Duplicate Sample Number	Sample Date
Surface Soils	CRSS-BG-2	CRSS-BG-2/D	12/11/98
	CRSS-4	CRSS-4/D	12/10/98
	CRSS-6	CRSS-6/D	12/11/98
	CRSS-14	CRSS-14/D	12/10/98
	CRSS-25	CRSS-25/D	12/10/98
	CRSS-40	CRSS-40/D	12/11/98
Subsurface Soils	CRTP-3	CRTP-3/D	1/5/99
Surface Water	CRSW-6	CRSW-6/D	1/26/99
	CRSW-12	CRSW-12D	6/30/99
Sediment	CRSD-5R	CRSD-5R/D	3/9/99
	CRSD-12	CRSD-12D	6/30/99
	CRSD-17	CRSD-17D	6/30/99
Waste	CRW-1	CRW-1/D	12/11/99
Groundwater	CRGW5048H	CRGW5048H/D	1/28/99

Town of Catskill Highway Department. Although only one drill water was scheduled to be collected on the work plan, one drill water sample was collected from each of the two rigs used on site (i.e., CRDW01 was collected from the track-mounted rig on January 13, and CRDW02 was collected from the truck-mounted rig on January 20, 1999). The results of the drill water samples are presented in Table 4-5. Due to a laboratory problem, the hexavalent chromium portion of CRDW01 was resampled on January 20, 1999 and the results are reported as sample CRDW01R.

4.2 Laboratory QC Samples

Laboratory QC samples provide mechanisms to check analytical precision. This is accomplished by routinely performing several internal QC checks. QC procedures used during the RI sample analyses are detailed below.

Method and Calibration Blanks

Quality checks on the laboratory instrumentation and methods are conducted by analysis of method blanks. Method blanks consist of organic-free deionized water subjected to every step of the analytical process to determine possible points of organic laboratory contaminant introduction.

Table 4-4 Summary of Rinsate Sample Analyses

Compound	CRRIN-SS
TCL Volatiles (µg/L)	
Methylene chloride	1 J
TCL Semivolatiles (µg/L)	
SVOCs	ND
TCL Pest/PCB (µg/L)	
Pest/PCBs	ND
TAL Metals (µg/L)	
Aluminum	2.3 J
Calcium	96.2 J
Iron	44.2 J
Manganese	0.66 J
Potassium	775 J
Sodium	774 J
Thallium	4.8 J
Hexavalent Chromium (mg/L)	
Cr^{+6}	0.011
Cyanide	ND J

Key:

Cr+6 = Hexavalent chromium.
J = Reported value was from reading less than Contract Required Detection Limit but greater than or equal to the instrument detection limit (same as B qualifier on Form 1 of the laboratory data pack for metals). Therefore, the value is estimated.
µg/L = Micrograms per liter.
mg/L = Milligrams per liter.
ND = Compound not detected.
Pest/PCB = Pesticides/polychlorinated biphenyls.
SVOC = Semivolatile organic compounds.
TAL = Target analyte list.
TCL = Target compound list.

Table 4-5 Summary of Drill Water Sample Analyses

Compound	CRDW01	CRDW01R	CRDW02
TCL Volatiles (µg/L)			
VOCs	ND	—	ND
TCL Semivolatiles (µg/L)			
SVOCs		—	ND
Di-n-butylphthalate	1 J	—	ND
bis(2-Ethlylhexyl)phthalate	8 J	—	ND
TCL Volatiles (µg/L)			
Pest/PCBs	ND	—	ND
TAL Metals (µg/L)			
Aluminum	3320	—	56 J
Barium	135J	—	82.2 J
Cadmium	0.9355	—	ND
Calcium	125000	—	66,500
Chromium	10.5	—	4.2 J
Cobalt	2.5	—	ND
Copper	39	—	11.8 J
Iron	4930	—	2,510
Magnesium	15400	—	7,790
Manganese	173	—	37.8
Potassium	1650 J	—	2,030 J
Silver	2.2 J	—	1.6 J
Sodium	141000	—	130,000
Thallium	4.9 J	—	4.2 J
Vanadium	2.6 J	—	
Zinc	89.3 J	—	16.9 J
Hexavalent Chromium (mg/L)			
Cr^{+6}	—	0.011	0.014
Cyanide	ND J		ND J

Table 4-5 Summary of Drill Water Sample Analyses

Compound	CRDW01	CRDW01R	CRDW02

Key:

Cr^{+6}	=	Hexavalent chromium.
J	=	Reported value was from reading less than Contract Required Detection Limit but greater than or equal to the instrument detection limit (same as B qualifier on Form 1 of the laboratory data pack for metals). Therefore, the value is estimated.
µg/L	=	Micrograms per liter.
mg/L	=	Milligrams per liter.
ND	=	Compound not detected.
Pest/PCB	=	Pesticides/polychlorinated biphenyls.
SVOC	=	Semivolatile organic compounds.
TAL	=	Target analyte list.
TCL	=	Target compound list.

Similarly, laboratory equipment used to conduct inorganic analyses (usually an inductively-coupled plasma unit) is evaluated by analyzing instrument calibration blanks. These blanks analyzing pure reagent matrix are compared to set instrument response baselines.

One method blank per 20 samples was analyzed, while one calibration blank was analyzed every two hours or every 10 samples, whichever was more frequent.

Spike Samples

Spike samples simulate the background effect and interferences found in the actual samples, and the calculated percent recovery of the spike is used as a measure of the accuracy of the total analytical method. Spike samples were prepared by adding to an environmental sample (before extraction or digestion) a known amount of pure analyte to be assayed. The percent recovery of the spike analyte measures the accuracy of the method. Spikes were added at a concentration approximately mid-point on the calibration curve. Spikes (e.g., laboratory control samples) added to a matrix blank were analyzed with each sample batch to assess analytical performance not affected by sample matrix. If matrix spike samples indicated a potential matrix effect, the matrix spike blanks were evaluated to verify the problems were not due to an analytical concern.

Laboratory Duplicate or Matrix Spike Duplicates

In addition to analytical error introduced by machinery and sample handling, error can also occasionally result from analytical process interference by a sample matrix. This can result in the reporting of analytes at concentrations lower than the true concentrations. Laboratory or matrix spike duplicates are aliquots of the same

RPD
relative percent difference

SOP
standard operating procedure

sample that are split prior to analysis and are treated exactly the same throughout the analytical method. The relative percent difference (RPD) between the values of the MS and MSD for organics or between the original and the duplicate for inorganics was taken as a measure of the precision of the analytical method. MS/MSD samples were collected at a rate of one per 20 field samples or batch MS/MDS samples were analyzed at a rate of one per day per matrix. Table 4-6 lists the samples for which extra MS/MSD volume was collected. MS/MSD data are evaluated as part of the data validation process.

4.3 Data Validation

Analytical data reports generated by the laboratory were checked to verify that the data reported is consistent with the laboratory QA Manual and standard operating procedures (SOPs). The data reports verified by the laboratory are included in Appendix B.

In addition to the laboratory review, an independent data validator reviewed the data. Chemworld Environmental, Inc., (Chemworld) Rockville, MD, performed the validation. Chemworld validated the data in accordance with the USEPA Region II Data Validation Checklists/Guidance and the appropriate methods from the NYSDEC Analytical Services Protocols (ASP), October 1995. The validation included an evaluation of the following:

- Holding times,
- Initial and continuing calibration,
- Reporting limit check standards,
- Laboratory blanks,
- Field blanks,
- MS/MSD samples,
- Laboratory control samples (LCS, same as matrix spike blanks),
- Laboratory duplicates,
- Field duplicates,
- Sample result verification, and
- Method-specific QC samples [e.g., gas chromatography/mass spectrometry (GC/ MS) tunes and inductively couple argon spectroscopy (ICP) serial dilutions).

Any deviations from acceptable QC specifications were discussed in a data validation report. The data validator added appropriate qualifiers to the data to indicate potential concerns with data usability. These qualifiers were transferred to the data presented on summary tables in Section 5.0. For the Phase I data, the following qualifiers were added:

- J - The qualifier indicates estimated value because the associated QC data indicated a potential laboratory or matrix problem. In addition, J flags indicate the results are below the contract required detection limit (CRDL), but above the instrument detection limit (IDL) or method detection limit (MDL). For inorganic data, a B flag on the laboratory report in Appendix D indicates these results. The J flag also may indicated potential interference. For inorganic data, an E flag on the laboratory report in Appendix D indicates these results.

- U - The result is considered non-detect due to blank contamination. If the result is above the CRDL, the CRDL is considered elevated.

The complete data validation reports will be provided to NYSDEC under separate cover. The Phase II data are still under evaluation and the validation qualifiers will be added to the report on the next revision.

The data validation reports submitted to date do not indicate any major problems in data usability, except for hexachromium in soil samples. The MS/MSD samples for hexachromium method showed all zero to low recoveries. The LCS recoveries were acceptable, indicating no problem with the analytical method. The results indicate the soil has a strong potential to reduce hexachromium to trivalent chromium, and essentially the entire spike amount was immediately reduced. The findings indicate that all the non-detect results for hexachromium in soils are estimated and that the actually detection limit is much higher than that reported by the laboratory. The non-detect results for hexachromium should be used with caution that accounts for the potential for a higher detection limit.

Table 4-6 Summary of MS/MSDs and Associated Samples

MS/MSD Sample Number	Sample Date	Associated Samples
Surface Soils and Sediment		
CRSS-11MS	12/11/98	CRSS-1 through CRSS-42, CRSS-BG-1 through CRSS-BG-5; and CRSD-1 through CRSD-9
CRSS-11MSD	12/11/98	
CRSS-17MS	12/19/98	
CRSS-17MSD	12/19/98	
CRSS-20MS	12/19/98	
CRSS-20MSD	12/19/98	
CRSD-12MS	6/30/99	CRSD-10 through CRSD-17
CRSD-12MSD	6/30/99	
Waste		
CRW-1MS	12/11/98	CRW-1 and CRW-2
CRW-1MSD	12/11/98	
Subsurface Soil		
CRTP-4MS	1/5/99	CRTP-2 through CRTP-7, CRTP-8-1, CRTP-8-2, CRTP-9-1, CRTP-9-2, CRTP-10; CRMW-5SB; CRMW-6SB
CRTP-4MSD	1/5/99	
Surface Water		
CRSW-3MS	1/26/99	CRSW-1 through CRSW-9
CRSW-3MSD	1/26/99	
CRSW-12MS	6/30/99	CRSW-11 and CRSW-12
CRSW-12MSD	6/30/99	
Groundwater		
CRGW-5040-MS	1/28/99	CRMW-1 through CRMW-6D; CRGW-5040; CRGW-5048B; CRGW-5048H; CRGW-5056
CRGW-5040-MSD	1/28/99	

5 Nature and Extent of Contamination

5.1 Introduction

This section presents results of the RI field activities, including geophysical interpretations, sample analysis screening, and aquifer test results in order to develop an understanding of the nature and extent of contamination at the site. This information was used to assess the fate and transport of contaminants that pose a threat to human health or the environment.

In addition to presenting complete analytical results, (see Tables 5-1 through 5-7), the data are screened to present the samples and analytes that may represent a possible threat to human health and the environment. For screening purposes, analytical data were compared to the New York State Class GA and Class C ambient water guidance values and standards (June 1998), the guidance values presented in the NYSDEC Technical and Administrative Guidance Manual (TAGM) 4046 (January 1994), and the screening criteria presented in the NYSDEC Technical Guidance for Screening Contaminated Sediments (January 1999).

TAGM
Technical and Administrative Guidance Manual

The TAGM 4046 guidance manual provides suggested soil contaminants levels that would be protective to human health. However, in the case of metals, this document recommends using soil background concentrations rather than health-based levels. Also, for many organics, the guidance values are based on migration to groundwater using an arbitrary equilibrium-based model. Despite these limitations, these guidance values are useful in identifying areas that may require consideration for cleanup. For background metals concentrations, a value of twice the average of the concentrations measured in the background surface soil samples was used for screening purposes. A value of twice the background is typically close to the true background plus three standard deviations. Using this value rather than the actual mean prevents identification of what are truly background metals concentrations from being identified as possible site contaminants. For some of the more common metals (e.g., iron, calcium, and magnesium) only a single background sample was analyzed. Therefore, for screening purposes, twice the concentration measured in this single sample was used as the comparison value.

Table 5-1 Analytical Data Summary of Positive Hits for Background Soil Samples, Cauterskill Road Site

Compound	NYSDEC TAGM 4046 [a]	CRSS-BG-1	CRSS-BG-2	CRSS-BG-2/D	CRSS-BG-3	CRSS-BG-4	CRSS-BG-5
TCL Volatiles µg/kg (Total VOCs <10ppm)							
Acetone	200	ND	NA	NA	NA	NA	NA
Methylene Chloride	100	ND	NA	NA	NA	NA	NA
Toluene	1.5	ND	NA	NA	NA	NA	NA
TCL Semivolatiles µg/kg (Total SVOCs <500ppm, individual SVOCs <50ppm)							
Diethylphthalate	7,100	ND	NA	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate (DEHP)	50,000	ND	NA	NA	NA	NA	NA
Butylbenzylphthalate	50,000	ND	NA	NA	NA	NA	NA
Di-n-butylphthalate	8,100	ND	NA	NA	NA	NA	NA
Polycyclic Aromatic Hydrocarbons							
Dibenzofuran	6,200	ND	NA	NA	NA	NA	NA
Carbazole	—	ND	NA	NA	NA	NA	NA
2-Methylnaphthalene	36,400	ND	NA	NA	NA	NA	NA
Acenaphthylene	41,000	ND	NA	NA	NA	NA	NA
Acenaphthene	50,000	ND	NA	NA	NA	NA	NA
Anthracene	50,000	ND	NA	NA	NA	NA	NA
Benzo(a)anthracene	224 [b]	ND	NA	NA	NA	NA	NA
Benzo(a)pyrene	61 [b]	ND	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	1,100	ND	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	1,100	64 J	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	50,000	ND	NA	NA	NA	NA	NA
Chrysene	400	89 J	NA	NA	NA	NA	NA

Key at end of table.

Table 5-1 Analytical Data Summary of Positive Hits for Background Soil Samples, Cauterskill Road Site

Compound	NYSDEC TAGM 4046 [a]	CRSS-BG-1	CRSS-BG-2	CRSS-BG-2/D	CRSS-BG-3	CRSS-BG-4	CRSS-BG-5
Dibenz(a,h)anthracene	14	ND	NA	NA	NA	NA	NA
Fluoranthene	50,000	150 J	NA	NA	NA	NA	NA
Fluorene	50,000	ND	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	3,200	ND	NA	NA	NA	NA	NA
Naphthalene	13,000	ND	NA	NA	NA	NA	NA
Pentachlorophenol	1,000 [b]	ND	NA	NA	NA	NA	NA
Phenanthrene	50,000	110 J	NA	NA	NA	NA	NA
Pyrene	50,000	110 J	NA	NA	NA	NA	NA
TCL Pesticide/PCB µg/kg (Total Pesticides <10ppm)							
Aldrin	41	ND	NA	NA	NA	NA	NA
Dieldrin	44	ND	NA	NA	NA	NA	NA
Endrin	100	ND	NA	NA	NA	NA	NA
Methoxychlor	—	ND	NA	NA	NA	NA	NA
Endrin Ketone	—	ND	NA	NA	NA	NA	NA
alpha-Chlordane	5,400	ND	NA	NA	NA	NA	NA
gamma-Chlordane	5,400	ND	NA	NA	NA	NA	NA
Heptachlor Epoxide	20	ND	NA	NA	NA	NA	NA
4,4'-DDT	2,100	ND	NA	NA	NA	NA	NA
Aroclor 1254	1,000 [c]	ND	NA	NA	NA	NA	NA
Aroclor 1260	1,000 [c]	ND	NA	NA	NA	NA	NA
Inorganics mg/kg							
Aluminum	SB	10,400	NA	NA	NA	NA	NA
Antimony	SB	ND	NA	NA	NA	NA	NA

Key at end of table.

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Table 5-1 Analytical Data Summary of Positive Hits for Background Soil Samples, Cauterskill Road Site

Compound	NYSDEC TAGM 4046 [a]	CRSS-BG-1	CRSS-BG-2	CRSS-BG-2/D	CRSS-BG-3	CRSS-BG-4	CRSS-BG-5
Arsenic	7.5 or SB	9.7	NA	NA	NA	NA	NA
Barium	300 or SB	300	NA	NA	NA	NA	NA
Beryllium	0.16 or SB	1.49	NA	NA	NA	NA	NA
Cadmium	1 or SB	1.54	1.40	1.92	2.32	3.24	1.93
Calcium	SB	16,700	NA	NA	NA	NA	NA
Chromium	10 or SB	10.8	14.0	12.9	14.2	12.5	13.0
Cobalt	30 or SB	12.5	NA	NA	NA	NA	NA
Copper	25 or SB	37.6	18.2	18.8	46.1	37.7	21.3
Iron	2,000 or SB	17,300	NA	NA	NA	NA	NA
Lead	SB	87.7	68.8	66.4	73.3	133	105
Magnesium	SB	1,530	NA	NA	NA	NA	NA
Manganese	SB	8,980	NA	NA	NA	NA	NA
Mercury	0.1	0.27	NA	NA	NA	NA	NA
Nickel	13 or SB	76.5	23.6	23.0	50.0	23.2	15.8
Potassium	SB	1,390	NA	NA	NA	NA	NA
Selenium	2 or SB	1.9	NA	NA	NA	NA	NA
Silver	SB	ND	NA	NA	NA	NA	NA
Sodium	SB	85.3	NA	NA	NA	NA	NA
Thallium	SB	ND	NA	NA	NA	NA	NA
Vanadium	150 or SB	27.1	NA	NA	NA	NA	NA
Zinc	20 or SB	164	117	102	191	207	134
Hexavalent Chromium	—	ND	NA	NA	NA	NA	NA
Cyanide	—	1.09	ND	ND	0.828	13.9J	ND

Key at end of table.

Table 5-1 Analytical Data Summary of Positive Hits for Background Soil Samples, Cauterskill Road Site

Compound	NYSDEC TAGM 4046 [a]	CRSS-BG-1	CRSS-BG-2	CRSS-BG-2/D	CRSS-BG-3	CRSS-BG-4	CRSS-BG-5
Total Solids %							
Total Solids	—	53	68.62	68.44	56.75	36.23	56.58

[a] NYSDEC Technical and Administrative Guidance Memorandum (TAGM) 4046 (January 1994) Soil Cleanup Objectives.

[b] Per TAGM 4046 the guidance value is the listed value or the MDL, whichever one is the most stringent.

[c] TAGM 4046 guidance value for PCBs in surface soils.

Key:

J = Reported value was from reading less than Contract Required Detection Limit but greater than or equal to the Instrument Detection Limit (same as B qualifier on Form 1 of the laboratory data pack for metals analyses). Therefore, the reported value is estimated.
NA = Not analyzed.
ND = Not detected.
MDL = Method detection limit.
mg/kg = Milligrams per kilogram.
NYSDEC = New York State Department of Environmental Conservation.
PCB = Polychlorinated biphenyl.
ppm = Parts per million.
SB = Site background.
SVOC = Semivolatile organic compound.
TCL = Target compound list.
VOC = Volatile organic compound.
µg/kg = Micrograms per kilogram.
< = Less than.
– = No soil cleanup objectives available/applicable.
% = Percent.

Table 5-2 Analytical Data Summary of Positive Hits for Surface Soil Samples, Cauterskill Road Site

Compound	NYSDEC TAGM 4046 [a]	CRSS-1	CRSS-2	CRSS-3	CRSS-4	CRSS-4/D	CRSS-5	CRSS-6	CRSS-6/D	CRSS-7
TCL Volatiles µg/kg (Total VOCs <10ppm)										
Methylene Chloride	100	NA	NA	NA	NA	NA	NA	2 J	1 J	NA
TCL Semivolatiles µg/kg (Total SVOCs <500ppm, individual SVOCs <50ppm)										
bis(2-Ethylhexyl) phthalate	50,000	NA	NA	NA	NA	NA	NA	ND	ND	NA
Butylbenzyl phthalate	50,000	NA	NA	NA	NA	NA	NA	ND	ND	NA
Di-n-butylphthalate	8,100	NA	NA	NA	NA	NA	NA	ND	ND	NA
Polycyclic Aromatic Hydrocarbons										
Dibenzofuran	6,200	NA	NA	NA	NA	NA	NA	ND	ND	NA
Carbazole	—	NA	NA	NA	NA	NA	NA	54 J	ND	NA
Acenaphthylene	41,000	NA	NA	NA	NA	NA	NA	60 J	ND	NA
Acenaphthene	50,000	NA	NA	NA	NA	NA	NA	ND	ND	NA
Anthracene	50,000	NA	NA	NA	NA	NA	NA	74 J	ND	NA
Benzo(a) anthracene	224 [b]	NA	NA	NA	NA	NA	NA	230 J	100 J	NA
Benzo(a)pyrene	61 [b]	NA	NA	NA	NA	NA	NA	240 J	110 J	NA
Benzo(b) fluoranthene	1,100	NA	NA	NA	NA	NA	NA	210 J	92 J	NA
Benzo(k) fluoranthene	1,100	NA	NA	NA	NA	NA	NA	210 J	96 J	NA
Benzo(g,h,i) perylene	50,000	NA	NA	NA	NA	NA	NA	220 J	160 J	NA
Chrysene	400	NA	NA	NA	NA	NA	NA	300 J	140 J	NA

Key at end of table.

Table 5-2 Analytical Data Summary of Positive Hits for Surface Soil Samples, Cauterskill Road Site

Compound	NYSDEC TAGM 4046 [a]	CRSS-1	CRSS-2	CRSS-3	CRSS-4	CRSS-4/D	CRSS-5	CRSS-6	CRSS-6/D	CRSS-7
Dibenz(a,h) anthracene	14	NA	NA	NA	NA	NA	NA	86 J	50 J	NA
Fluoranthene	50,000	NA	NA	NA	NA	NA	NA	570	240 J	NA
Fluorene	50,000	NA	NA	NA	NA	NA	NA	ND	ND	NA
Indeno(1,2,3-cd) pyrene	3,200	NA	NA	NA	NA	NA	NA	200 J	130 J	NA
Phenanthrene	50,000	NA	NA	NA	NA	NA	NA	280 J	100 J	NA
Pyrene	50,000	NA	NA	NA	NA	NA	NA	400 J	180 J	NA
TCL Pesticide/PCB μg/kg (Total Pesticides <10ppm)										
Dieldrin	44	NA	NA	NA	NA	NA	NA	ND	ND	NA
Endrin	100	NA	NA	NA	NA	NA	NA	ND	ND	NA
Methoxychlor	—	NA	NA	NA	NA	NA	NA	ND	ND	NA
Endrin Ketone	—	NA	NA	NA	NA	NA	NA	ND	ND	NA
alpha-Chlordane	5,400	NA	NA	NA	NA	NA	NA	ND	ND	NA
gamma-Chlor-dane	5,400	NA	NA	NA	NA	NA	NA	ND	ND	NA
Heptachlor Epoxide	20	NA	NA	NA	NA	NA	NA	ND	ND	NA
4,4'-DDT	2,100	NA	NA	NA	NA	NA	NA	ND	ND	NA
Aroclor 1254	1,000 [c]	NA	NA	NA	NA	NA	NA	ND	ND	NA
Aroclor 1260	1,000 [c]	NA	NA	NA	NA	NA	NA	ND	ND	NA
Inorganics mg/kg										
Aluminum	20,800 [d, e]	NA	NA	NA	NA	NA	NA	10,500	10,100	NA
Arsenic	19.4 [d, e]	NA	NA	NA	NA	NA	NA	3.2	5.1	NA
Barium	600 [d, e]	NA	NA	NA	NA	NA	NA	62.3	71.2	NA
Beryllium	2.98 [d, e]	NA	NA	NA	NA	NA	NA	0.559	0.542	NA

Key at end of table.

Table 5-2 Analytical Data Summary of Positive Hits for Surface Soil Samples, Cauterskill Road Site

Compound	NYSDEC TAGM 4046 [a]	CRSS-1	CRSS-2	CRSS-3	CRSS-4	CRSS-4/D	CRSS-5	CRSS-6	CRSS-6/D	CRSS-7
Cadmium	4.12 [d]	ND	0.700	ND	ND	1.44	29.6	39.1	8.98	ND
Calcium	33,400 [d, e]	NA	NA	NA	NA	NA	NA	11600	9030	NA
Chromium	24.8 [d]	16.9	17.3	10.7	15.3	14.4	16.7	13.4	13.3	18.1
Cobalt	25 [d, e]	NA	NA	NA	NA	NA	NA	8.70	7.60	NA
Copper	59.9 [d]	22.3	24.3	26.7	21.5	21.0	280	71.4	60.4	27.5
Iron	34,600 [d, e]	NA	NA	NA	NA	NA	NA	20600	18700	NA
Lead	178.07 [d]	49.1	19	53.3	25	26	175	32	36.0	66.0
Magnesium	3,060 [d, e]	NA	NA	NA	NA	NA	NA	3,620	3,310	NA
Manganese	17,960 [d, e]	NA	NA	NA	NA	NA	NA	478	570	NA
Mercury	0.1	NA	NA	NA	NA	NA	NA	0.050	0.043	NA
Nickel	70.7 [d]	27.6	50.9	22.6	25.6	27.8	1,580	28.0	23.8	27.2
Potassium	2,780 [d, e]	NA	NA	NA	NA	NA	NA	1430	1320	NA
Sodium	170.6 [d, e]	NA	NA	NA	NA	NA	NA	56.1	54.1	NA
Vanadium	54.2 [d, e]	NA	NA	NA	NA	NA	NA	18.9	18.2	NA
Zinc	305 [d]	90.3	76.8	76.9	76.3	71.8	201	94.2	118	107
Hexavalent Chromium	—	NA	NA	NA	NA	NA	NA	ND	ND	NA
Cyanide	—	ND	ND	0.859	0.996	0.938	7.11	ND	6.92	ND
Total Solids %										
Total Solids	—	70.39	74.12	66.48	71.60	70.48	67.38	77	77	69.77

Key at end of table.

Table 5-2 Analytical Data Summary of Positive Hits for Surface Soil Samples, Cauterskill Road Site

Compound	NYSDEC TAGM 4046 [a]	CRSS-8	CRSS-9	CRSS-10	CRSS-11	CRSS-12	CRSS-13	CRSS-14	CRSS-14/D
TCL Volatiles µg/kg (Total VOCs <10ppm)									
Methylene Chloride	100	NA	NA	NA	1 J	NA	NA	NA	NA
TCL Semivolatiles µg/kg (Total SVOCs <500ppm, individual SVOCs <50ppm)									
bis(2-Ethylhexyl)phthalate	50,000	NA	NA	NA	76 J	NA	NA	NA	NA
Butylbenzylphthalate	50,000	NA	NA	NA	ND	NA	NA	NA	NA
Di-n-butylphthalate	8,100	NA	NA	NA	45 J	NA	NA	NA	NA
Polycyclic Aromatic Hydrocarbons									
Dibenzofuran	6,200	NA	NA	NA	ND	NA	NA	NA	NA
Carbazole	—	NA	NA	NA	ND	NA	NA	NA	NA
Acenaphthylene	41,000	NA	NA	NA	ND	NA	NA	NA	NA
Acenaphthene	50,000	NA	NA	NA	ND	NA	NA	NA	NA
Anthracene	50,000	NA	NA	NA	ND	NA	NA	NA	NA
Benzo(a)anthracene	224 [b]	NA	NA	NA	ND	NA	NA	NA	NA
Benzo(a)pyrene	61 [b]	NA	NA	NA	ND	NA	NA	NA	NA
Benzo(b)fluoranthene	1,100	NA	NA	NA	ND	NA	NA	NA	NA
Benzo(k)fluoranthene	1,100	NA	NA	NA	ND	NA	NA	NA	NA
Benzo(g,h,i)perylene	50,000	NA	NA	NA	ND	NA	NA	NA	NA
Chrysene	400	NA	NA	NA	ND	NA	NA	NA	NA
Dibenz(a,h)anthracene	14	NA	NA	NA	ND	NA	NA	NA	NA
Fluoranthene	50,000	NA	NA	NA	ND	NA	NA	NA	NA
Fluorene	50,000	NA	NA	NA	ND	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	3,200	NA	NA	NA	ND	NA	NA	NA	NA
Phenanthrene	50,000	NA	NA	NA	ND	NA	NA	NA	NA
Pyrene	50,000	NA	NA	NA	ND	NA	NA	NA	NA

Key at end of table.

Table 5-2 Analytical Data Summary of Positive Hits for Surface Soil Samples, Cauterskill Road Site

Compound	NYSDEC TAGM 4046 [a]	CRSS-8	CRSS-9	CRSS-10	CRSS-11	CRSS-12	CRSS-13	CRSS-14	CRSS-14/D
TCL Pesticide/PCB µg/kg (Total Pesticides <10ppm)									
Dieldrin	44	NA	NA	NA	ND	NA	NA	NA	NA
Endrin	100	NA	NA	NA	ND	NA	NA	NA	NA
Methoxychlor	—	NA	NA	NA	ND	NA	NA	NA	NA
Endrin Ketone	—	NA	NA	NA	ND	NA	NA	NA	NA
alpha-Chlordane	5,400	NA	NA	NA	ND	NA	NA	NA	NA
gamma-Chlordane	5,400	NA	NA	NA	ND	NA	NA	NA	NA
Heptachlor Epoxide	20	NA	NA	NA	ND	NA	NA	NA	NA
4,4'-DDT	2,100	NA	NA	NA	ND	NA	NA	NA	NA
Aroclor 1254	1,000 [c]	NA	NA	NA	66	NA	NA	NA	NA
Aroclor 1260	1,000 [c]	NA	NA	NA	ND	NA	NA	NA	NA
Inorganics mg/kg									
Aluminum	20,800 [d, e]	NA	NA	NA	12,600	NA	NA	NA	NA
Arsenic	19.4 [d, e]	NA	NA	NA	3.0	NA	NA	NA	NA
Barium	600 [d, e]	NA	NA	NA	40.2	NA	NA	NA	NA
Beryllium	2.98 [d, e]	NA	NA	NA	0.702	NA	NA	NA	NA
Cadmium	4.12 [d]	ND	1.47	5.40	ND	0.952	0.919	23.6	39.3
Calcium	33,400 [d, e]	NA	NA	NA	8260	NA	NA	NA	NA
Chromium	24.8 [d]	12.2	13.3	21.9	23.4J	16.7	11.5	18.5	13.1
Cobalt	25 [d, e]	NA	NA	NA	9.40	NA	NA	NA	NA
Copper	59.9 [d]	18.1	58.9	71.5	56.7J	30.6	19.3	4600	59.5
Iron	34,600 [d, e]	NA	NA	NA	34,000	NA	NA	NA	NA
Lead	178.07 [d]	55.4	178	16	21	82.2	49.7	121	84.8
Magnesium	3,060 [d, e]	NA	NA	NA	3,720	NA	NA	NA	NA
Manganese	17,960 [d, e]	NA	NA	NA	417	NA	NA	NA	NA

Key at end of table.

Table 5-2 Analytical Data Summary of Positive Hits for Surface Soil Samples, Cauterskill Road Site

Compound	NYSDEC TAGM 4046 [a]	CRSS-8	CRSS-9	CRSS-10	CRSS-11	CRSS-12	CRSS-13	CRSS-14	CRSS-14/D
Mercury	0.1	NA	NA	NA	0.043	NA	NA	NA	NA
Nickel	70.7 [d]	20.3	50.8	41.9	54.1	24.5	38.1	32.3	25.7
Potassium	2,780 [d, e]	NA	NA	NA	572	NA	NA	NA	NA
Sodium	170.6 [d, e]	NA	NA	NA	77.7	NA	NA	NA	NA
Vanadium	54.2 [d, e]	NA	NA	NA	17.0	NA	NA	NA	NA
Zinc	305 [d]	386	166	211	844	205	147	118	516
Hexavalent Chromium		NA	NA	NA	ND	NA	NA	NA	NA
Cyanide	—	ND	ND	17.2	12.9J	ND	ND	1.79	3.36
Total Solids %									
Total Solids	—	65.99	71.69	87.41	83	72.05	73.79	84.53	81.02

Key at end of table.

Table 5-2 Analytical Data Summary of Positive Hits for Surface Soil Samples, Cauterskill Road Site

Compound	NYSDEC TAGM 4046 [a]	CRSS-15	CRSS-16	CRSS-17	CRSS-18	CRSS-19	CRSS-20	CRSS-21	CRSS-22
TCL Volatiles µg/kg (Total VOCs <10ppm)									
Methylene Chloride	100	NA	NA	NA	NA	ND	NA	NA	NA
TCL Semivolatiles µg/kg (Total SVOCs <500ppm, individual SVOCs <50ppm)									
bis(2-Ethylhexyl)phthalate	50,000	NA	NA	NA	NA	66 J	NA	NA	NA
Butylbenzylphthalate	50,000	NA	NA	NA	NA	ND	NA	NA	NA
Di-n-butylphthalate	8,100	NA	NA	NA	NA	72 J	NA	NA	NA
Polycyclic Aromatic Hydrocarbons									
Dibenzofuran	6,200	NA	NA	NA	NA	110 J	NA	NA	NA
Carbazole	—	NA	NA	NA	NA	610	NA	NA	NA
Acenaphthylene	41,000	NA	NA	NA	NA	65 J	NA	NA	NA
Acenaphthene	50,000	NA	NA	NA	NA	150 J	NA	NA	NA
Anthracene	50,000	NA	NA	NA	NA	570	NA	NA	NA
Benzo(a)anthracene	224 [b]	NA	NA	NA	NA	1,600	NA	NA	NA
Benzo(a)pyrene	61 [b]	NA	NA	NA	NA	1,800	NA	NA	NA
Benzo(b)fluoranthene	1,100	NA	NA	NA	NA	2,300	NA	NA	NA
Benzo(k)fluoranthene	1,100	NA	NA	NA	NA	1,800	NA	NA	NA
Benzo(g,h,i)perylene	50,000	NA	NA	NA	NA	520	NA	NA	NA
Chrysene	400	NA	NA	NA	NA	1,900	NA	NA	NA
Dibenz(a,h)anthracene	14	NA	NA	NA	NA	260 J	NA	NA	NA
Fluoranthene	50,000	NA	NA	NA	NA	4,000 D	NA	NA	NA
Fluorene	50,000	NA	NA	NA	NA	200 J	NA	NA	NA
Indeno(1,2,3-cd)pyrene	3,200	NA	NA	NA	NA	560	NA	NA	NA
Phenanthrene	50,000	NA	NA	NA	NA	2,700	NA	NA	NA
Pyrene	50,000	NA	NA	NA	NA	2,700	NA	NA	NA

Key at end of table.

Table 5-2 Analytical Data Summary of Positive Hits for Surface Soil Samples, Cauterskill Road Site

Compound	NYSDEC TAGM 4046 [a]	CRSS-15	CRSS-16	CRSS-17	CRSS-18	CRSS-19	CRSS-20	CRSS-21	CRSS-22
TCL Pesticide/PCB µg/kg (Total Pesticides <10ppm)									
Dieldrin	44	NA	NA	NA	NA	ND	NA	NA	NA
Endrin	100	NA	NA	NA	NA	ND	NA	NA	NA
Methoxychlor	—	NA	NA	NA	NA	ND	NA	NA	NA
Endrin Ketone	—	NA	NA	NA	NA	ND	NA	NA	NA
alpha-Chlordane	5,400	NA	NA	NA	NA	ND	NA	NA	NA
gamma-Chlordane	5,400	NA	NA	NA	NA	ND	NA	NA	NA
Heptachlor Epoxide	20	NA	NA	NA	NA	ND	NA	NA	NA
4,4'-DDT	2,100	NA	NA	NA	NA	ND	NA	NA	NA
Aroclor 1254	1,000 [c]	NA	NA	NA	NA	ND	NA	NA	NA
Aroclor 1260	1,000 [c]	NA	NA	NA	NA	ND	NA	NA	NA
Inorganics mg/kg									
Aluminum	20,800 [d, e]	NA	NA	NA	NA	6,880	NA	NA	NA
Arsenic	19.4 [d, e]	NA	NA	NA	NA	5.4	NA	NA	NA
Barium	600 [d, e]	NA	NA	NA	NA	48.9	NA	NA	NA
Beryllium	2.98 [d, e]	NA	NA	NA	NA	0.562	NA	NA	NA
Cadmium	4.12 [d]	2.08	ND	2.04	0.949	1.53	3.22J	1.06	9.40
Calcium	33,400 [d, e]	NA	NA	NA	NA	7,190	NA	NA	NA
Chromium	24.8 [d]	41.5	14.4	17.2	865	54.4	22.4	22.8	24.1
Cobalt	25 [d, e]	NA	NA	NA	NA	11.2	NA	NA	NA
Copper	59.9 [d]	39.4	28.3	35.0	23.9	32.9	636	16.7	45.3
Iron	34,600 [d, e]	NA	NA	NA	NA	20,000	NA	NA	NA
Lead	178.07 [d]	12	54.7	339J	65.2	24	1,160	28.8	298
Magnesium	3,060 [d, e]	NA	NA	NA	NA	5,090	NA	NA	NA
Manganese	17,960 [d, e]	NA	NA	NA	NA	361	NA	NA	NA

Key at end of table.

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Table 5-2 Analytical Data Summary of Positive Hits for Surface Soil Samples, Cauterskill Road Site

Compound	NYSDEC TAGM 4046 [a]	CRSS-15	CRSS-16	CRSS-17	CRSS-18	CRSS-19	CRSS-20	CRSS-21	CRSS-22
Mercury	0.1	NA	NA	NA	NA	0.050	NA	NA	NA
Nickel	70.7 [d]	42.3	20.4	26.4	33.3	69.1	88.4J	24.9	611
Potassium	2,780 [d, e]	NA	NA	NA	NA	692	NA	NA	NA
Sodium	170.6 [d, e]	NA	NA	NA	NA	70.1	NA	NA	NA
Vanadium	54.2 [d, e]	NA	NA	NA	NA	15.7	NA	NA	NA
Zinc	305 [d]	108	192	1,540	70.4	72.3	632	44.4	596
Hexavalent Chromium	—	NA	NA	NA	NA	ND	NA	NA	NA
Cyanide	—	0.938	ND	ND	ND	1.31	ND	ND	0.856
Total Solids %									
Total Solids		82.10	71.26	73.47	80.69	88	82.82	88.32	77.69

Key at end of table.

Table 5-2 Analytical Data Summary of Positive Hits for Surface Soil Samples, Cauterskill Road Site

Compound	NYSDEC TAGM 4046 [a]	CRSS-23	CRSS-24	CRSS-25	CRSS-25/D	CRSS-26	CRSS-27	CRSS-28	CRSS-29
TCL Volatiles µg/kg (Total VOCs <10ppm)									
Methylene Chloride	100	NA	NA	NA	NA	ND	1 J	NA	NA
TCL Semivolatiles µg/kg (Total SVOCs <500ppm, individual SVOCs <50ppm)									
bis(2-Ethylhexyl) phthalate	50,000	NA	NA	NA	NA	45 J	ND	NA	NA
Butylbenzylphthalate	50,000	NA	NA	NA	NA	ND	ND	NA	NA
Di-n-butylphthalate	8,100	NA	NA	NA	NA	ND	ND	NA	NA
Polycyclic Aromatic Hydrocarbons									
Dibenzofuran	6,200	NA	NA	NA	NA	ND	ND	NA	NA
Carbazole	—	NA	NA	NA	NA	ND	ND	NA	NA
Acenaphthylene	41,000	NA	NA	NA	NA	43 J	ND	NA	NA
Acenaphthene	50,000	NA	NA	NA	NA	ND	ND	NA	NA
Anthracene	50,000	NA	NA	NA	NA	44 J	ND	NA	NA
Benzo(a)anthracene	224 [b]	NA	NA	NA	NA	82 J	ND	NA	NA
Benzo(a)pyrene	61 [b]	NA	NA	NA	NA	88 J	ND	NA	NA
Benzo(b) fluoranthene	1,100	NA	NA	NA	NA	72 J	ND	NA	NA
Benzo(k) fluoranthene	1,100	NA	NA	NA	NA	78 J	ND	NA	NA
Benzo(g,h,i) perylene	50,000	NA	NA	NA	NA	47 J	ND	NA	NA
Chrysene	400	NA	NA	NA	NA	95 J	ND	NA	NA
Dibenz(a,h) anthracene	14	NA	NA	NA	NA	ND	ND	NA	NA
Fluoranthene	50,000	NA	NA	NA	NA	150 J	ND	NA	NA
Fluorene	50,000	NA	NA	NA	NA	ND	ND	NA	NA

Key at end of table.

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Table 5-2 Analytical Data Summary of Positive Hits for Surface Soil Samples, Cauterskill Road Site

Compound	NYSDEC TAGM 4046 [a]	CRSS-23	CRSS-24	CRSS-25	CRSS-25/D	CRSS-26	CRSS-27	CRSS-28	CRSS-29
Indeno(1,2,3-cd) pyrene	3,200	NA	NA	NA	NA	48 J	ND	NA	NA
Phenanthrene	50,000	NA	NA	NA	NA	78 J	ND	NA	NA
Pyrene	50,000	NA	NA	NA	NA	93 J	ND	NA	NA
TCL Pesticide/PCB µg/kg (Total Pesticides <10ppm)									
Dieldrin	44	NA	NA	NA	NA	ND	ND	NA	NA
Endrin	100	NA	NA	NA	NA	13	ND	NA	NA
Methoxychlor	—	NA	NA	NA	NA	ND	ND	NA	NA
Endrin Ketone	—	NA	NA	NA	NA	ND	ND	NA	NA
alpha-Chlordane	5,400	NA	NA	NA	NA	ND	ND	NA	NA
gamma-Chlordane	5,400	NA	NA	NA	NA	13	ND	NA	NA
Heptachlor Epoxide	20	NA	NA	NA	NA	ND	ND	NA	NA
4,4'-DDT	2,100	NA	NA	NA	NA	ND	ND	NA	NA
Aroclor 1254	1,000 [c]	NA	NA	NA	NA	1,200 D	ND	NA	NA
Aroclor 1260	1,000 [c]	NA	NA	NA	NA	ND	58	NA	NA
Inorganics mg/kg									
Aluminum	20,800 [d, e]	NA	NA	NA	NA	17,300	14,600	NA	NA
Arsenic	19.4 [d, e]	NA	NA	NA	NA	5.7	4.8	NA	NA
Barium	600 [d, e]	NA	NA	NA	NA	139	120	NA	NA
Beryllium	2.98 [d, e]	NA	NA	NA	NA	1.04	0.944	NA	NA
Cadmium	4.12 [d]	1.14	2.42	14.1	16.0	5.16	7.3	ND	ND
Calcium	33,400 [d, e]	NA	NA	NA	NA	8,080	11,900	NA	NA
Chromium	24.8 [d]	19.4	34.6	41.8	66.8	31.6	30.7	16.8	15.2
Cobalt	25 [d, e]	NA	NA	NA	NA	14.0	13.3	NA	NA
Copper	59.9 [d]	18.8	37.3	400	993	169	40.6	13.7	20.7
Iron	34,600 [d, e]	NA	NA	NA	NA	38,100	34300	NA	NA

Key at end of table.

Table 5-2 Analytical Data Summary of Positive Hits for Surface Soil Samples, Cauterskill Road Site

Compound	NYSDEC TAGM 4046 [a]	CRSS-23	CRSS-24	CRSS-25	CRSS-25/D	CRSS-26	CRSS-27	CRSS-28	CRSS-29
Lead	178.07 [d]	33.2	35.4	54.2	99.9	46.9	62.6	73.8	21
Magnesium	3,060 [d, e]	NA	NA	NA	NA	7,000	5,900	NA	NA
Manganese	17,960 [d, e]	NA	NA	NA	NA	548	710	NA	NA
Mercury	0.1	NA	NA	NA	NA	0.040	0.080	NA	NA
Nickel	70.7 [d]	22.1	43.2J	489	654	69.2	56.5	13.3	24.4
Potassium	2,780 [d, e]	NA	NA	NA	NA	1920	1,990	NA	NA
Sodium	170.6 [d, e]	NA	NA	NA	NA	77.9	87.9	NA	NA
Vanadium	54.2 [d, e]	NA	NA	NA	NA	25.7	22.1	NA	NA
Zinc	305 [d]	69.8	169J	2,840	5,760	148	95.7	76.7	57.5
Hexavalent Chromium		NA	NA	NA	NA	ND	ND	NA	NA
Cyanide	—	ND	34.9J	1.83	1.14	0.582	ND	0.748	ND
Total Solids %									
Total Solids	—	87.54	88.57J	80.45	75.15	79	78	64.16	85.80

Key at end of table.

Table 5-2 Analytical Data Summary of Positive Hits for Surface Soil Samples, Cauterskill Road Site

Compound	NYSDEC TAGM 4046 [a]	CRSS-30	CRSS-31	CRSS-32	CRSS-33	CRSS-34	CRSS-35	CRSS-36	CRSS-37
TCL Volatiles µg/kg (Total VOCs <10ppm)									
Methylene Chloride	100	NA	NA	NA	NA	ND	NA	NA	ND
TCL Semivolatiles µg/kg (Total SVOCs <500ppm, individual SVOCs <50ppm)									
bis(2-Ethylhexyl)phthalate	50,000	NA	NA	NA	NA	1,300	NA	NA	64 J
Butylbenzylphthalate	50,000	NA	NA	NA	NA	140 J	NA	NA	ND
Di-n-butylphthalate	8,100	NA	NA	NA	NA	14,000 D	NA	NA	ND
Polycyclic Aromatic Hydrocarbons									
Dibenzofuran	6,200	NA	NA	NA	NA	ND	NA	NA	ND
Carbazole	—	NA	NA	NA	NA	ND	NA	NA	ND
Acenaphthylene	41,000	NA	NA	NA	NA	59 J	NA	NA	ND
Acenaphthene	50,000	NA	NA	NA	NA	ND	NA	NA	ND
Anthracene	50,000	NA	NA	NA	NA	67 J	NA	NA	ND
Benzo(a)anthracene	224 [b]	NA	NA	NA	NA	63 J	NA	NA	ND
Benzo(a)pyrene	61 [b]	NA	NA	NA	NA	78 J	NA	NA	ND
Benzo(b)fluoranthene	1,100	NA	NA	NA	NA	57 J	NA	NA	ND
Benzo(k)fluoranthene	1,100	NA	NA	NA	NA	57 J	NA	NA	ND
Benzo(g,h,i)perylene	50,000	NA	NA	NA	NA	85 J	NA	NA	ND
Chrysene	400	NA	NA	NA	NA	78 J	NA	NA	49 J
Dibenz(a,h)anthracene	14	NA	NA	NA	NA	ND	NA	NA	ND
Fluoranthene	50,000	NA	NA	NA	NA	70 J	NA	NA	87 J
Fluorene	50,000	NA	NA	NA	NA	ND	NA	NA	ND
Indeno(1,2,3-cd)pyrene	3,200	NA	NA	NA	NA	69 J	NA	NA	ND
Phenanthrene	50,000	NA	NA	NA	NA	ND	NA	NA	51 J
Pyrene	50,000	NA	NA	NA	NA	68 J	NA	NA	68 J

Key at end of table.

Table 5-2 Analytical Data Summary of Positive Hits for Surface Soil Samples, Cauterskill Road Site

Compound	NYSDEC TAGM 4046 [a]	CRSS-30	CRSS-31	CRSS-32	CRSS-33	CRSS-34	CRSS-35	CRSS-36	CRSS-37
TCL Pesticide/PCB μg/kg (Total Pesticides <10ppm)									
Dieldrin	44	NA	NA	NA	NA	16 J	NA	NA	ND
Endrin	100	NA	NA	NA	NA	40	NA	NA	ND
Methoxychlor	—	NA	NA	NA	NA	180 P	NA	NA	ND
Endrin Ketone	—	NA	NA	NA	NA	75	NA	NA	ND
alpha-Chlordane	5,400	NA	NA	NA	NA	ND	NA	NA	ND
gamma-Chlordane	5,400	NA	NA	NA	NA	6.3 J	NA	NA	ND
Heptachlor Epoxide	20	NA	NA	NA	NA	4.8 J	NA	NA	ND
4,4'-DDT	2,100	NA	NA	NA	NA	39 J	NA	NA	ND
Aroclor 1254	1,000 [c]	NA	NA	NA	NA	ND	NA	NA	ND
Aroclor 1260	1,000 [c]	NA	NA	NA	NA	4,900 PD	NA	NA	72
Inorganics mg/kg									
Aluminum	20,800 [d, e]	NA	NA	NA	NA	8,450	NA	NA	14,800
Arsenic	19.4 [d, e]	NA	NA	NA	NA	9.0	NA	NA	9.9
Barium	600 [d, e]	NA	NA	NA	NA	61.0	NA	NA	161
Beryllium	2.98 [d, e]	NA	NA	NA	NA	0.569	NA	NA	1.13
Cadmium	4.12 [d]	ND	ND	1.49	1.54	24.2	ND	0.951	1.69
Calcium	33,400 [d, e]	NA	NA	NA	NA	4,040	NA	NA	5,560
Chromium	24.8 [d]	8.27	7.70	18.5	21.4	50.2	12.2	9.20	22.9
Cobalt	25 [d, e]	NA	NA	NA	NA	8.60	NA	NA	14.9
Copper	59.9 [d]	26.8	14.5	21.1	23.7	1,600	13.2	16.9	18.8
Iron	34,600 [d, e]	NA	NA	NA	NA	37,400	NA	NA	55,800
Lead	178.07 [d]	67.7	59.1	15	38.9	63.7	28	47.2	38.7
Magnesium	3,060 [d, e]	NA	NA	NA	NA	2,990	NA	NA	3,930
Manganese	17,960 [d, e]	NA	NA	NA	NA	372	NA	NA	1,720

Key at end of table.

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Table 5-2 Analytical Data Summary of Positive Hits for Surface Soil Samples, Cauterskill Road Site

Compound	NYSDEC TAGM 4046 [a]	CRSS-30	CRSS-31	CRSS-32	CRSS-33	CRSS-34	CRSS-35	CRSS-36	CRSS-37
Mercury	0.1	NA	NA	NA	NA	0.044	NA	NA	0.056
Nickel	70.7 [d]	26.0	16.9	33.7	31.1	9,840	15.5	22.8	49.9
Potassium	2,780 [d, e]	NA	NA	NA	NA	1,030	NA	NA	1,340
Sodium	170.6 [d, e]	NA	NA	NA	NA	56.7	NA	NA	40.3
Vanadium	54.2 [d, e]	NA	NA	NA	NA	15.5	NA	NA	30.3
Zinc	305 [d]	168	84.2	74.2	199	195	66.4	108	90.0
Hexavalent Chromium		NA	NA	NA	NA	ND	NA	NA	ND
Cyanide	—	ND	1.23	ND	0.681	23.7	ND	2.60	1.06
Total Solids %									
Total Solids	—	60.31	65.24	81.39	73.09	75	75.48	67.33	75

Key at end of table.

Table 5-2 Analytical Data Summary of Positive Hits for Surface Soil Samples, Cauterskill Road Site

Compound	NYSDEC TAGM 4046 [a]	CRSS-38	CRSS-39	CRSS-40	CRSS-40/D	CRSS-41	CRSS-42
TCL Volatiles µg/kg (Total VOCs <10 ppm)							
Methylene Chloride	100	NA	NA	NA	NA	ND	NA
TCL Semivolatiles µg/kg (Total SVOCs <500 ppm, individual SVOCs <50 ppm)							
bis(2-Ethylhexyl)phthalate	50,000	NA	NA	NA	NA	3,200	NA
Butylbenzylphthalate	50,000	NA	NA	NA	NA	130 J	NA
Di-n-butylphthalate	8,100	NA	NA	NA	NA	390 J	NA
Polycyclic Aromatic Hydrocarbons							
Dibenzofuran	6,200	NA	NA	NA	NA	ND	NA
Carbazole	—	NA	NA	NA	NA	ND	NA
Acenaphthylene	41,000	NA	NA	NA	NA	ND	NA
Acenaphthene	50,000	NA	NA	NA	NA	ND	NA
Anthracene	50,000	NA	NA	NA	NA	ND	NA
Benzo(a)anthracene	224 [b]	NA	NA	NA	NA	ND	NA
Benzo(a)pyrene	61 [b]	NA	NA	NA	NA	ND	NA
Benzo(b)fluoranthene	1,100	NA	NA	NA	NA	ND	NA
Benzo(k)fluoranthene	1,100	NA	NA	NA	NA	ND	NA
Benzo(g,h,i)perylene	50,000	NA	NA	NA	NA	ND	NA
Chrysene	400	NA	NA	NA	NA	ND	NA
Dibenz(a,h)anthracene	14	NA	NA	NA	NA	ND	NA
Fluoranthene	50,000	NA	NA	NA	NA	ND	NA
Fluorene	50,000	NA	NA	NA	NA	ND	NA
Indeno(1,2,3-cd)pyrene	3,200	NA	NA	NA	NA	ND	NA
Phenanthrene	50,000	NA	NA	NA	NA	ND	NA
Pyrene	50,000	NA	NA	NA	NA	ND	NA
TCL Pesticide/PCB µg/kg (Total Pesticides <10 ppm)							
Dieldrin	44	NA	NA	NA	NA	ND	NA
Endrin	100	NA	NA	NA	NA	ND	NA
Methoxychlor	—	NA	NA	NA	NA	ND	NA

Key at end of table.

Table 5-2 Analytical Data Summary of Positive Hits for Surface Soil Samples, Cauterskill Road Site

Compound	NYSDEC TAGM 4046[a]	CRSS-38	CRSS-39	CRSS-40	CRSS-40/D	CRSS-41	CRSS-42
Endrin Ketone	—	NA	NA	NA	NA	ND	NA
alpha-Chlordane	5,400	NA	NA	NA	NA	8.3	NA
gamma-Chlordane	5,400	NA	NA	NA	NA	4.9 P	NA
Heptachlor Epoxide	20	NA	NA	NA	NA	ND	NA
4,4'-DDT	2,100	NA	NA	NA	NA	12 P	NA
Aroclor 1254	1,000[c]	NA	NA	NA	NA	ND	NA
Aroclor 1260	1,000[c]	NA	NA	NA	NA	ND	NA
Inorganics mg/kg							
Aluminum	20,800[d, e]	NA	NA	NA	NA	6,900	NA
Arsenic	19.4[d, e]	NA	NA	NA	NA	8.0	NA
Barium	600[d, e]	NA	NA	NA	NA	256	NA
Beryllium	2.98[d, e]	NA	NA	NA	NA	ND	NA
Cadmium	4.12[d]	1.77	4.29	1.99	1.74	2.11	3.84J
Calcium	33,400[d, e]	NA	NA	NA	NA	19,600	NA
Chromium	24.8[d]	24.0	78.1	18.5	16.3	56.0	7.30
Cobalt	25[d, e]	NA	NA	NA	NA	6.10	NA
Copper	59.9[d]	25.8	68.0	20.5	18.0	39.1	69.2J
Iron	34,600[d, e]	NA	NA	NA	NA	21,500	NA
Lead	178.07[d]	41.1	359	35	35	527	163J
Magnesium	3,060[d, e]	NA	NA	NA	NA	3,520	NA
Manganese	17,960[d, e]	NA	NA	NA	NA	429	NA
Mercury	0.1	NA	NA	NA	NA	0.25	NA
Nickel	70.7[d]	42.6	339	40.1	35.4	234	13.0
Potassium	2,780[d, e]	NA	NA	NA	NA	1,300	NA
Sodium	170.6[d, e]	NA	NA	NA	NA	101	NA
Vanadium	54.2[d, e]	NA	NA	NA	NA	13.2	NA
Zinc	305[d]	149	392	105	94.1	485	348
Hexavalent Chromium		NA	NA	NA	NA	ND	NA
Cyanide	—	ND	7.19	ND	ND	1.36	48.5

Key at end of table.

Table 5-2 Analytical Data Summary of Positive Hits for Surface Soil Samples, Cauterskill Road Site

Compound	NYSDEC TAGM 4046 [a]	CRSS-38	CRSS-39	CRSS-40	CRSS-40/D	CRSS-41	CRSS-42
Total Solids %							
Total Solids	—	73.06	38.09	60.39	60.35	83.51	83.51

[a] NYSDEC Technical and Administrative Guidance Memorandum (TAGM) 4046 (January 1994) Soil Cleanup Objectives.

[b] Per TAGM 4046 the guidance value is the listed value or the method detection limit, whichever one is the most stringent.

[c] TAGM 4046 guidance value for PCBs in surface soils.

[d] Per TAGM 4046, site background concentrations are recommended to be used. For screening purposes, a guidance value of twice the arithmetic mean of the concentrations measured in the background sample was used.

[e] Since only one background concentration was available, the guidance value used here represents twice the concentration measured in the background sample.

Key:

D = Dilution result reported, original analysis exceeded calibration range.
J = Estimated value.
NA = Not analyzed.
ND = Not detected.
mg/kg = Milligrams per kilogram.
NYSDEC = New York State Department of Environmental Conservation.
PCB = Polychlorinated biphenyl.
ppm = Parts per million.
SVOC = Semivolatile organic compound.
TCL = Target compound list.
VOC = Volatile organic compound.
µg/kg = Micrograms per kilogram.
< = Less than.
– = No soil cleanup objectives available/applicable.
% = Percent.
[shaded box] = Reported value exceeds NYSDEC TAGM 4046 guidance value.

Table 5-3 Analytical Data Summary of Positive Hits for Subsurface Soil Samples, Cauterskill Road Site

Compound	NYSDEC TAGM 4046 [a]	CRMW-5SB	CRMW-6SB	CRTP-2	CRTP-3	CRTP-3/D	CRTP-4	CRTP-5
TCL Volatiles µg/kg (Total VOCs <10ppm)								
Acetone	200	ND	ND	ND	ND	ND	ND	ND
Toluene	1.5	ND	2 J	ND	ND	ND	ND	ND
TCL Semivolatiles µg/kg (Total SVOCs <500ppm, individual SVOCs <50ppm)								
Diethylphthalate	7,100	ND	NA	81 J	ND	66 J	ND	82 J
bis(2-Ethylhexyl)phthalate (DEHP)	50,000	170 J	NA	ND	ND	ND	ND	91 J
Butylbenzylphthalate	50,000	ND	NA	ND	ND	ND	ND	ND
Di-n-butylphthalate	8,100	ND	NA	ND	ND	ND	ND	130 J
Polycyclic Aromatic Hydrocarbons								
Dibenzofuran	6,200	ND	NA	ND	ND	ND	ND	ND
Carbazole	—	ND	NA	ND	ND	ND	ND	ND
2-Methylnaphthalene	36,400	ND	NA	ND	ND	ND	ND	ND
Acenaphthylene	41,000	40 J	NA	ND	ND	ND	ND	ND
Acenaphthene	50,000	ND	NA	ND	ND	ND	ND	ND
Anthracene	50,000	46 J	NA	ND	ND	ND	ND	ND
Benzo(a)anthracene	224 [b]	100 J	NA	ND	ND	ND	ND	ND
Benzo(a)pyrene	61 [b]	69 J	NA	ND	ND	ND	ND	ND
Benzo(b)fluoranthene	1,100	56 J	NA	ND	ND	ND	ND	ND
Benzo(k)fluoranthene	1,100	77 J	NA	ND	ND	ND	ND	ND
Benzo(g,h,i)perylene	50,000	ND	NA	ND	ND	ND	ND	ND
Chrysene	400	120 J	NA	ND	ND	ND	ND	ND
Dibenz(a,h)anthracene	14	ND	NA	ND	ND	ND	ND	ND
Fluoranthene	50,000	220 J	NA	ND	ND	ND	ND	ND
Fluorene	50,000	ND	NA	ND	ND	ND	ND	ND

Key at end of table.

Table 5-3 Analytical Data Summary of Positive Hits for Subsurface Soil Samples, Cauterskill Road Site

Compound	NYSDEC TAGM 4046 [a]	CRMW-5SB	CRMW-6SB	CRTP-2	CRTP-3	CRTP-3/D	CRTP-4	CRTP-5
Indeno(1,2,3-cd)pyrene	3,200	49 J	NA	ND	ND	ND	ND	ND
Naphthalene	13,000	ND	NA	ND	ND	ND	ND	ND
Pentachlorophenol	1,000 [b]	ND	NA	ND	ND	ND	ND	ND
Phenanthrene	50,000	190 J	NA	ND	ND	ND	ND	ND
Pyrene	50,000	170 J	NA	ND	ND	ND	ND	ND
TCL Pesticide/PCB µg/kg (Total Pesticides <10ppm)								
Aldrin	41	ND	NA	ND	ND	ND	ND	ND
Endrin	100	ND	NA	ND	ND	4.3 J	ND	ND
Methoxychlor	—	ND	NA	ND	ND	ND	ND	ND
Endrin Ketone	—	ND	NA	ND	ND	ND	ND	ND
gamma-Chlordane	5,400	ND	NA	ND	ND	ND	ND	ND
Heptachlor Epoxide	20	ND	NA	ND	ND	ND	ND	ND
Aroclor 1260	10,000 [c] 10400 SB [e]	ND	NA	ND	ND	310	ND	ND
Inorganics mg/kg								
Aluminum	20,800 [d, e]	13,900	NA	15,400	14,400	10,300	12,600	7,790
Antimony	9.45 [d, f]	2.6 J	NA	3.4 J	2.9 J	1.3 J	2.4 J	1.5 J
Arsenic	19.4 [d, e]	9.6	NA	13.6	21.2	13.9	10.1	4.9
Barium	600 [d, e]	57.8	NA	110	329	158	120	78.1
Beryllium	2.98 [d, e]	0.64 J	NA	1.1	1.4	0.92 J	0.87 J	0.65 J
Cadmium	4.12 [d]	0.19 J	NA	0.43 J	0.97 J	0.73 J	0.48 J	ND
Calcium	33,400 [d, e]	53,500	NA	3,400	56,200	158,000	30,900	25,300
Chromium	24.8 [d]	22.0	NA	22.6 J	21.2 J	12.9	16.7	9.5
Cobalt	25 [d, e]	7.4 J	NA	12.8 J	12.2 J	8.2 J	8.4 J	4.9 J
Copper	59.9 [d]	26.4	NA	31.2 J	29.3 J	17.6 J	26.8 J	180
Iron	34,600 [d, e]	29,000	NA	31,600	33,800	23,400	27,300	19,900

Key at end of table.

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Table 5-3 Analytical Data Summary of Positive Hits for Subsurface Soil Samples, Cauterskill Road Site

Compound	NYSDEC TAGM 4046 [a]	CRMW-5SB	CRMW-6SB	CRTP-2	CRTP-3	CRTP-3/D	CRTP-4	CRTP-5
Lead	178.07 [d]	20.6	NA	22.1 J	39.4 J	31.2 J	20.6 J	14.9
Magnesium	3,060 [d, e]	5,880	NA	4,440	3,060	2,820	3,010	2,010
Manganese	17,960 [d, e]	734	NA	1,630	4,570	2,790	2,000	1,100
Mercury	0.1	ND	NA	ND	ND	ND	ND	ND
Nickel	70.7 [d]	30.5	NA	51.4	37.1	25.8	28.8	1,200
Potassium	2,780 [d, e]	1,160	NA	1,420	1,180	844 J	659 J	763 J
Selenium	3.8 [d, e]	4.8	NA	8.6	10	6.2	7.7	5.7
Silver	0.47 [d, f]	1.1 J	NA	ND	1.8 J	3.4	0.73 J	0.25 J
Sodium	170.6 [d, e]	136 J	NA	ND	ND	102 J	ND	ND
Thallium	0.475 [d, f]	2.2	NA	3.7	8.5	5.9	4.3	2.7
Vanadium	54.2 [d, e]	16.4	NA	26.9 J	30.6 J	19.3 J	17.2 J	9.9
Zinc	305 [d]	81.2	NA	95.9 J	128 J	92.5 J	94.6 J	68.0 J
Hexavalent Chromium	—	ND J	NA	NDJ	NDJ	NDJ	NDJ	NDJ
Cyanide	—	ND J	NA	ND	0.72	ND	0.46	1.9
Total Solids %								
Total Solids	—	85	86	85	76	77	80	81

Key at end of table.

Table 5-3 Analytical Data Summary of Positive Hits for Subsurface Soil Samples, Cauterskill Road Site

Compound	NYSDEC TAGM 4046 [a]	CRTP-6	CRTP-7	CRTP-8-1	CRTP-8-2	CRTP-9-1	CRTP-9-2	CRTP-10
TCL Volatiles μg/kg (Total VOCs <10ppm)								
Acetone	200	ND	ND	ND	ND	ND	86	ND
Methylene Chloride	100	ND	ND	ND	ND	ND	ND	ND
Toluene	1.5	ND	ND	ND	ND	ND	ND	ND
TCL Semivolatiles μg/kg (Total SVOCs <500ppm, individual SVOCs <50ppm)								
Diethylphthalate	7,100	ND	ND	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)phthalate (DEHP)	50,000	ND	710	ND	ND	64 J	1,600	44 J
Butylbenzylphthalate	50,000	ND	140 J	ND	ND	ND	80 J	ND
Di-n-butylphthalate	8,100	ND	120 J	ND	ND	ND	ND	ND
Polycyclic Aromatic Hydrocarbons								
Dibenzofuran	6,200	ND	480	ND	ND	ND	100 J	240 J
Carbazole	—	ND	1500	ND	ND	ND	210 J	140 J
2-Methylnaphthalene	36,400	ND	200 J	ND	ND	ND	61 J	740
Acenaphthylene	41,000	ND	460	ND	ND	ND	84 J	810
Acenaphthene	50,000	ND	1,300	ND	ND	ND	190 J	200 J
Anthracene	50,000	ND	3,500 DJ	ND	ND	ND	470	1,100
Benzo(a)anthracene	224 [b]	ND	11,000 D	ND	ND	ND	1,100	1,000
Benzo(a)pyrene	61 [b]	ND	11,000 D	ND	ND	ND	920	790
Benzo(b)fluoranthene	1,100	ND	9,700 D	ND	ND	ND	710	570
Benzo(k)fluoranthene	1,100	ND	7,700 D	ND	ND	ND	620	580
Benzo(g,h,i)perylene	50,000	ND	1,600	ND	ND	ND	600	240 J
Chrysene	400	ND	12,000 D	ND	ND	ND	1,100	1,100
Dibenz(a,h)anthracene	14	ND	830	ND	ND	ND	240 J	110
Fluoranthene	50,000	ND	22,000 D	ND	ND	ND	2,400	2,400

Key at end of table.

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Table 5-3 Analytical Data Summary of Positive Hits for Subsurface Soil Samples, Cauterskill Road Site

Compound	NYSDEC TAGM 4046 [a]	CRTP-6	CRTP-7	CRTP-8-1	CRTP-8-2	CRTP-9-1	CRTP-9-2	CRTP-10
Fluorene	50,000	ND	1,100	ND	ND	ND	170 J	760 J
Indeno(1,2,3-cd)pyrene	3,200	ND	1,800	ND	ND	ND	570	250 J
Naphthalene	13,000	ND	300 J	ND	ND	ND	170 J	470
Pentachlorophenol	1,000 [b]	ND	200 J	ND	ND	ND	ND	ND
Phenanthrene	50,000	ND	12,000 D	ND	ND	ND	1,500	35,000 D
Pyrene	50,000	ND	13,000 D	ND	ND	ND	1,700	1,400
TCL Pesticide/PCB µg/kg (Total Pesticides <10ppm)								
Aldrin	41	ND	13 J	ND	ND	ND	ND	ND
Endrin	100	ND	ND	ND	ND	ND	ND	ND
Methoxychlor	—	ND	170	ND	ND	ND	ND	ND
Endrin Ketone	—	ND	76 J	ND	ND	ND	ND	ND
gamma-Chlordane	5,400	ND	13 J	ND	ND	ND	ND	ND
Heptachlor Epoxide	20	ND	87 J	ND	ND	ND	5.2 J	ND
Aroclor 1260	10,000 [c]	ND	ND	ND	ND	ND	ND	ND
Inorganics mg/kg								
Aluminum	20,800 [d, e]	21,800	15,400	12,600	13,500	5,120	17,200	13,300
Antimony	9.45 [d, f]	4.8 J	4.3 J	2.9 J	3.0 J	0.79 J	6.2 J	3.0 J
Arsenic	19.4 [d, e]	11.7	8.1	7.2	7.0	6.3	16.4 J	11.7 J
Barium	600 [d, e]	73.5	146	38.0	38.7	37.3	183	111
Beryllium	2.98 [d, e]	0.70 J	0.76 J	0.51 J	0.53 J	0.23 J	1.0 J	0.72 J
Cadmium	4.12 [d]	ND	10.4	ND	0.08 J	0.25 J	11.2 J	6.4 J
Calcium	33,400 [d, e]	2,920	13,300	883	751	ND	6,790	39,400
Chromium	24.8 [d]	27.2	45.9	18.0	18.1	7.3	81.7	18.6
Cobalt	25 [d, e]	5.9 J	9.8 J	4.8 J	6.4 J	3.7 J	7.4 J	6.3 J
Copper	59.9 [d]	40.3 J	47.1 J	22.8 J	23.7 J	12.9	51.7	1,130

Key at end of table.

Table 5-3 Analytical Data Summary of Positive Hits for Subsurface Soil Samples, Cauterskill Road Site

Compound	NYSDEC TAGM 4046 [a]	CRTP-6	CRTP-7	CRTP-8-1	CRTP-8-2	CRTP-9-1	CRTP-9-2	CRTP-10
Iron	34,600 [d, e]	42,500	30,700	29,000	31,200	11,400	61,600	31,200
Lead	178.07 [d]	17.8 J	127 J	16.2 J	15.2	8.0 J	46.0 J	129 J
Magnesium	3,060 [d, e]	5,820	5,800	4,730	4,880	10,800	4,940	3,970
Manganese	17,960 [d, e]	259	422	355	720	168	1,800	1,170
Mercury	0.1	ND	0.17	ND	ND	ND	ND	ND
Nickel	70.7 [d]	38.5 J	50.7 J	27.6 J	27.8 J	14.1 J	108	31.1
Potassium	2,780 [d, e]	3,290 J	1,550 J	769 J	619 J	838	1200 J	2290
Selenium	3.8 [d, e]	10.1	8.5	7.0	7.7	3.4	14.9	7.2
Silver	0.47 [d, f]	ND	0.81 J	ND	ND	2.3	0.64 J	0.85 J
Sodium	170.6 [d, e]	107 J	ND	134 J	ND	ND	184 J	ND
Thallium	0.475 [d, f]	2.0	1.6	1.9	2.5	0.94 J	5.3	3.5
Vanadium	54.2 [d, e]	25.7	23.3	14.0	14.3	4.7 J	28.6 J	22.0 J
Zinc	305 [d]	91.1	227	103	75.1	43.2	199 J	171 J
Hexavalent Chromium	—	ND J	ND J	ND J	ND J	ND J	ND J	ND J
Cyanide	—	0.89	1.6	2.7	ND	ND	6.3	7.7

Key at end of table.

Table 5-3 Analytical Data Summary of Positive Hits for Subsurface Soil Samples, Cauterskill Road Site

Compound	NYSDEC TAGM 4046 [a]	CRTP-6	CRTP-7	CRTP-8-1	CRTP-8-2	CRTP-9-1	CRTP-9-2	CRTP-10
Total Solids %								
Total Solids	—	78	77	88	92	93	73	78

[a] NYSDEC Technical and Administrative Guidance Memorandum (TAGM) 4046 (January 1994) Soil Cleanup Objectives.

[b] Per TAGM 4046 the soil cleanup objective is the listed value or the method detection limit, whichever one is the most stringent.

[c] TAGM 4046 guidance value for PCBs in subsurface soils.

[d] Per TAGM 4046, site background concentrations are recommended to be used. For screening purposes, a guidance value of twice the arithmetic mean of the concentrations measured in the background sample was used.

[e] Since only one background concentration was available, the guidance value used here represents twice the concentration measured in the background sample.

[f] Since the concentration of this metal was below detection limit (DL) in the site background sample, the guidance value used here represents 0.25xDL.

Key:

- D = Dilution result reported, original analysis exceeded calibration.
- E = Reported value is estimated because of the presence of interference.
- J = Estimated value.
- NA = Not analyzed.
- ND = Not detected.
- mg/kg = Milligrams per kilogram.
- NYSDEC = New York State Department of Environmental Conservation.
- PCB = Polychlorinated biphenyl.
- ppm = parts per million.
- SVOC = Semivolatile organic compound.
- TCL = Target compound list.
- VOC = Volatile organic compound.
- µg/kg = Micrograms per kilogram.
- < = Less than.
- – = No soil cleanup objectives available/applicable.
- % = Percent.
- [shaded box] = Reported value exceeds NYSDEC TAGM 4046 Soil Cleanup Objective.

Table 5-4 Analytical Data Summary of Positive Hits for Groundwater Samples, Cauterskill Road Site

Compound	NYSDEC Class GA Groundwater Standards [a]	CRMW-1	CRMW-2	CRMW-3	CRMW-4	CRMW-5	CRMW-6D
TCL Volatiles µg/L							
Trichloroethene	5	ND	ND	ND	ND	ND	ND
Toluene	5	ND	ND	1 J	ND	ND	ND
TCL Semivolatiles µg/L							
N-Nitrosodiphenylamine	50 [b]	ND	2 J	ND	ND	ND	ND
Di-n-butylphthalate	50 [b]	ND	ND	1 J	ND	3 J	ND
Butylbenzylphthalate	50 [b]	2 J	ND	ND	ND	ND	ND
bis(2-Ethylhexyl)phthalate	5	ND	3 J	5 J	ND	2 J	ND
TCL Pest/PCBs µg/L							
Pesticides/PCBs	—	ND	ND	ND	ND	ND	ND
Inorganics µg/L							
Aluminum	—	861 J	247 J	ND	ND	ND	2,490 J
Arsenic	25	ND	4.8 J	ND	ND	4.8 J	ND
Barium	1,000	31.0 J	123 J	130 J	63.4 J	67.2 J	221
Cadmium	5	0.53 J	ND	ND	ND	ND	ND
Calcium	—	130,000	75,700	93,500	110,000	122,000	91,600
Chromium	50	7.9 J	ND	ND	8.7 J	48.4	5.1 J
Cobalt	—	ND	ND	ND	9.9 J	22.7 J	4.1 J
Copper	200	ND	ND	ND	ND	ND	ND
Iron	300	1,240	607	68.3 J	55.2 J	49.6 J	2,510
Lead	25	2.8 J	ND	ND	2.6 J	ND	2.9 J
Magnesium	35,000 [b]	4,650 J	9,850	28,200	32,000	16,700	35,000
Manganese	300	73.8	18.8	10.6 J	34.7	197	52.5
Mercury	0.7	ND	ND	ND	ND	ND	ND
Nickel	100	4.7 J	1.2 J	1.0 J	7.6 J	98.2	5.9 J

Key at end of table.

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Table 5-4 Analytical Data Summary of Positive Hits for Groundwater Samples, Cauterskill Road Site

Compound	NYSDEC Class GA Groundwater Standards [a]	CRMW-1	CRMW-2	CRMW-3	CRMW-4	CRMW-5	CRMW-6D
Potassium	—	1,770 J	1,180 J	3,230 J	3,630 J	13,300	1,750 J
Silver	50	1.5 J	ND	1.4 J	1.5 J	1.7 J	1.4
Sodium	20,000	37,800	12,200	40,100	14,500	82,900	32,200
Thallium	0.5 [b]	5.2 J	ND	ND	ND	ND	ND
Vanadium	—	2.2 J	0.92 J	ND	ND	ND	4.4 J
Zinc	2,000 [b]	6.7 J	7.1 J	ND	7.8 J	8.0 J	10.2 J
Hexavalent Chromium	50	ND	ND	ND	ND	50	ND
Cyanide	200	ND J	ND J	ND J	ND J	14.0 J	ND J

Key at end of table.

Table 5-4 Analytical Data Summary of Positive Hits for Groundwater Samples, Cauterskill Road Site

Compound	NYSDEC Class GA Groundwater Standards [a]	CRGW-5040	CRGW-5048B	CRGW-5048H	CRGW-5048H/D	CRGW-5056
TCL Volatiles µg/L						
Trichloroethene	5	ND	2 J	ND	ND	ND
Toluene	5	ND	ND	ND	ND	ND
TCL Semivolatiles µg/L						
N-Nitroso diphenylamine	50 [b]	ND	ND	ND	ND	ND
Di-n-butylphthalate	50 [b]	ND	ND	ND	ND	ND
Butylbenzylphthalate	50 [b]	ND	ND	ND	ND	ND
bis(2-Ethylhexyl) phthalate	5	ND	ND	ND	ND	2 J
TCL Pest/PCBs µg/L						
Pesticides/PCBs	—	ND	ND	ND	ND	ND
Inorganics µg/L						
Aluminum	—	ND	477 J	ND	ND	ND
Arsenic	25	ND	ND	ND	ND	ND
Barium	1,000	44.1 J	44.8 J	103 J	105 J	174 J
Cadmium	5	ND	ND	ND	ND	ND
Calcium	—	148,000	130,000	91,000	92,800	84,500
Chromium	50	ND	ND	ND	ND	4.8 J
Cobalt	—	ND	ND	ND	ND	ND
Copper	200	43.6	ND	20.6 J	20.3 J	ND
Iron	300	17.14 J	785	22.6 J	15.0 J	487
Lead	25	5.9	5.2	3.3	4.9	ND
Magnesium	35,000 [b]	9,140	9,280	16,800	16,900	23,300
Manganese	300	2.3 J	25.7	1.3 J	0.84 J	3.2 J

Key at end of table.

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Table 5-4 Analytical Data Summary of Positive Hits for Groundwater Samples, Cauterskill Road Site

Compound	NYSDEC Class GA Groundwater Standards [a]	CRGW-5040	CRGW-5048B	CRGW-5048H	CRGW-5048H/D	CRGW-5056
Mercury	0.7	ND	ND	1.1	ND	ND
Nickel	100	1.1 J	1.5 J	2.8	5.4 J	ND
Potassium	—	2,100 J	4,340 J	677 J	739 J	2,130 J
Silver	50	1.9 J	1.7 J	ND	ND	ND
Sodium	20,000	74,700	93,700	36,300	36,800	226,000
Thallium	0.5 [b]	ND	ND	ND	ND	ND
Vanadium	—	ND	1.1 J	ND	ND	ND
Zinc	2,000 [b]	64.7 J	42.2 J	25.0	30.6 J	28.2 J
Hexavalent Chromium	50	ND	ND	ND	ND	ND
Cyanide	200	ND J	ND J	ND J	ND J	ND J

[a] NYSDEC (June 1998), Ambient Water Quality Standards and Guidance Values, Class GA Groundwater.

[b] NYSDEC guidance value is used because a standard has not been established.

Key:

J = Estimated value.
ND = compound not detected.
NYSDEC = New York State Department of Environmental Conservation.
PCB = Polychlorinated biphenyl.
Pest = Pesticide.
TCL = Target compound list
μg/L = Micrograms per liter.
– = No standard/guidance value available/applicable.
[shaded box] = Reported value exceeds NYSDEC Class GA Ambient Water Quality Standard/Guidance.

Table 5-5 Analytical Data Summary of Positive Hits for Surface Water Samples, Cauterskill Road Site

Compound	NYSDEC Class C Ambient Water Standards[a]	CRSW-1	CRSW-2	CRSW-3	CRSW-4	CRSW-5
TCL Volatiles μg/L						
VOCs	—	ND	NA	ND	NA	NA
TCL Semivolatiles μg/L						
Butylbenzylphthalate	—	ND	NA	ND	NA	NA
bis(2-Ethylhexyl) phthalate	0.6	3 J	NA	ND	NA	NA
TCL Pest/PCB μg/L						
Pesticides/PCBs	—	ND	NA	ND	NA	NA
Total Hardness as $CaCO_3$ mg/L						
Total Hardness	—	180	170	180	170	180
Inorganics μg/L						
Aluminum	100	316	NA	312	NA	NA
Antimony	—	ND	ND	ND	NA	NA
Barium	—	28.7 J	NA	26.6 J	NA	NA
Calcium	—	65,400	NA	64,300	NA	NA
Iron	300	325	NA	364	NA	NA
Lead	—[b]	ND	ND	ND	ND	ND
	11.8					
	9.25					
	9.67					
Magnesium	—	5,580	NA	5,380	NA	NA
Manganese	—	19.8	NA	17.2	NA	NA
Nickel	85.5[b, c]	1.3 J				
	81.5[b, c]		0.9 J			
	—[b]			ND	ND	ND
	128[b,c]					
	105[b,c]					
	109[b,c]					
Potassium	—	1,940 J	NA	1,650 J	NA	NA
Silver	0.1[d]	1.5 J	NA	1.7 J	NA	NA
Sodium	—	39,700	NA	38,900	NA	NA
Vanadium	14[e]	0.85 J	NA	0.88 J	NA	NA
Zinc	136.18[b, c]	7.1 J		5.6 J		
	—[b,c]		ND		ND	ND
	204[b,c]					

Table 5-5 Analytical Data Summary of Positive Hits for Surface Water Samples, Cauterskill Road Site

Compound	NYSDEC Class C Ambient Water Standards[a]	CRSW-1	CRSW-2	CRSW-3	CRSW-4	CRSW-5
	167.7[b,c]					
	173.9[b,c]					
Hexavalent Chromium	11 [c]	ND	NA	ND	NA	NA
Cyanide	5.2	ND J	ND J	10.0 J	ND J	ND J

Key at end of table.

Table 5-5 Analytical Data Summary of Positive Hits for Surface Water Samples, Cauterskill Road Site

Compound	NYSDEC Class C Ambient Water Standards[a]	CRSW-6	CRSW-6D	CRSW-7	CRSW-8	CRSW-9
TCL Volatiles µg/L						
VOCs	—	ND	ND	NA	NA	ND
TCL Semivolatiles µg/L						
Butylbenzylphthalate	—	1 J	ND	NA	NA	ND
bis(2-Ethylhexyl) phthalate	0.6	5 J	ND	NA	NA	ND
TCL Pest/PCB µg/L						
Pesticides/PCBs	—	ND	NA	ND	NA	ND
Total Hardness as $CaCO_3$ mg/L						
Total Hardness	—	160	170	170	170	170
Inorganics µg/L						
Aluminum	100	62.9 J	80.5	NA	NA	435
Antimony	—	ND	ND	NA	NA	ND
Barium	—	24.9 J	25.9 J	NA	NA	28.9 J
Calcium	—	66,300	70,300	NA	NA	69,500
Iron	300	80.6 J	180	NA	NA	547
Lead	—[b]	ND	ND	ND	ND	ND
	11.8					
	9.25					
	9.67					
Magnesium	—	5,460	5,800	NA	NA	5,750
Manganese	—	6.3 J	4.8 J	NA	NA	19.9
Nickel	85.5[b,c]					
	81.5[b,c]			1.0 J		
	—[b]	ND	ND		ND	ND
	128[b]					
	105[b]					
	109[b]					
Potassium	—	1,560 J	1,600 J	NA	NA	1,630 J
Silver	0.1[d]	1.8 J	1.5 J	NA	NA	1.5 J
Sodium	—	43,000	45,400	NA	NA	45,600
Vanadium	14[e]	ND	ND	NA	NA	ND

Key at end of table.

Table 5-5 Analytical Data Summary of Positive Hits for Surface Water Samples, Cauterskill Road Site

Compound	NYSDEC Class C Ambient Water Standards[a]	CRSW-6	CRSW-6D	CRSW-7	CRSW-8	CRSW-9
Zinc	138.18 [b, c]					
	— [b, c]	ND	ND	ND	ND	ND
	204 [b, c]					
	167.7 [b, c]					
	173.9 [b, c]					
Hexavalent Chromium	11 [c]	ND	ND	NA	NA	ND
Cyanide	5.2	11.0 J	ND J	ND J	ND J	10.0 J

Key at end of table.

Table 5-5 Analytical Data Summary of Positive Hits for Surface Water Samples, Cauterskill Road Site

Compound	NYSDEC Class C Ambient Water Standards[a]	CRSW-10[f]	CRSW-11	CRSW-12	CRSW-12D
TCL Volatiles µg/L					
VOCs	—	NS	NA	NA	NA
TCL Semivolatiles µg/L					
Butylbenzylphthalate	—	NS	NA	NA	NA
bis(2-Ethylhexyl) phthalate	0.6	NS	NA	NA	NA
TCL Pest/PCB µg/L					
Pesticides/PCBs	—	NS	ND	ND	ND
Total Hardness as $CaCO_3$ mg/L					
Total Hardness	—	NS	290	230	240
Inorganics µg/L					
Aluminum	100	NS	43.3	[redacted]	[redacted]
Antimony	—	NS	ND	3.5	ND
Barium	—	NS	48.7	88.1	87.2
Calcium	—	NS	96200	76700	76200
Iron	300	NS	149	[redacted]	[redacted]
Lead	--[b]	NS			
	11.8[b]		4.3		
	9.25[b]			ND	
	9.67[b]				ND
Magnesium	—	NS	9740	8200	8150
Manganese	—	NS	92.8	244	232
Nickel	85.5[b,c]				
	81.5[b,c]				
	—[b]	NS			
	128[b,c]		11.3		
	105[b,c]			ND	
	109[b,c]				4.0
Potassium	—	NS	2140	1870	2250
Silver	0.1[d]	NS	ND	ND	ND
Sodium	—	NS	250000	146000	144000
Vanadium	14[e]	NS	ND	ND	ND

Key at end of table.

Table 5-5 Analytical Data Summary of Positive Hits for Surface Water Samples, Cauterskill Road Site

Compound	NYSDEC Class C Ambient Water Standards[a]	CRSW-10[f]	CRSW-11	CRSW-12	CRSW-12D
Zinc	136.18[b,c]				
	—[b]	NS			
	204[b,c]		44.9		
	167.7[b,c]			12.8	
	173.9[b,c]				13.2
Hexavalent Chromium	11[c]	NS	ND	ND	0.01
Cyanide	5.2	NS	ND	ND	ND

a NYSDEC (June 1998), Ambient Water Quality Standards and Guidance Values, Class C Fresh Surface Water (protection for fish propagation).

b Standard is calculated using sample hardness, therefore it is sample-specific. The standard was calculated for detected compounds only.

c Standard applies to the dissolved form.

d Standard applies to the ionic form.

e Standard applies to the acid-soluble form.

f Sample was not collected because location was dry.

Key:

$CaCO_3$ = Calcium carbonate.

J = Reported value was from reading less than Contract Required Detection Limit but greater than or equal to the Instrument Detection Limit (same as B qualifier on Form 1 of the laboratory data pack for metals analyses). Therefore, the reported value is estimated.

NA = Not analyzed.

ND = Compound not detected.

NYSDEC = New York State Department of Environmental Conservation.

PCB = Polychlorinated biphenyl.

Pest = Pesticide.

TCL = Target compound list

VOC = Volatile organic compound.

µg/L = Micrograms per liter.

— = Standard/guidance not applicable or not available/not calculated.

[shaded box] = Reported value exceeds NYSDEC Class C Fresh Water Quality Standard/Guidance.

Key at end of table.

Table 5-6a Organic Analytical Data Summary of Positive Hits for Sediment Samples, Cauterskill Road Site

Compound	NYSDEC Sediment Screening Levels [a]	CRSD-1	CRSD-2	CRSD-3	CRSD-4	CRSD-5	CRSD-6	CRSD-7	CRSD-8	CRSD-9R
Total Organic Carbon mg/kg										
TOC [b]	—	60,000	32,000	72,000	12,000	13,000	NA	29,000	55,000	225,000
TCL Volatiles µg/kg										
VOCs	—	ND	NA	ND	NA	NA	ND	NA	NA	ND
TCL Semivolatiles µg/kg										
bis(2-Ethyl hexyl)phthalate	44,887 [c, d]	ND	NA	ND	NA	NA	110 J	NA	NA	190 J
Polycyclic Aromatic Hydrocarbons										
Acenaphthene	—	ND	NA	ND	NA	NA	ND	NA	NA	ND
Acenaphthylene	—	340 J	NA	390 J	NA	NA	170 J	NA	NA	140 J
Fluorene	576 [c, d]	ND	NA	57 J	NA	NA	ND	NA	NA	ND
Phenanthrene	7,200 [c, d]	490 J								
	8,640 [c, d]			590						
	27,000 [c, d]									200 J
	7,470 [c, d]						470 J			
	—		NA		NA	NA		NA	NA	
Anthracene	6,420 [c, d]	320 J								
	7,704 [c, d]			330 J						
	24,075 [c, d]									120 J
	6,660 [c, d]						170 J			
	—		NA		NA	NA		NA	NA	
Carbazole	—	71 J	NA	75 J	NA	NA	ND	NA	NA	ND

Key at end of table.

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Table 5-6a Organic Analytical Data Summary of Positive Hits for Sediment Samples, Cauterskill Road Site

Compound	NYSDEC Sediment Screening Levels [a]	CRSD-1	CRSD-2	CRSD-3	CRSD-4	CRSD-5	CRSD-6	CRSD-7	CRSD-8	CRSD-9R
Fluoranthene	61,200 [c, d]	850								
	73,440 [c, d]			960						
	229,500 [c, d]									300 J
	63,495 [c, d]						550 J			
	—		NA		NA	NA		NA	NA	
Pyrene	57,660 [c, d]	770								
	69,192 [c, d]			710						
	216,225 [c, d]									260 J
	59,822 [c, d]						400 J			
	—		NA		NA	NA		NA	NA	
Benzo(a) anthracene	720 [c, d]	600 J								
	864 [c, d]			550						
	2,700 [c, d]									180 J
	747 [c, d]						280 J			
	—		NA		NA	NA		NA	NA	
Chrysene	78 [c, e]	610 J								
	93.6 [c, e]			560						
	292.5 [c, e]									210 J
	80.9 [c, e]						300 J			
	—		NA		NA	NA		NA	NA	
Dibenzo(a,h) anthracene	—	250 J	NA	220 J	NA	NA	120 J	NA	NA	ND
Benzo(g,h,i) perylene	—	550 J	NA	510 J	NA	NA	260 J	NA	NA	210 J

Key at end of table.

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Table 5-6a Organic Analytical Data Summary of Positive Hits for Sediment Samples, Cauterskill Road Site

Compound	NYSDEC Sediment Screening Levels [a]	CRSD-1	CRSD-2	CRSD-3	CRSD-4	CRSD-5	CRSD-6	CRSD-7	CRSD-8	CRSD-9R
Benzo(b) fluoranthene	78 [c, e]	390 J								
	93.6 [c, e]			360 J						
	292.5 [c, e]									160 J
	80.9 [c, e]						200 J			
	—		NA		NA	NA		NA	NA	
Benzo(k) fluoranthene	78 [c, e]	530 J								
	93.6 [c, e]			500 J						
	292.5 [c, e]									170 J
	80.9 [c, e]						270 J			
	—		NA		NA	NA		NA	NA	
Benzo(a)pyrene	78 [c, e]	580 J								
	93.6 [c, e]			480 J						
	292.5 [c, e]									190 J
	80.9 [c, e]						260 J			
	—		NA		NA	NA		NA	NA	
Indeno(1,2,3-cd)pyrene	78 [c, e]	570 J								
	93.6 [c, e]			500 J						
	292.5 [c, e]									220 J
	80.9 [c, e]						250 J			
	—		NA		NA	NA		NA	NA	
2-methylnaph-thalene	—	ND	NA	ND	NA	NA	ND	NA	NA	ND

Key at end of table.

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Table 5-6a Organic Analytical Data Summary of Positive Hits for Sediment Samples, Cauterskill Road Site

Compound	NYSDEC Sediment Screening Levels [a]	CRSD-1	CRSD-2	CRSD-3	CRSD-4	CRSD-5	CRSD-6	CRSD-7	CRSD-8	CRSD-9R
TCL Pesticides/PCBs µg/kg										
Heptachlor Epoxide	1.8 [c, f]						4.0 J			
	6.75 [c, f]									4.6 P
	—	ND	NA	ND	NA	NA		NA	NA	
Aroclor 1254	87.15 [c, f]						84 P			
	—	ND	NA	ND	NA	NA		NA	NA	ND
Total Solids %										
Total Solids	—	51	68.21	61	83.38	75.01	50	60.57	77.74	65

Key at end of table.

Table 5-6a Organic Analytical Data Summary of Positive Hits for Sediment Samples, Cauterskill Road Site

Compound	NYSDEC Sediment Screening Levels [a]	CRSD-10	CRSD-11	CRSD-12	CRSD-12D	CRSD-13	CRSD-14	CRSD-15	CRSD-16	CRSD-17
Total Organic Carbon mg/kg										
TOC[b]	—	6.13	3.78	2.84	2.42	11.7	4.76	2.87	4.34	2.54
TCL Volatiles µg/kg										
VOCs	—	NA	NA	NA	NA	NA	NA	NA	NA	NA
Polycyclic Aromatic Hydrocarbons (PAHs) (µg/kg dry wt.)										
Acenaphthene	8582[c,d]	ND			ND			ND	ND	ND
	5292[c,d]		1320							
	3976[c,d]			380J						
	16380[c,d]					2700				
	6664[c,d]						210J			
Acenaphthylene	—	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluorene	490.4[c,d]	23J							ND	
	302.4[c,d]		283							
	227.2[c,d]			63.1						
	193.6[c,d]				7.8					
	936[c,d]					192				
	229.6[c,d]							41J		
	203.2[c,d]									45.6
Phenanthrene	7356[c,d]	325								
	4536[c,d]		1660							
	3408[c,d]			159						
	2904[c,d]				26J					
	14040[c,d]					1760				
	5712[c,d]						135			
	3444[c,d]							71.4		

Table 5-6a Organic Analytical Data Summary of Positive Hits for Sediment Samples, Cauterskill Road Site

Compound	NYSDEC Sediment Screening Levels [a]	CRSD-10	CRSD-11	CRSD-12	CRSD-12D	CRSD-13	CRSD-14	CRSD-15	CRSD-16	CRSD-17
	5208[c,d]								44.3	
	3048[c,d]									328
Anthracene	6559.1[c,d]	37		ND	ND		ND	ND		ND
	4044.6[c,d]		167							
	5093.2[c,d]					286				
	4643.8[c,d]								26J	
Carbazole	—	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	62526[c,d]	787								
	38556[c,d]		2270							
	28968[c,d]			284						
	24684[c,d]				100J					
	119340[c,d]					4560				
	48552[c,d]						327			
	29274[c,d]							164		
	44268[c,d]								101	
	25908[c,d]									507
Pyrene	58909.3[c,d]	458						ND		
	36325.8[c,d]		1290							
	27292.4[c,d]			256						
	23256.2[c,d]				88J					
	112437[c,d]					2290				
	45743.6[c,d]						207			
	41707.4[c,d]								51J	
	24409.4[c,d]									258

Table 5-6a Organic Analytical Data Summary of Positive Hits for Sediment Samples, Cauterskill Road Site

Compound	NYSDEC Sediment Screening Levels [a]	CRSD-10	CRSD-11	CRSD-12	CRSD-12D	CRSD-13	CRSD-14	CRSD-15	CRSD-16	CRSD-17
Benzo(a) anthracene	79.69[c,e]	243								
	49.14[c,e]		615							
	36.92[c,e]			80.6						
	31.46[c,e]				29J					
	152.1[c,e]					1300				
	61.88[c,e]						103			
	56.42[c,e]								19J	
	33.02[c,e]									121
Chrysene	79.69[c,e]	341								
	49.14[c,e]		783							
	36.92[c,e]			126						
	31.46[c,e]				40J					
	152.1[c,e]					1800				
	61.88[c,e]						137			
	37.31[c,e]							112		
	56.42								42.3	
	33.02[c,e]									199
Dibenzo(a,h) anthracene	—	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(g,h,i) perylene	—	149	231	67J	ND	755	45J	43J	72J	ND
Benzo(b) fluoranthene	79.69[c,e]	478								
	49.14[c,e]		686							
	36.92[c,e]			226						
	31.46[c,e]				28J					

Table 5-6a Organic Analytical Data Summary of Positive Hits for Sediment Samples, Cauterskill Road Site

Compound	NYSDEC Sediment Screening Levels [a]	CRSD-10	CRSD-11	CRSD-12	CRSD-12D	CRSD-13	CRSD-14	CRSD-15	CRSD-16	CRSD-17
	152.1[c,e]					1910				
	61.88[c,e]						143			
	37.31[c,e]							105		
	56.42[c,e]								45.4	
	33.02[c,e]									105
Benzo(k) fluoranthene	79.69[c,e]	201		ND	ND					
	49.14[c,e]		384							
	61.88[c,e]					940				
	37.31[c,e]						65.6			
	56.42[c,e]							289		
	33.02[c,e]								54.2	
	79.69[c,e]									74.3
Benzo(a)pyrene	79.69[c,e]	383								
	49.14[c,e]		571							
	36.92[c,e]			95.4						
	31.46[c,e]				43J					
	152.1[c,e]					1420				
	61.88[c,e]						119			
	37.31[c,e]							52.6		
	56.42[c,e]								45.4	
	33.02[c,e]									109
Indeno(1,2,3-cd)pyrene	79.69[c,e]	209			ND			ND		
	49.14[c,e]		252							
	36.92[c,e]			41J						
	152.1[c,e]					869				

Table 5-6a Organic Analytical Data Summary of Positive Hits for Sediment Samples, Cauterskill Road Site

Compound	NYSDEC Sediment Screening Levels [a]	CRSD-10	CRSD-11	CRSD-12	CRSD-12D	CRSD-13	CRSD-14	CRSD-15	CRSD-16	CRSD-17
	61.88[c,e]						84.9			
	56.42[c,e]								34J	
	33.02[c,e]									43.8
2-methylnaphthalene	2084.2[c,d]	717		ND	ND		ND	ND	ND	
	1285.2[c,d]		1950							
	3978[c,d]					1350				
	863.6[c,d]									387
TCL Pesticides/PCBs µg/kg										
Heptachlor Epoxide	1.8[c,f]									
	6.75[c,f]									
	—	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table 5-6a Organic Analytical Data Summary of Positive Hits for Sediment Samples, Cauterskill Road Site

Compound	NYSDEC Sediment Screening Levels [a]	CRSD-10	CRSD-11	CRSD-12	CRSD-12D	CRSD-13	CRSD-14	CRSD-15	CRSD-16	CRSD-17
Aroclor 1254	87.15[c,f]	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Solids %										
Total Solids										

a NYSDEC Technical Guidance for Screening Contaminated Sediments (January 1999).

b Total organic carbon for CRSD-1 through CRSD-8 (except CRSD-6) samples were determined from samples collected in March 1999 (CRSS-1R through CRSD-8R, respectively)..

c The sediment criterion was calculated using sample TOC, therefore it is sample specific and cannot be determined without TOC results. Criteria were calculated for detected compounds only. Since TOC was not determined for sample CRSD-6, the mean of the measured TOC was used to determine the sample-specific sediment screening criteria.

d Site-specific criterion for benthic aquatic life chronic toxicity was used.

e Site-specific sediment criterion for human bioaccumulation was used.

f Site-specific sediment criterion for wildlife bioaccumulation was used.

Key:

B = The compound was also detected in the blank.
J = Estimated value.
mg/kg = Milligrams per kilogram.
µg/kg = Micrograms per kilogram.
NA = Not analyzed.
ND = Not detected.
NYSDEC = New York State Department of Environmental Conservation.
PCB = Polychlorinated biphenyl.
TCL = Target compound list.
TOC = Total organic carbon.
VOC = Volatile organic compound.
– = No screening guidance available/applicable.
% = Percent.
[box] = Reported value exceeds NYSDEC Technical Guidance for Screening Contaminated Sediments.

Table 5-6b Inorganic Analytical Data Summary of Positive Hits for Sediment Samples, Cauterskill Road Site

Compound	NYSDEC Lowest Effect Level [a]	NYSDEC Severe Effect Level [a]	CRSD-1	CRSD-2	CRSD-3	CRSD-4	CRSD-5	CRSD-6	CRSD-7	CRSD-8	CRSD-9R
Inorganics mg/kg											
Aluminum	—	—	13000	NA	13600	NA	NA	14300	NA	NA	14800
Antimony	2.0		ND	NA	ND	NA	NA	ND	NA	NA	2.7 J
Arsenic	6	33	15	NA	7.6	NA	NA	5.9	NA	NA	13.1
Barium	—	—	178	NA	134	NA	NA	118	NA	NA	169
Beryllium	—	—	1.26	NA	0.996	NA	NA	1.03	NA	NA	1.1 J
Cadmium	0.6	9	3.02	2.77	ND	3.65	1.51	2.86	3.26	1.89	3.8
Calcium	—	—	15800	NA	9910	NA	NA	9480	NA	NA	11500
Chromium	26	110	16.5	24.0	15.7	19.0	22.2	24.2	21.0	16.1	23.5
Cobalt	—	—	12.3	NA	12.1	NA	NA	12.9	NA	NA	12.0 J
Copper	16	110	21.0	22.4	19.7	20.8	27.6	26.8	25.8	18.6	41.3 J
Iron	20000	40000	38000	NA	30300	NA	NA	30900	NA	NA	34100
Lead	31	110	37	50.3	38	28.3	20	29	26	29.8	44.1
Magnesium	—	—	3870	NA	3990	NA	NA	4320	NA	NA	4540
Manganese	460	1100	1990	NA	1250	NA	NA	266	NA	NA	1200
Mercury	0.15	1.3	0.083	NA	0.072	NA	NA	0.062	NA	NA	ND
Nickel	16	50	51.1	67.0	40.2 J	46.9 J	47.0	52.5 J	36.0 J	48.9	62.9
Potassium	—	—	1180	NA	1230	NA	NA	1400	NA	NA	1110 J
Selenium	—		ND	NA	ND	NA	NA	ND	NA	NA	10.7 J
Silver	—	—	ND	ND	ND	ND	ND	ND	ND	ND	ND

Key at end of table.

Table 5-6b Inorganic Analytical Data Summary of Positive Hits for Sediment Samples, Cauterskill Road Site

Compound	NYSDEC Lowest Effect Level [a]	NYSDEC Severe Effect Level [a]	CRSD-1	CRSD-2	CRSD-3	CRSD-4	CRSD-5	CRSD-6	CRSD-7	CRSD-8	CRSD-9R
Sodium	—	—	82.8	NA	118	NA	NA	122	NA	NA	202 J
Thallium	—		ND	NA	ND	NA	NA	ND	NA	NA	2.9
Vanadium	—	—	28.3	NA	6.30	NA	NA	26.2	NA	NA	25.0
Zinc	120	—	113	159	105	86.0	97.0	144	97.8	86.8	143
Cyanide	—	—	ND	ND	ND	ND	4.51	ND	ND	ND	ND J

Key at end of table.

Table 5-6b Inorganic Analytical Data Summary of Positive Hits for Sediment Samples, Cauterskill Road Site

Compound	NYSDEC Lowest Effect Level [a]	NYSDEC Severe Effect Level [a]	CRSD-10	CRSD-11	CRSD-12	CRSD-13	CRSD-14	CRSD-15	CRSD-16	CRSD-17
Inorganics mg/kg										
Aluminum	—	—	15500	13900	26300	25900	12500	15000	24800	10200
Antimony	2.0		1.4 J	ND	ND	ND	ND	2.3 J	1.7 J	ND
Arsenic	6	33	12.9	8.7	9.2	10.6	4.7 J	8	10	5.9
Barium	—	—	169	86.9	253	263	153	127	258	92
Beryllium	—	—	1	0.77 J	1.5 J	1.7 J	0.78 J	0.88J	1.5	0.71 J
Cadmium	0.6	9	5.4	5.4	0.97 J	1.7 J	3.6	2.7	1.5	1 J
Calcium	—	—	11700	16900	20500	20100	25700	8850	33100	8220
Chromium	26	110	24.1	26.7	30.4	30.6	23.2	25.6	28.6	15.2
Cobalt	—	—	10.7	9.5 J	6.6 J	14.2 J	9.6 J	11.3 J	5.8 J	5.7 J
Copper	16	110	36.1	52.4	26.1	29	49.2	34.3	29.5	17.1
Iron	20000	40000	31900	30000	40400	46200	26400	29100	40800	20700
Lead	31	110	58.8	79	20.5	22	67.9	32.2	22.3	22.1
Magnesium	—	—	4460	5300	5160	5620	4000	4580	4850	2770
Manganese	460	1100	1740	659	409	837	768	280	384	440
Mercury	0.15	1.3	ND	ND	ND	ND	ND	ND	ND	ND
Nickel	16	50	50.6	68.8	32.4	33.7	24.1	49.4	32.9	24.7
Potassium	—	—	1380	1070	2820	1790	2030	1510	2270	998
Selenium	—		9	7.4	10	11	11.1	7.4	11.3	5.8
Silver	—	—	ND	ND	ND	ND	0.7	ND	ND	ND

Key at end of table.

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Table 5-6b Inorganic Analytical Data Summary of Positive Hits for Sediment Samples, Cauterskill Road Site

Compound	NYSDEC Lowest Effect Level [a]	NYSDEC Severe Effect Level [a]	CRSD-10	CRSD-11	CRSD-12	CRSD-13	CRSD-14	CRSD-15	CRSD-16	CRSD-17
Sodium	—	—	118 J	610 J	357 J	400 J	175 J	112 J	422 J	205 J
Thallium	—		2	2.9	ND	ND	ND	ND	2.2	ND
Vanadium	—	—	29.7	21	38.1	39.5	25.9	25.7	37.1	17.5
Zinc	120	—	146	200	95.8	102	201	147	100	75.6
Cyanide	—	—	ND	ND	ND	ND	ND	ND	ND	ND

[a] NYSDEC Technical Guidance for Screening Contaminated Sediments (January 1999). A sediment is considered contaminated if either criterion is exceeded. If both criteria are exceeded the sediment is considered severely impacted. If only the lowest effect level criterion is exceeded the impact is considered moderate.

Key:

J	=	Estimated value.
mg/kg	=	Milligrams per kilogram.
NA	=	Not analyzed.
ND	=	Not detected.
NYSDEC	=	New York State Department of Environmental Conservation.
—	=	No screening guidance available/applicable.
[box]	=	Reported value exceeds the lowest effect level NYSDEC criterion for Screening Contaminated Sediments.
[box]	=	Reported value exceeds both (severe and lowest) NYSDEC criteria for Screening Contaminated Sediments.

Table 5-7 Analytical Data Summary of Positive Hits for Exposed Waste Samples, Cauterskill Road Site

Compound	Regulatory Levels [a]	CRW1	CRW1/D	CRW2
TCLP Metals mg/L				
Arsenic	5.0	ND	ND	0.0422 J
Barium	100	0.0409 J	0.0496 J	ND
Cadmium	1.0	ND	ND	0.0407 J
Chromium	5.0	0.0050 J	0.0040 J	0.0192 J
Lead	5.0	0.0090 J	0.0062 J	0.0070 J
Selenium	1.0	0.0132 J	0.0907 J	ND
Releasable Cyanide mg/kg				
Cyanide	-	ND	1.0	ND

[a] NYSDEC Division of Solid & Hazardous Materials, 6 NYCRR Part 371, Identification and Listing of Hazardous Wastes (November 1998), Toxicity Characteristic Regulatory Levels.

Key:

J = Estimated value.
ND = Not detected.
mg/kg = Milligrams per kilogram.
mg/L = Milligrams per liter.
NYSDEC = New York State Department of Environmental Conservation.
TCLP = Toxicity Characteristic Leaching Procedure.
— = No regulatory level available/applicable.

Unlike the soil screening criteria, the groundwater standards are promulgated standards with which all ambient waters of the State of New York are to comply. Groundwater samples were compared to class GA (drinking water quality) standards. Similarly, surface water concentrations were screened against NYSDEC Class C standards established for protection of fishing and fish propagation in fresh surface waters.

NYSDEC's guidance to evaluating organic analytes in sediment requires selecting one of four protection levels: human health bioaccumulation; benthic aquatic life acute toxicity; benthic aquatic life chronic toxicity; or wildlife bioaccumulation. For the purposes of this report, sediment criteria were considered with respect to wildlife, and were uniquely calculated for each sediment sample using measured TOC, when available. For organic compounds with no available wildlife bioaccumulation criteria, the benthic aquatic life chronic toxicity criteria or human bioaccumulation criteria were used (as indicated in Table 5-6a). For screening metals in sediments, NYSDEC has established two risk levels: lowest effect level, and severe effect level. All metals concentrations detected in the sediment samples were screened against both the severe and lowest effects levels listed in the guidance.

5.2 Geophysical Survey Results

The geophysical survey consisted of a total earth's magnetic field survey and a ground conductivity survey over most of the site. Areas with obvious cultural interference (near buildings, fences, etc.) and significant surficial metallic debris (i.e., near the southeast corner of the site, on the west side of the grass trail) were avoided to minimize masking effects from known features. Survey objectives and procedures are described in Section 2.4 of this report, and the results are described below.

5.2.1 Magnetic Survey Results

Several magnetic anomalies were detected across the site (see Figure 5-1). The sources of the anomalies in the central and west central portions of the grid are from unavoidable cultural interference. The sources of the anomalies in the northern, east central, and southeast portions of the grid are from buried ferromagnetic objects. Some of these objects are protruding from the embankment on the west side of the tributary to Kaaterskill Creek.

The cultural interference is represented by magnetic spikes and depressions near the corners of the site buildings (see Figure 5-1). As mentioned above, the disposal area in the southeast corner of the site (on the northwest side of the grass trail) does not appear to be an anomalous area even though it contains a large volume of surficial metallic debris (i.e., household trash, machinery, vats, and drums) because magnetic readings were not recorded in this area. However, anomalies caused by the buried metallic objects are represented by a series of magnetic spikes and depressions within 50 feet of the area along the eastern and northern portions of the embankment. Two of these areas were excavated during this investigation (see Section 2.6.1). Test pit 9 was excavated over the high intensity anomaly between grid nodes (150, 200 and 200, 200). The anomaly was verified to be caused by buried metallic debris consisting of containers, one or two drums, chairs, auto parts, a pickup truck, pipes, wire, vats, and other miscellaneous material. Test pit 10 was excavated over the lower intensity anomaly between grid nodes (150, 300 and 150, 275). This anomaly was verified to be caused by buried metallic debris consisting of machinery, strapping, wire, and other miscellaneous material. The other magnetic anomalies were not excavated because they were caused by cultural interference.

5.2.2 Conductivity Survey Results

The ground conductivity and in-phase surveys conducted at the site also revealed several anomalous areas generally coinciding with

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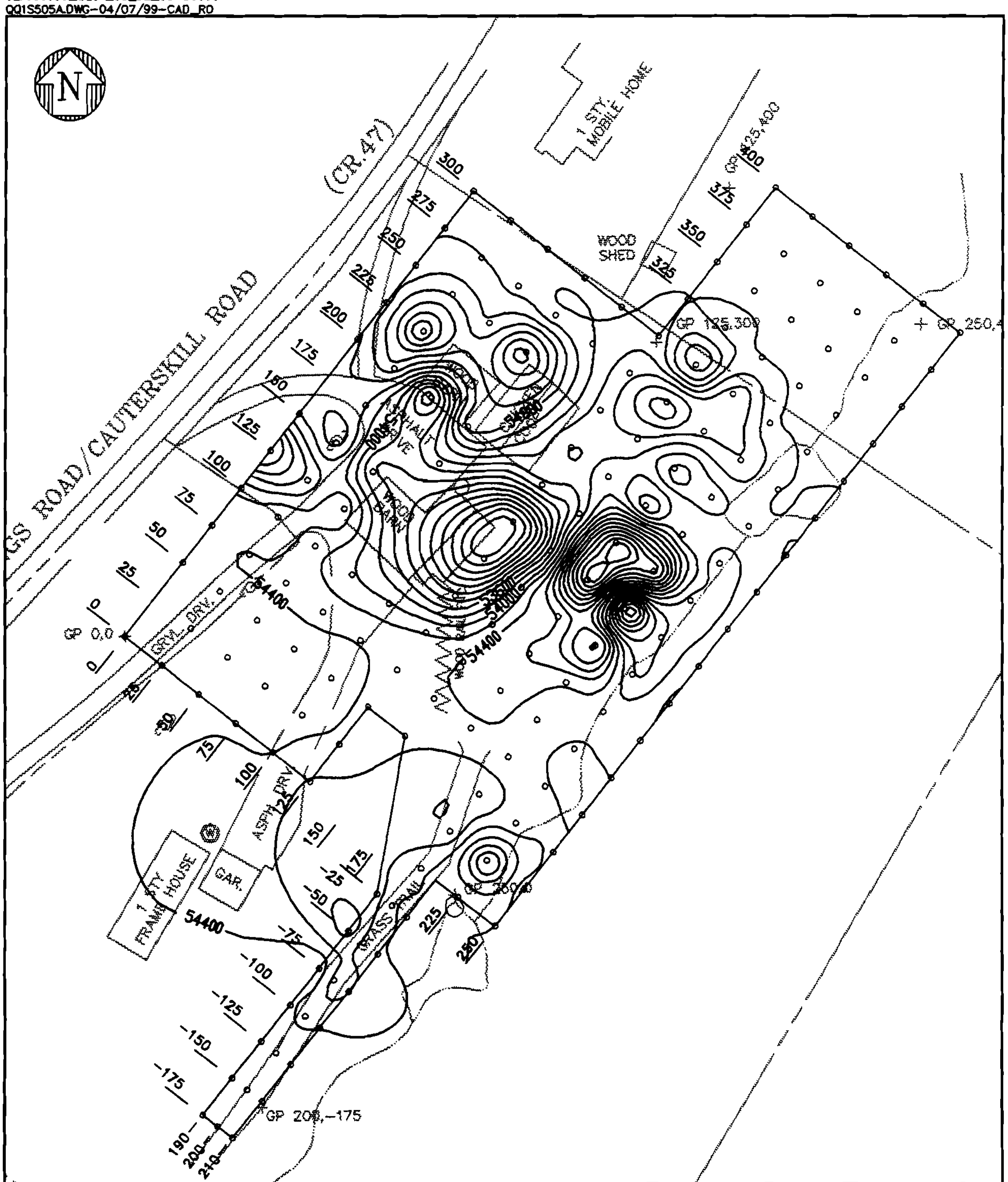

LEGEND

○ GEOPHYSICAL SURVEY NODE

INTERMITTENT STREAM

MAGNETIC CONTOUR
CONTOUR INTERVAL = 200 gammas

SCALE IN FEET

0 80 160 240

ecology and environment

Figure 5-1
TOTAL EARTH'S MAGNETIC FIELD
CAUTERSKILL ROAD, CATSKILL, NEW YORK

the results of the magnetic survey. However, the effect of cultural interference on the EM31 was less intense than that recorded by the magnetometer. Relatively consistent readings (indicating the presence of shallow bedrock) were recorded throughout most of the grid for vertical dipole conductivity and in-phase measurements with the instrument oriented in both directions (see Figures 5-2 through 5-5), and horizontal dipole conductivity and in-phase measurements with the instrument oriented north/south (see Figures 5-6 and 5-7). As with the magnetometer, anomalous readings were detected within 50 feet of the northern and east central portions of the embankment. Once again, the source of these anomalous areas is the fill material.

In addition to the obvious cultural interference and anomalies along the embankment, five high intensity anomalies were detected in the vicinity of the barns. One of the anomalies is located at grid node 50, 175 (see Figures 5-4 and 5-5). This was only detected in the vertical dipole mode with the instrument oriented east/west. The other four anomalies were detected at grid nodes 75, 100; 50, 250; 50, 300; and 100, 275 in the horizontal dipole, with the instrument oriented east/west (see Figures 5-8 and 5-9). Since the anomalies were only detected in one instrument orientation, the source is most likely an elongated object (i.e., elongated objects such as pipes, cables, and tanks exhibit a stronger instrument response when the instrument crosses over the object perpendicular to the object's long axis). The anomaly at all of the above-mentioned grid nodes was limited to that particular grid node. Therefore, the objects detected appear to be small and isolated. The depth to most of these objects is believed to be very shallow (near the surface) due to the nature of the bedrock in these areas (see Section 3.2.2) and the fact that they were detected predominantly in the horizontal dipole mode. The anomaly at node 50,175 may be a little deeper (down to 5-feet) since it was only detected in the vertical dipole mode. An attempt was made to verify the source of this anomaly using a backhoe. However, due to surficial ice and frozen ground, the backhoe could not penetrate this area of compact gravel. The anomalies at 50, 250 and 100, 275 were investigated by excavating test pits 1 and 2, respectively. In both cases, the source of the anomaly was undetermined. The anomalies at 50, 300 and 75, 100 were not investigated. Therefore, the source of the above-mentioned anomalies is unknown.

5.2.3 Conclusions

The magnetic data indicates several anomalous areas. The anomalies in the central portion of the grid were caused by cultural interference. However, magnetic anomalies along the embankment in the northern and eastern portions of the site were caused by buried ferromagnetic objects. The EM31 confirmed the magnetic results along the embankment, and pinpointed five point source anomalies which are from unknown sources. The objects represented by

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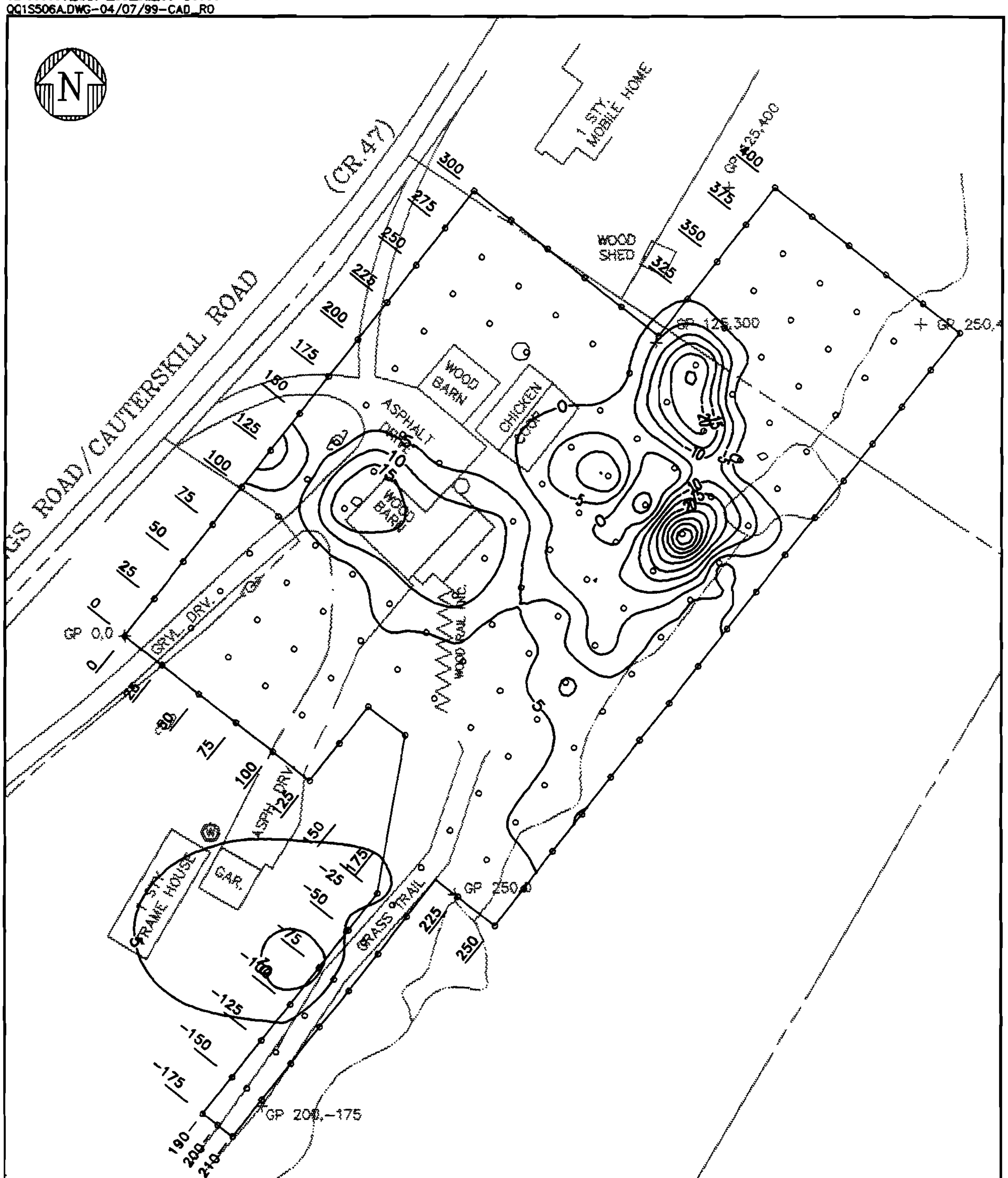

LEGEND

- ○ GEOPHYSICAL SURVEY NODE
- INTERMITTENT STREAM
- EM31 CONDUCTIVITY CONTOUR
  CONTOUR INTERVAL = 5 millimhos/meter

SCALE IN FEET

0 80 160 240

ecology and environment

Figure 5-2
EM31 CONDUCTIVITY
VERTICAL DIPOLE 1
CAUTERSKILL ROAD, CATSKILL, NEW YORK

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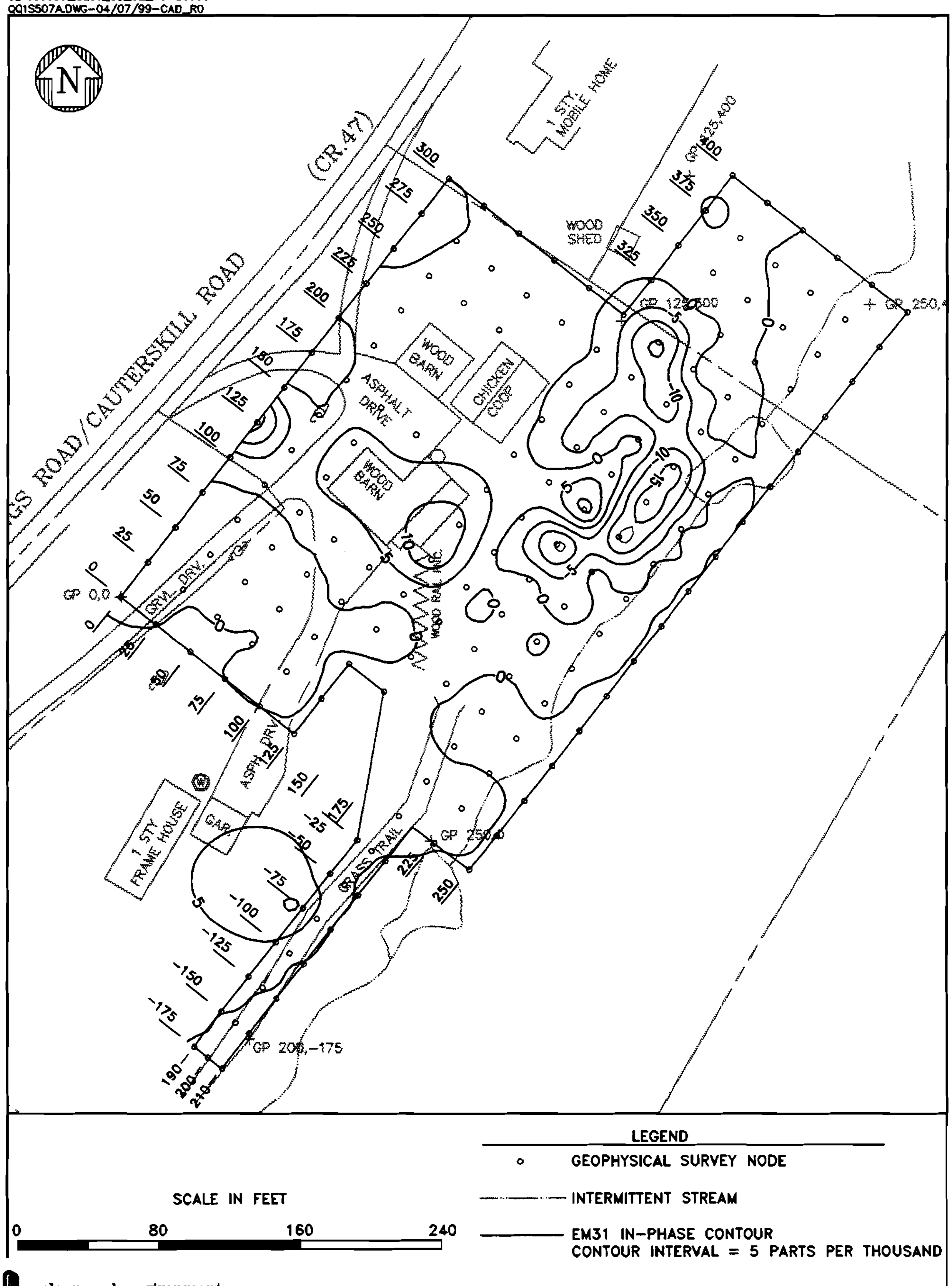

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Figure 5-3
EM31 IN-PHASE
VERTICAL DIPOLE 1
CAUTERSKILL ROAD, CATSKILL, NEW YORK

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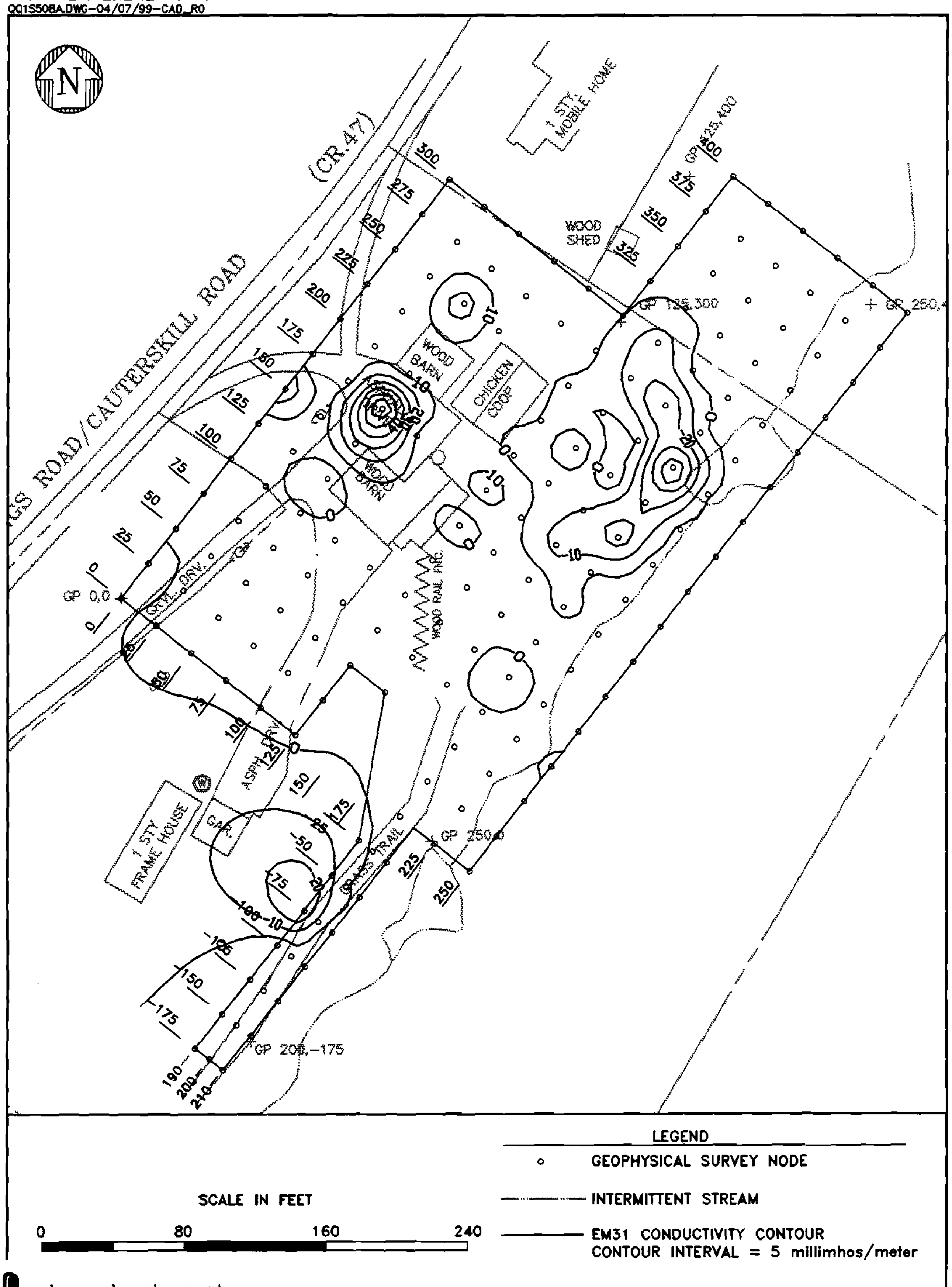

Figure 5-4
EM31 CONDUCTIVITY
VERTICAL DIPOLE 2
CAUTERSKILL ROAD, CATSKILL, NEW YORK

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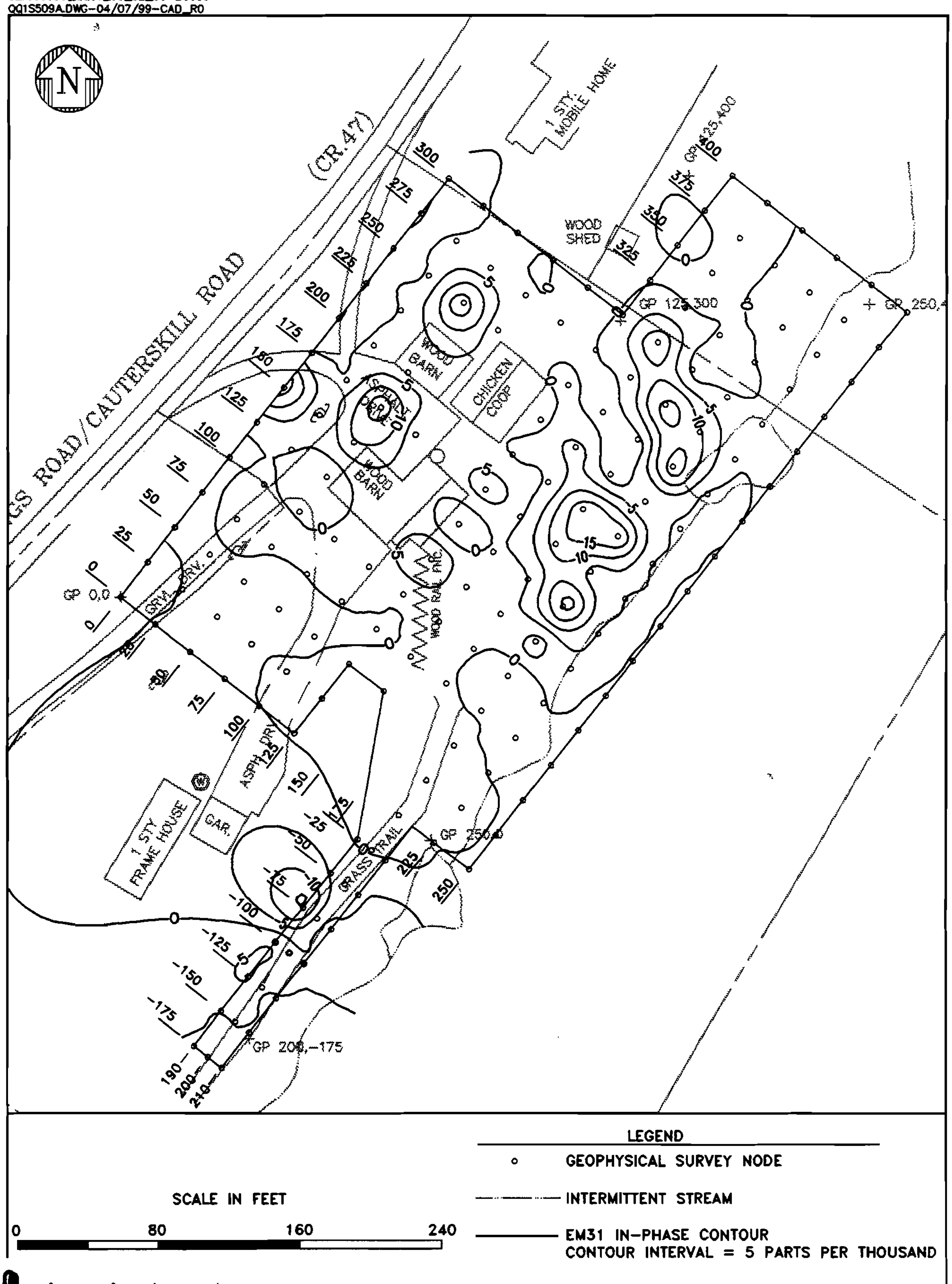

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Figure 5-5
EM31 IN-PHASE
VERTICAL DIPOLE 2
CAUTERSKILL ROAD, CATSKILL, NEW YORK

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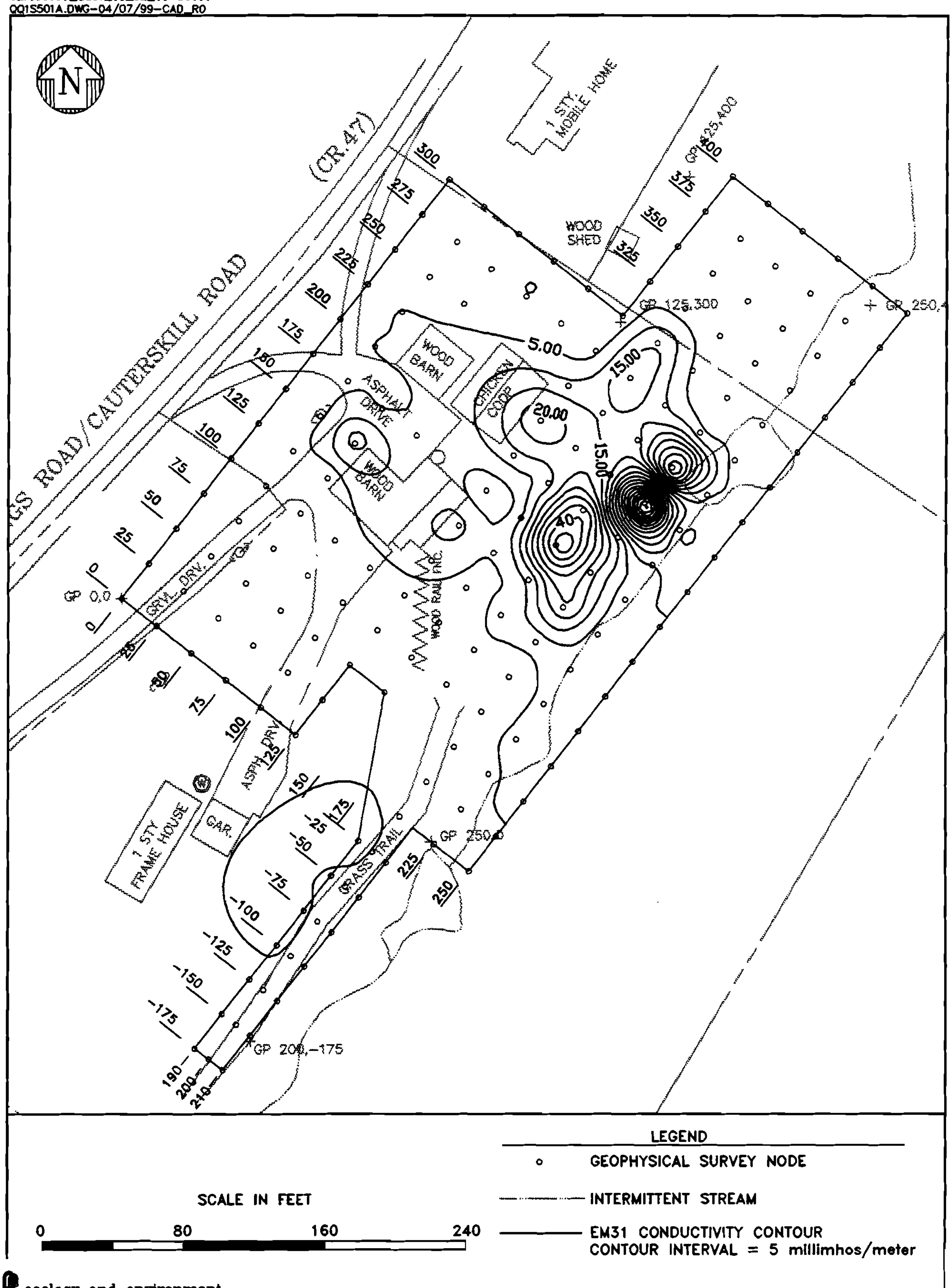

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Figure 5-6
EM31 CONDUCTIVITY
HORIZONTAL DIPOLE 1
CAUTERSKILL ROAD, CATSKILL, NEW YORK

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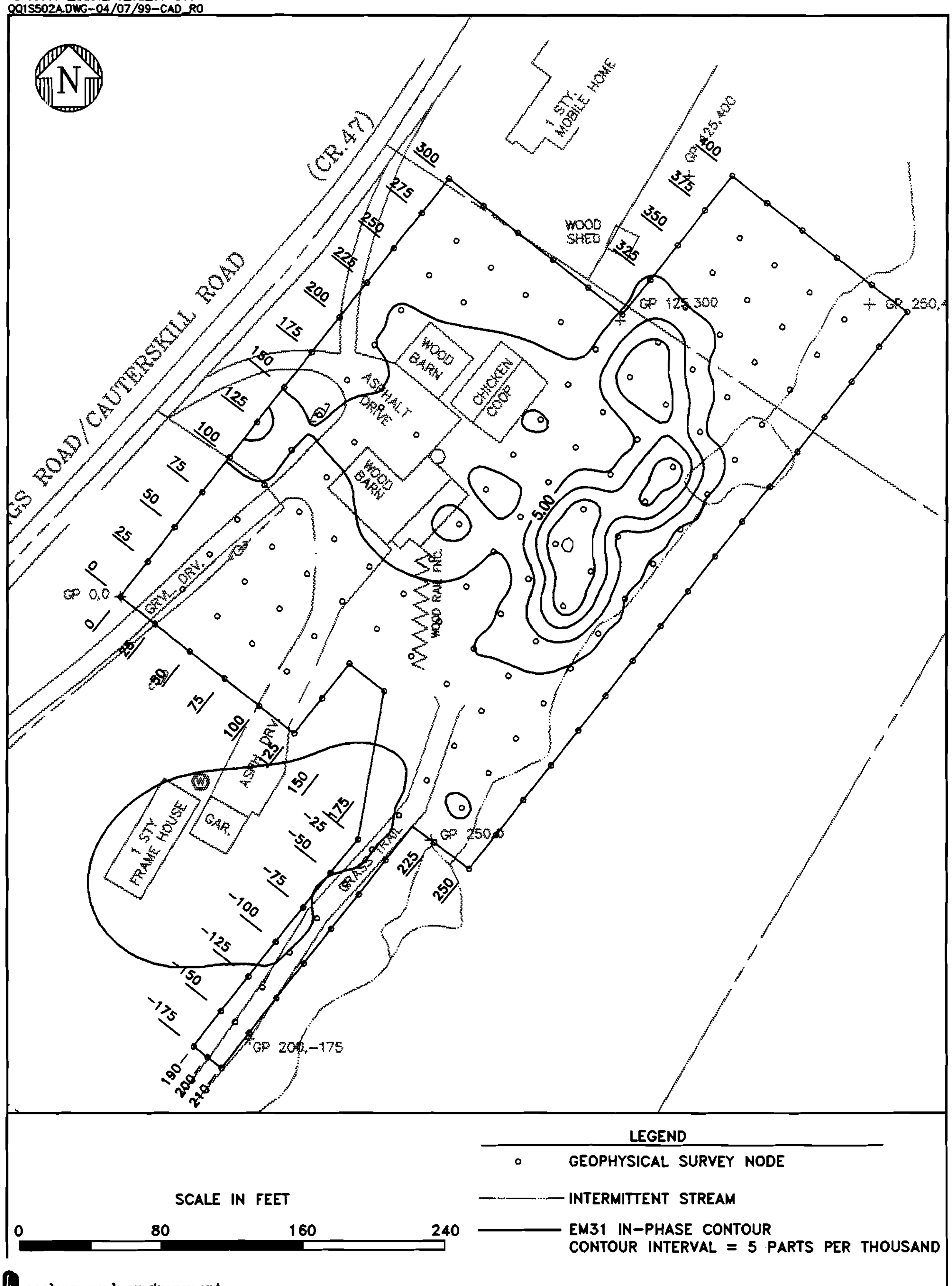

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Figure 5-7
EM31 IN-PHASE
HORIZONTAL DIPOLE 1
CAUTERSKILL ROAD, CATSKILL, NEW YORK

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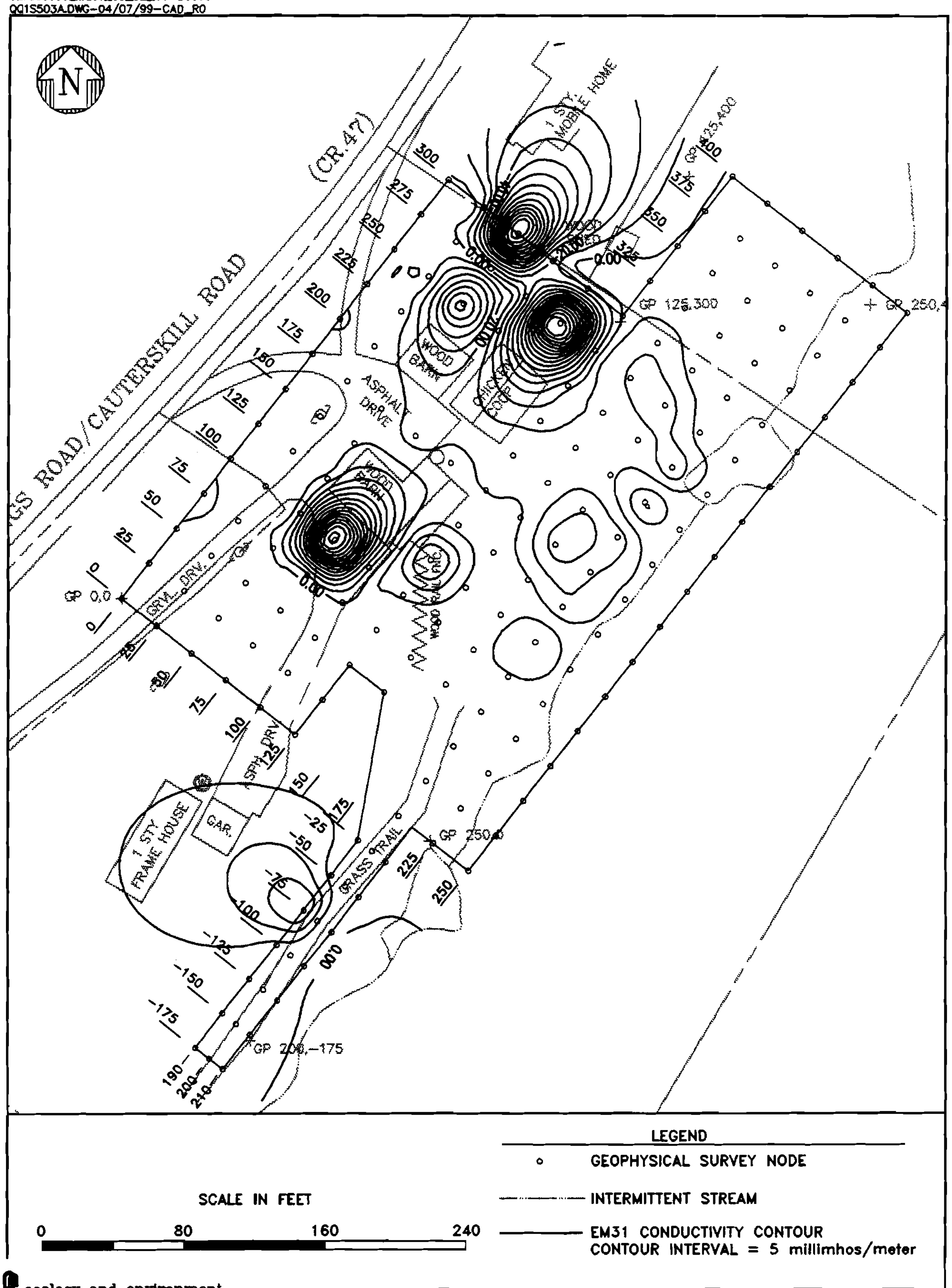

ecology and environment

Figure 5-8
EM31 CONDUCTIVITY
HORIZONTAL DIPOLE 2
CAUTERSKILL ROAD, CATSKILL, NEW YORK

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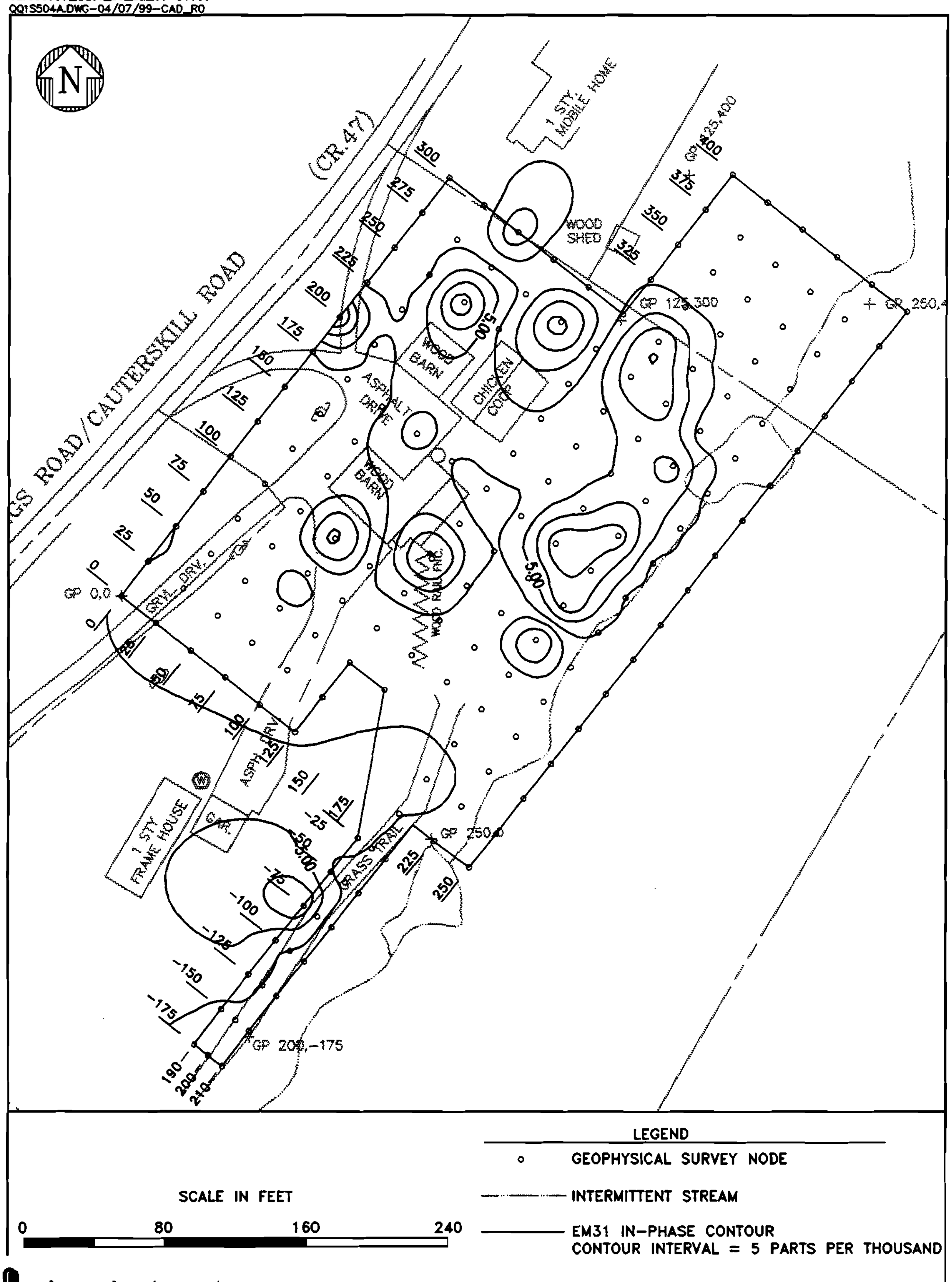

ecology and environment

Figure 5-9
EM31 IN-PHASE
HORIZONTAL DIPOLE 2
CAUTERSKILL ROAD, CATSKILL, NEW YORK

these anomalies are believed to be elongated, small in size, and close to the surface.

The burial area at the site consists of metallic and conductive material within a narrow band (less than 50 feet wide) along the embankment (see Figure 5-10). No other significant burial areas were found. The grass trail in the southeast corner of the site appears to be underlain by bedrock, limiting disposal to surficial dumping on the west side of the road. This was confirmed by test pit excavations (see Section 2.6.1).

5.3 Surface Soil Investigation

Forty-two surface soil samples (CRSS-1 through CRSS-42) were collected at the Cauterskill Road site on December 10 and 11, 1998 (Table 2-2). Additionally, five off-site background surface soil samples (CRSS-BG-1 through CRSS-BG-5) were collected (see Figure 5-11a).

TCL
target compound list

VOCs
volatiles

SVOCs
semivolatiles

PCBs
polychlorinated biphenyls

TAL
target analyte list

TIC
tentatively identified organic compound

μg/kg
micrograms per kilogram

Eight of the 42 on-site surface soil samples and one of the background samples were analyzed for target compound list (TCL) volatiles (VOCs), semivolatiles (SVOCs), pesticides and polychlorinated biphenyls (PCBs), target analyte list (TAL) metals, cyanide, and hexavalent chromium. The remaining samples, thirty-four on-site and four background, were analyzed for seven inorganics, including cadmium, chromium, copper, cyanide, nickel, lead, and zinc. The samples were collected from a depth of 0 to 2 inches BGS along a grid with 25-foot spacings.

Tables 5-1 and 5-2 present summaries of the positive hits for the background and the on-site surface soil sample analyses, respectively.

Volatiles

No volatiles were detected in the background sample (CRSS-BG-1) tested (see Table 5-1).

One VOC, methylene chloride, was detected in three of the eight on-site samples tested at concentrations well below the guidance value (see Table 5-2). Since methylene chloride is a common laboratory contaminant, the low concentrations detected in the on-site soil samples is not considered to be indicative of site conditions.

One volatile tentatively identified organic compound (TIC), 1R-alpha- pinene, was detected in the background sample CR-SS-BG-1 at a concentration of 15 micrograms per kilogram (μg/kg) (see Appendix D). All TIC concentrations are estimated values and there are no specific standards to compare them with. However, total VOCs in the sample, including TICs, did not exceed the guidance value of 10 ppm. Diisoctyl adipate was detected in samples CR-SS-34 and CR-SS-37; an unknown siloxane was detected in CR- SS-27; and a hexadecanoic acid was detected in CR-SS-41. None of the on-site surface soil samples exceeded the guidance value for total VOCs.

Semivolatiles

Five SVOCs were detected in the background sample; none exceeded guidance values (see Table 5-1).

PAH
polycyclic aromatic hydrocarbon

Up to 20 SVOCs were detected in seven of the eight on-site surface soil samples tested (see Table 5-2). All but three (bis[2-ethylhexyl]phthalate, butylbenzylphthalate, and di-n-butylphthalate) of the SVOCs are polycyclic aromatic hydrocarbons (PAHs). Chrysene, fluoranthene, pyrene, and bis(2-ethylhexyl)phthalate were detected in five samples, and acenaphthylene, anthracene, benzo(a)pyrene, benzo(b) fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, indeno(1,2,3-cd)pyrene, phenanthrene, and di-n-butylphthalate were detected in four samples.

Seven of the twenty SVOCs detected were found at concentrations exceeding guidance values. Specifically, the PAHs benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and dibenz(a,h)anthracene were detected above guidance values in sample CRSS-19. CRSS-19 was collected from the base of the disposal area on the west bank of the tributary to Kaaterskill Creek (see Figure 5-11b). Benzo(a)pyrene was also detected above guidance values in samples CRSS-6 (and in the duplicate), CRSS-26, and CRSS-34. Additionally, sample CRSS-34 contained di-n-butylphthalate at a concentration exceeding the regulatory level. CRSS-6 was collected from the base of the disposal area in the northeast corner of the site; CRSS-26 was collected approximately 50 feet south of CRSS-19 along the west bank of the tributary; and CRSS-34 was collected from a stressed vegetation area along the grass trail in the southeast corner of the site (see Figure 5-11b).

Although PAHs were detected in the background sample and are common in urban and suburban areas, the levels of PAHs on site are apparently elevated from disposal of materials at the site.

Thirty-one semivolatile TICs were detected in the background surface soil sample, including four unknown SVOCs, four unknown terpenes, four unknown hydrocarbons, four unknown oxygenated hydrocarbons, two unknown carboxylic acids, straight alkanes, and other SVOCs. A maximum of 31 TICs were also detected in the eight on-site samples analyzed. Some of the TICs detected included unknown SVOCs, unknown hydrocarbons, unknown PAHs, unknown oxygenated hydrocarbons, hexadecanoic, octadecanoic, docosanoic acids, unknown

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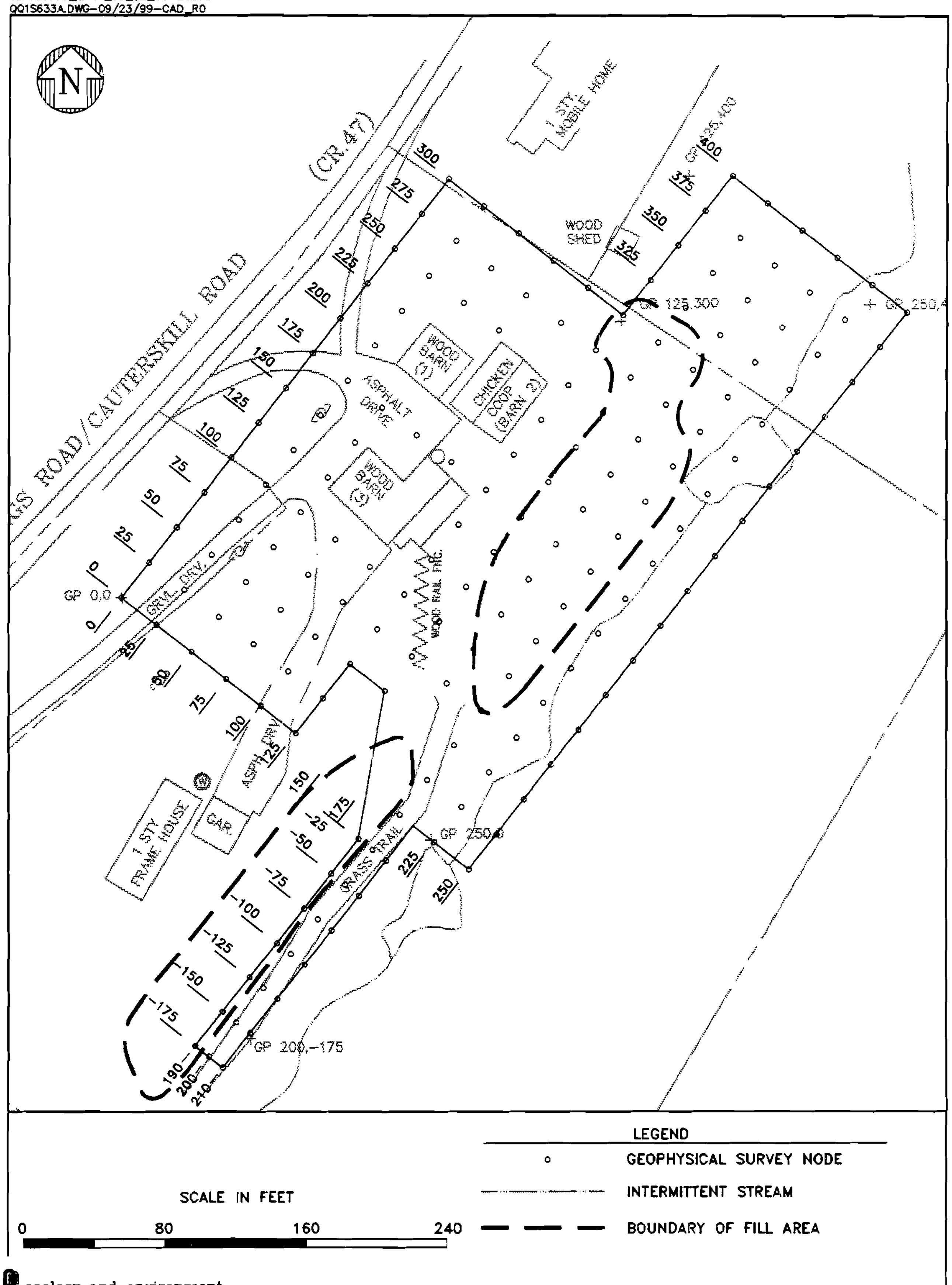

ecology and environment

Figure 5-10
FILL LOCATION MAP BASED ON VISUAL
OBSERVATIONS AND GEOPHYSICAL SURVEY RESULTS
CAUTERSKILL ROAD, CATSKILL, NEW YORK

carboxylic esters, vitamin E, alkanes (straight, cyclic, and branched), and other SVOCs (see Appendix D). None of the TICs exceeded the general guidance value of 50 ppm for individual SVOCs and none of the surface samples exceeded the guidance value of 500 ppm of total SVOCs.

Pesticides and PCBs

No pesticides or PCBs were detected in the background sample (see Table 5-1).

Up to eight pesticides were detected in three of the eight surface soil samples tested (see Table 5-2). The most frequently encountered pesticide was gamma-chlordane, detected in three samples. Other pesticides detected were eldrin, dieldrin, methoxychlor, endrin ketone, alpha-chlordane, heptachlor epoxide, and 4,4'-DDT. No pesticides were detected at concentrations exceeding the guidance values. The pesticides were detected in CRSS-26 (located at the base of the embankment), CRSS-34 (located at a stressed vegetation area on the grass trail in the southeast corner of the site), and CRSS-41 (located in the disposal area on the west side of the grass trail). The source of the pesticides appears to be material disposal. However, the low levels detected, below guidance values, are not of concern.

Two PCBs were detected in five of the eight samples tested; Aroclor 1260 was detected in three samples (CRSS-27, CRSS-34, and CRSS-37) and Aroclor 1254 was detected in two samples (CRSS-11 and CRSS-26). Only aroclor 1260 in CRSS-34 was detected at a concentration (4,900 µg/kg) above the guidance value of 1000 µg/kg for surface soils. As stated above, CRSS-34 was collected from a stressed vegetation area in the southeast corner of the site (see Figure 5-11).

Since no PCBs were detected in the background sample, and PCBs were detected from a stressed vegetation area, the source of the PCBs is apparently from the on-site disposal.

Inorganics

Several metals were detected in the surface soils. Since many of these metals are naturally occurring, it is difficult to distinguish between naturally occurring levels and those elevated from on-site disposal practices. As discussed above, the guidance values for metals are typically based on background concentrations. The site background values listed in Table 5-2 represent twice the arithmetic mean of the background sample results (see also Table 5-1). Twenty-one metals were detected in the background samples.

Up to 20 distinct inorganic analytes were detected in the samples tested (see Table 5-2). Five of these inorganic analytes (chromium, copper, lead, nickel, and zinc) were detected in all the samples;

cadmium was detected in 35 samples; cyanide was detected in 25 samples; and the remaining 13 metals were detected in the nine samples that were analyzed for TAL metals. No hexavalent chromium was found in any of the surface soil samples.

Nine metals (cadmium, chromium, copper, iron, lead, magnesium, mercury, nickel, and zinc) were detected above background-based guidance values (see Section 5.1). Of the 42 samples tested, chromium was detected at concentrations exceeding screening values in 13 samples, copper in 12, chromium and zinc in 11, nickel in eight, and lead in five. Additionally, out of the nine samples that were analyzed for TAL metals, magnesium exceeded guidance values in eight samples, iron in three, and mercury in one. Cyanide was detected in 22 samples at concentrations ranging from non-detect (ND) to 48.5 μg/kg. However, there is no cleanup criterion available for cyanide. The level of cyanide in the background samples ranged from ND to 13.9 mg/kg.

ND
non-detect

Iron and magnesium are naturally occurring components of the soils and underlying rock. Therefore, these metals are not of concern. However, cadmium was detected at levels up to approximately nine times the guidance value; chromium levels were up to 35 times the guidance; copper levels were up to 77 times the guidance; in one of the samples, the lead level was as high as 6.5 times the guidance; the mercury concentration in one sample was 2.5 times above the guidance; nickel levels were up to 139 times the guidance; and zinc levels were up to 19 times the guidance. Samples with multiple high exceedances include CRSS-20, CRSS-25, CRSS-34, CRSS-37, CRSS 39, and CRSS-41 (see Table 5-2). In general, the high exceedances occurred in samples collected north of Barn 1; northeast and east of the chicken coop; inside, under the overhang, and to the east of Barn 3; at the stressed vegetation area on the grass trail; and from the disposal area on the west side of the grass trail in the southeast corner of the site. Figure 5-11b presents metal concentrations exceeding the guidance value and cyanide detections.

5.4 Subsurface Soil Investigation

Subsurface soil sampling was conducted in two phases: test pit excavations and monitoring well installations. A description of the analytical data of these activities is described below, and a summary of the positive hits is presented in Table 5-3.

5.4.1 Test Pit Excavations

Ten test pits (CRTP-1 through CRTP-10) were excavated during the January field activities to characterize the subsurface soils and delineate the fill area. A total of 11 soil samples, one each from test pits CRTP-2 through CRTP-7, and CRTP-10; and two from pits CRTP-8 and CRTP-9, were collected. No samples were collected from CRTP-1 because there was no visible evidence of

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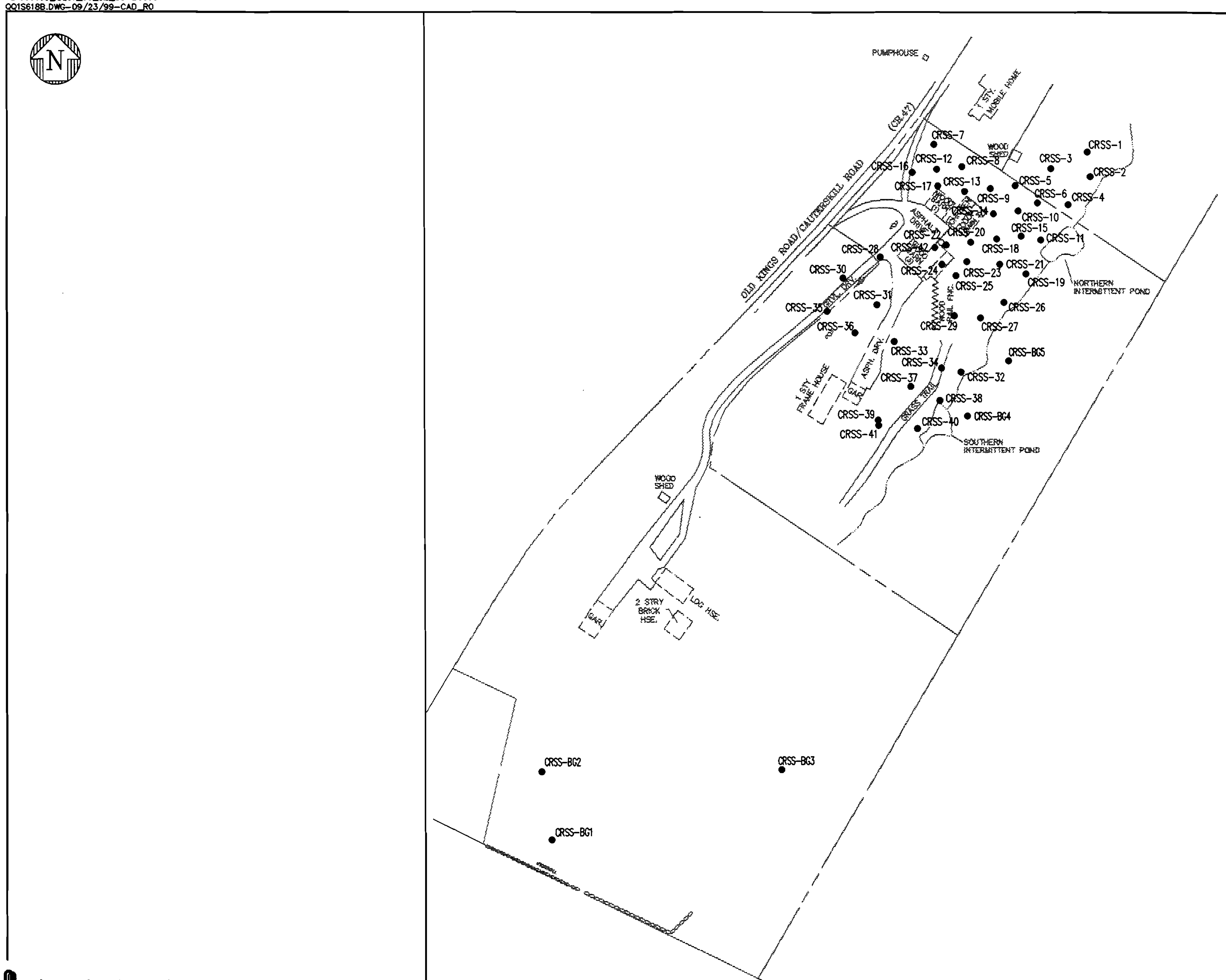

LEGEND	
CRSS-17 •	SURFACE SOIL SAMPLE LOCATION
CRSS-BG1 •	SURFACE SOIL BACKGROUND SAMPLE LOCATION

SCALE IN FEET

0 150 300 450

ecology and environment

Figure 5-11a SURFACE SOIL SAMPLE AND BACKGROUND SAMPLE LOCATIONS CAUTERSKILL ROAD CATSKILL, NEW YORK

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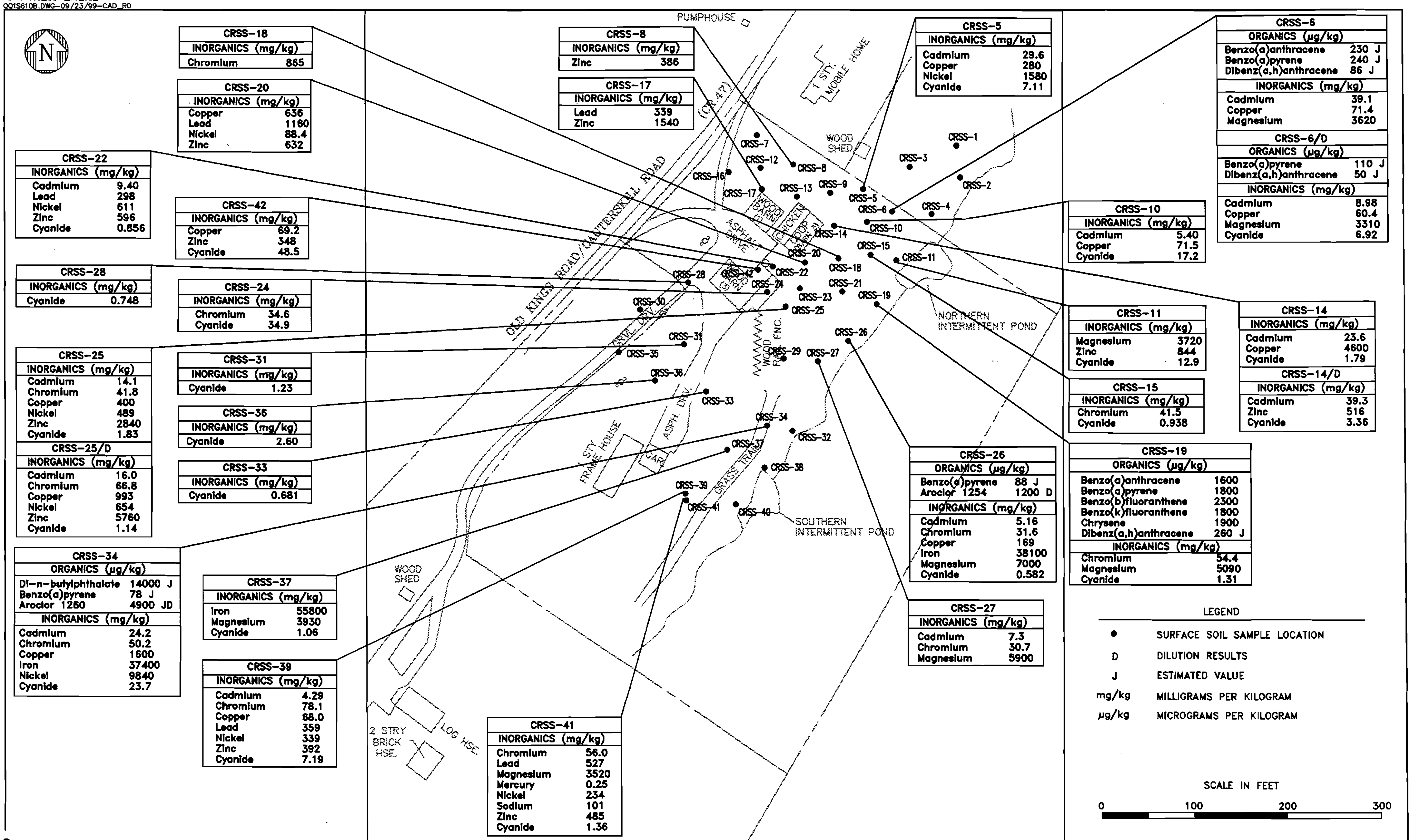

Figure 5-11b SURFACE SOIL SAMPLE RESULTS EXCEEDING SCREENING CRITERIA
CAUTERSKILL ROAD
CATSKILL, NEW YORK

disposal at this location. Sample depth, description, and analyses are provided in Table 2-4. All test pit samples were analyzed for TCL VOCs, TCL SVOCs, TCL pesticides and PCBs, TAL metals, cyanide, and hexavalent chromium

Volatiles

Acetone, the only VOC found in the test pit subsurface soil samples, was detected in sample CRTP-9-2, below its guidance value at a concentration of 86 μg/kg (see Table 5-3). Although acetone is a common laboratory contaminant, this sample was a composite from three buried vats, one of which contained automobile parts. Therefore, it is possible that the acetone was used for parts cleaning.

One volatile TIC, an unknown siloxane, was detected in test pit sample CRTP-4 at a concentration of 8 μg/kg (see Appendix D) The unknown is most likely from glassware. None of the test pit soil samples exceeded the 10 ppm guidance value for total volatiles.

Semivolatiles

Up to 24 SVOCs were detected in six of the 11 test pit soil samples (see Table 5-3). Twenty of the detected SVOCs were PAHs detected in three samples, and four were phthalates detected in seven samples.

Six of the twenty PAHs detected were found at concentrations exceeding guidance values. Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and dibenz(a,h)anthracene were detected above guidance values in sample CRTP-7. CRTP-7 was excavated from the middle of the backyard east of the chicken coop at an alleged burn pit area (see Figure 5-12). Concentrations of benzo(a)anthracene, benzo(a)pyrene, dibenz(a,h)anthracene, and chrysene also exceeded guidance values in samples CRTP-9-2 and CRTP-10. Test pit CRTP-9 was excavated near the brush line on the east side of the site, CRTP-9-02 was a composite sludge sample collected from three vats found in the west end of the test pit. CRTP10 was collected from the north end of site near the tree-line (see Figure 5-12).

The levels of PAHs detected in the subsurface soil samples collected from the test pits are significantly higher than the background surface sample levels, and are apparently due to materials disposed of or buried at the site.

At least one semivolatile TIC was detected in each test pit soil sample. Thirty-one TICs were detected in samples CR-TR07, CR-TP9-2, and CRTP-10; 30 TICS were found in samples CRTP-3 and CRTP-5. The TICS found in the test pit samples include unknown SVOCs; unknown hydrocarbons, unknown PAHs, unknown oxygenated and unknown chlorinated hydrocarbons; unknown aromatics; unknown oxygenated PAHs; alkanes (straight and branched); phenylacetic and benzeacetic acids; benzonaphthofuran and benzonaphthothiophene isomers; and anhydrite (see Appendix D). No SVOCs, including the TICs, exceeded the general guidance value of 50 ppm for individual compounds and none of the test pit samples exceeded the 500 ppm guidance value for total SVOCs.

Pesticides and PCBs

Up to six pesticides were detected in three of the 11 test pit subsurface soil samples tested (see Table 5-3). Aldrin, endrin ketone, methoxychlor, gamma-chlordane, and heptachlor epoxide were detected in CRTP-7; endrin was detected in the duplicate sample collected from TP03; and heptachlor epoxide was detected in TP09-2.

Heptachlor epoxide was detected in sample CRTP-7 at a concentration of 87 μg/kg which exceeds the guidance value of 20 μg/kg (see Figure 5-12). No other pesticides exceeded guidance values. Pesticide contamination is apparently due to disposal.

Sample TP03/D (duplicate of sample TP03) contained the only PCB, Aroclor 1260 (see Table 5-3). The PCB concentration of 310 μg/kg was below the guidance value for subsurface soils of 10,000 μg/kg.

Inorganics

Up to 23 metals were detected in the 11 test pit soil samples (see Table 5-3). Eighteen of these metals (aluminum, antimony, arsenic, barium, beryllium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, selenium, thallium, vanadium, and zinc) were detected in all the samples; calcium was detected in 10 samples; cadmium was detected in eight samples; silver was detected in seven samples; sodium was detected in four samples; and mercury was detected in one sample. No hexavalent chromium was found in any of the test pit soil samples. Cyanide was also detected in eight samples at concentrations ranging from 0.46 to 7.7 mg/kg.

Fourteen metals (aluminum, cadmium, calcium, chromium, copper, iron, magnesium, mercury, nickel, potassium, selenium, silver, sodium, and thallium) were detected above background-based guidance values. Thallium was detected at concentrations above guidance values in all 11 test pit samples; selenium exceeded guidance values in 10 of the 11 samples; magnesium exceeded guidance values in eight samples; silver exceeded guidance values in six samples; and chromium exceeded guidance values in three

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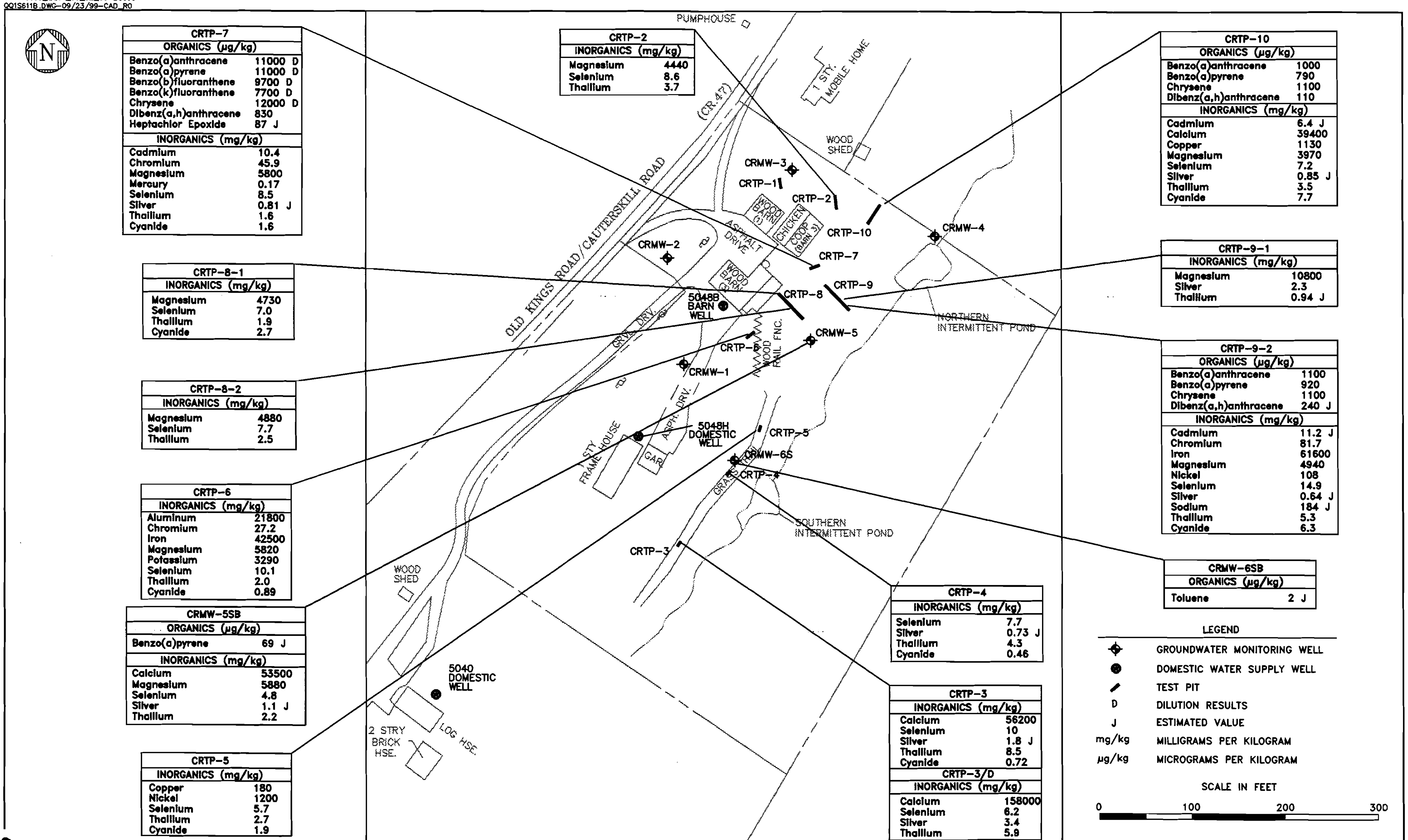

ecology and environment

Figure 5-12 SUBSURFACE SOIL SAMPLE RESULTS EXCEEDING SCREENING CRITERIA CAUTERSKILL ROAD CATSKILL, NEW YORK samples. Additionally, cadmium was detected above guidance values in three samples; calcium, copper, iron, and nickel concentrations exceeded guidance values in two samples; and aluminum, mercury, potassium, and sodium concentrations exceeded guidance values in one sample.

Iron and magnesium are naturally occurring components of the soils and underlying rock. Therefore, these metals are not of concern. However, copper was detected up to 19 times the guidance value; the nickel concentration in one of the samples was 17 times greater than the guidance; thallium was detected up to eleven times above the guidance; silver was detected up to seven times above the guidance; selenium was found at concentrations approximately four times above the guidance; chromium concentrations were up to three times above the guidance; cadmium was detected at levels 2.7 times above the guidance; mercury and aluminum were detected in one sample each at a concentration exceeding the guidance by 1.7; and calcium, potassium, and sodium concentrations were only slightly (less than 1.5 times) above the guidance value. Samples with multiple high exceedances include CRTP-9-2, CRTP-3, CRTP-7, and CRTP-10 (see Table 5-3 and Figure 5-12). In general, levels of inorganics in the test pit samples were below the levels detected in the surface soil samples. Figure 5-12 presents metals concentrations exceeding guidance values and cyanide detections (no guidance values for cyanide).

5.4.2 Monitoring Well Borehole Sampling

Only two subsurface soil samples (CRMW-5SB and CRMW-6SB) were collected from the six monitoring well boreholes because of the shallow nature of the bedrock and poor split-spoon recovery. Sample CRMW-5SB was analyzed for TCL VOCs, TCL SVOCs, TCL pesticides, and PCBs, TAL metals, cyanide, and hexavalent chromium; however, sample CRMW-6SB, due to poor recovery, was analyzed only for volatiles (see Table 2-6).

Volatiles

Toluene, the only VOC in the borehole subsurface soil samples, was detected in sample CRMW-6SB at an estimated concentration of 2 μg/kg, which is slightly above its guidance value of 1.5 μg/kg (see Table 5-3). Toluene was not detected in any of the other soil samples including background samples. CRMW-6 is located along the grass trail at the base of the hill between the creek and the 5048 residence (see Figure 5-12). The sample was collected from 4 to 5 feet BGS.

Two unknown volatiles, one a hydrocarbon, were detected in sample CRMW-5SB (see Appendix D). No TICs were detected in sample CRMW-6SB. The guidance value of 10 ppm of total volatiles was not exceeded for either sample.

Semivolatiles

Twelve SVOCs, including 11 PAHs, were detected in subsurface soil sample CRMW-5SB (see Table 5-3). Only five of the SVOCs detected in this sample were also found in the background sample.

Benzo(a)pyrene was detected at an estimated concentration of 69 μg/kg, slightly above its guidance value of 61 μg/kg. The remaining 11 SVOCs, including acenaphthylene, anthracene, chrysene, fluoranthene, pyrene, phenanthrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, and indeno(1,2,3-cd)pyrene, were detected at concentrations well below guidance values. Well CRMW-5 is located east of Barn 3, near the edge of the fill area (see Figure 5-12) The sample was collected from the 2- to 6-foot BGS interval.

The levels of PAHs detected in the borehole subsurface soil sample are significantly higher than the background surface sample levels, apparently due to materials disposed of or buried at the site.

Four TICs (three unknowns and one unknown hydrocarbon) were detected in sample CRMW-5SB (see Appendix E). No SVOCs, including the TICS, exceeded the general guidance value of 50 ppm for individual SVOCs, and none of the samples exceeded the guidance value of 500 ppm for total SVOCs.

Pesticides and PCBs

No pesticides or PCBs were detected in the borehole soil samples.

Inorganics

Twenty-two metals were detected in the borehole subsurface soil sample (see Table 5-3). No hexavalent chromium was found in the sample.

Five of these metals (calcium, magnesium, selenium, silver, and thallium) were detected at concentrations above their guidance values. The same metals were also detected above guidance values in the test pit samples (see Figure 5-12 and Table 5-3).

Calcium and magnesium are naturally occurring components in the soils and underlying rock. Therefore, these metals are not of concern. However, thallium was detected at concentrations 4.6 times above the guidance value; silver was detected 2.3 times above the guidance; and selenium was detected 1.3 times above its guidance.

5.5 Groundwater Investigation

Groundwater samples were collected from six new monitoring wells (CRMW-1 through CRMW-6D) and four existing residential wells (CRGW-5040, CRGW-5048B, CRGW-5048H, and CRGW-5056). All the groundwater samples were analyzed for

TCL VOCs, TCL SVOCs, TCL pesticides and PCBs, TAL metals, cyanide, and hexavalent chromium. Well descriptions and sample date, analyses, and field chemistry measurements are summarized in Table 2-10. A summary of the positive analytical results for all the groundwater samples is presented in Table 5-4.

5.5.1 Monitoring Well Sampling

The six new monitoring wells were sampled following purging of at least three well volumes (see Section 2.7.3). Table 2-9 presents well construction summaries for the new monitoring wells, including total well depths, and Table 3-1 presents water level measurements.

Volatiles

Only one VOC, toluene, was found in one groundwater sample CRMW-3 (see Table 5-4). Toluene was detected at an estimated concentration of 1 μg/L well below the Class GA groundwater standard of 5 μg/L (June 1998). Toluene was not detected in any of the other groundwater samples or in any of the surface soil samples collected from the site; it was, however, detected in subsurface soil sample CRMW-6SB (see Tables 5-1 through 5-4). Due to its isolated occurrence and its low detection, toluene is not considered to be of concern.

Two volatile TICs, butylbenzene isomer and eucalyptol, were detected in groundwater sample CRMW-5 at a total estimated concentration of 28 μg/L (see Appendix E). No standards are available for comparison with groundwater TIC detection values.

Semivolatiles

Low concentrations of four SVOCs were detected in four of the six newly installed monitoring wells (see Table 5-4). Bis(2-ethylhexyl)phthalate was detected in groundwater samples CRMW-2, CRMW-3, and CRMW-5 at estimated concentrations ranging from 2 to 5 μg/L; di-n-butylphthalate was detected in wells CRMW-3 and CRMW-5; butylbenzylphthalate was detected in sample CRMW-3; and n-nitrosodiphenylamine was detected in sample CRMW-2. None of the SVOCs detected in the monitoring well groundwater samples exceeded the groundwater standards. Although these phthalates were also detected in some of the soil samples, because of the low concentrations, they are not considered to be of concern in the groundwater samples.

Semivolatile TICs, including a number of unknown SVOCs, some unknown hydrocarbons and unknown oxygenated hydrocarbons, caprolactam, 1-methoxy-4-(2-propenyl)benzene, a phenol, straight alkanes, and 1,8-diaza-2,9-diketocyclotetradecane, were detected in the groundwater samples collected from the monitoring wells (see Appendix D). Six TICs were detected in sample CRMW-1 at a total concentration of 267 μg/L; 18 TICs were detected in

CRMW-2 at a total estimated concentration of 1,266 μg/L; 12 TICs were detected in CRMW-3 at a total estimated concentration of 359 μg/L; four TICs were detected in CRMW-4 at a total estimated concentration of 28 μg/L; 22 TICs were detected in CRMW-5 at a total estimated concentration of 1,392 μg/L; and 10 TICs were detected in CRMW-6D at a total estimated concentration of 693 μg/L. No standards are available for comparison with groundwater TIC detection values.

Pesticides and PCBs
No pesticides or PCBs were detected in the groundwater samples collected from the monitoring wells (see Table 5-4).

Inorganics
Nineteen inorganics were detected in the monitoring well groundwater samples (see Table 5-4). Eight of these metals (barium, calcium, iron, magnesium, manganese, nickel, potassium, and sodium) were detected in all the groundwater samples; zinc and silver were detected in five of the six samples; chromium was detected in four samples; aluminum, cobalt, lead, and vanadium were detected in three samples; arsenic was detected in two samples; and cadmium, thallium, and cyanide were detected in one sample.

Hexavalent chromium was detected in sample CRMW-5 at its groundwater standard concentration of 50 μg/L. No hexavalent chromium was detected in any of the soils or the other groundwater samples. Cyanide was detected below the groundwater standard in sample CRMW-5; cyanide was not detected in the subsurface soil sample collected from the borehole for this well.

Three metals (iron, sodium, and thallium) were detected in the monitoring well samples at concentrations exceeding the groundwater standards (see Table 5-4 and Figure 5-13). Iron is a naturally occurring component of the surrounding soil and rock; therefore, it is not of concern. However, sodium exceeded its groundwater standard in four of the six samples (CRMW-1, CRMW-3, CRMW-5, and CRMW-6D) with the highest concentration four times above the standard; and thallium exceeded the standard in sample CRMW-1 at a concentration approximately 10 times the standard. Thallium was not detected in any of the surface soil samples. It was, however, detected above guidance values in all the subsurface soil samples tested.

5.5.2 Residential Well Sampling
Four existing residential wells (5040, 5048B, 5048H, and 5056) were sampled. The residential wells were purged prior to sampling as described in Section 2.7.3. Well 5048B has a total measured depth of 179 feet BGS, 5048H was measured to be greater than

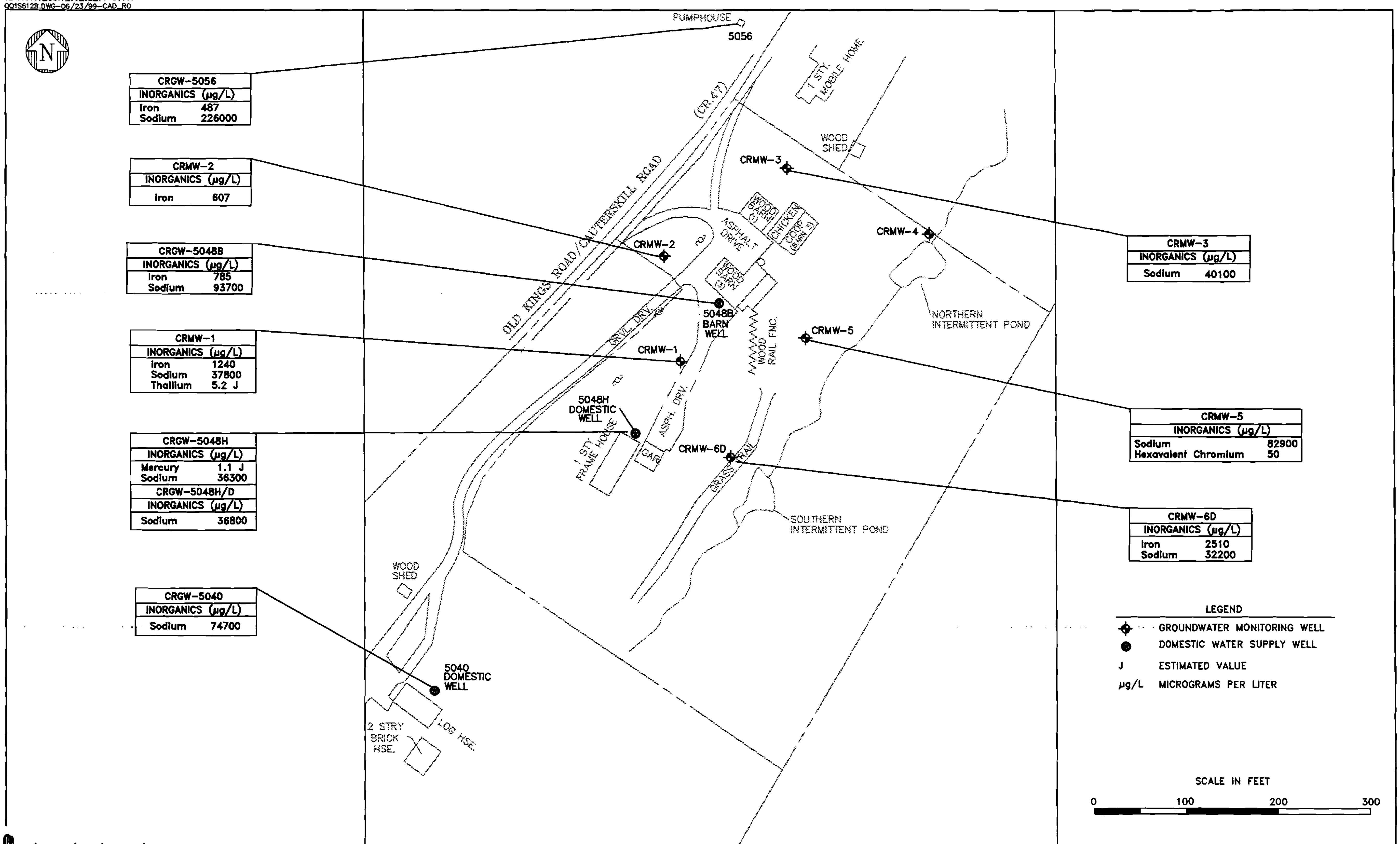

Figure 5-13 GROUNDWATER SAMPLE RESULTS EXCEEDING SCREENING CRITERIA CAUTERSKILL ROAD CATSKILL, NEW YORK

100 feet from TOIC, and the depth of the other two wells is unknown.

Volatiles

Only one VOC, trichloroethene, was found in the groundwater samples collected from the residential wells (see Table 5-4). Trichloroethene was detected in groundwater sample CRGW-5048B at an estimated concentration (2 μg/L) below the groundwater standard of 5 μg/L. Residential well 5048B is located south of Barn 3 (see Figure 5-13). Trichloroethene was not detected in any of the other groundwater samples or in any the soil samples collected from the site. Therefore, the presence of this volatile in the deep groundwater sample is not considered to be due to waste disposal.

No volatile TICs were detected in the residential well samples (see Appendix D).

Semivolatiles

Only one SVOC, bis(2-ethylhexyl)phthalate, was found in the residential groundwater samples (see Table 5-4). Bis(2-ethylhexyl)phthalate was detected in groundwater sample CRGW-5056 at an estimated concentration (2 μg/L) below the groundwater standard of 5 μg/L. Well 5056 is located northwest of the site (see Figure 5-13). Bis(2-ethylhexyl)phthalate was not detected in any of the other groundwater samples (from both monitoring and residential wells); it was detected, however, in some of the soil samples and in the groundwater samples collected from the new wells. Phthalates are common field/laboratory contaminants that result from the use of protective gloves. Therefore, the low concentration of bis(2-ethylhexyl)phthalate is not considered to be of concern.

Up to six semivolatile TICs were detected in three of the four residential wells (see Appendix D). Five unknown SVOCs at a total estimated concentration of 1,227 μg/L and one unknown oxygenated hydrocarbon at an estimated concentration of 7 μg/L were detected in sample CRGW-5040; two unknown semivolatiles at a total estimated concentration of 16 μg/L and one unknown oxygenated hydrocarbon at an estimated concentration of 15 μg/L were detected in CRGW-5048B; and five unknown semivolatiles were detected in CRGW-5056 at a total estimated concentration of 42 μg/L. The source of these TICs is unknown.

Pesticides and PCBs

No pesticides or PCBs were detected in the groundwater samples collected from the residential wells (see Table 5-4).

Inorganics

Sixteen metals were detected in the four residential well groundwater samples (see Table 5-4). Eight of these metals (barium, calcium, iron, magnesium, manganese, potassium, sodium, and zinc) were detected in all the samples; lead and nickel were detected in three samples; copper and silver were detected in two samples; aluminum, chromium, mercury, and vanadium were detected in one sample. No cyanide or hexavalent chromium were found in any of the residential groundwater samples.

Three metals (iron, mercury, and sodium) were detected above groundwater standards (see Figure 5-13). Sodium exceeded the standard in all four samples; iron exceeded the standard in two samples (CRGW-5048B and CRGW-5056); and mercury exceeded the standard in one sample (CRGW-5048H). Iron is a naturally occurring component in the surrounding soils and rock therefore, it is not of concern. However, sodium was detected in CRGW-5056 at a level of 113 times above the standard, and the concentration of mercury in CRGW-5048H was 1.6 times greater than the standard. The source of mercury is unknown. Although mercury was detected in surface soil sample CRSS-41 from the tire dump area downgradient of the 5048 residence, no mercury was detected in any of the new shallower wells. Since the residential well is very deep (>100 feet), and no mercury was detected in the new shallow wells, the mercury in the residential well is not believed to be site related.

5.6 Surface Water and Sediment Investigation

Eleven surface water samples were collected along the tributary to Kaaterskill Creek (on the eastern side of the site). A sediment sample was collected at the same general location as each surface water except for CRSW/SD-6. CRSW-6 was collected at a seep at the toe of the fill area approximately 30 feet southwest of CRSD-6 (see Figure 5-14a). Surface water sample CRSW-10 was not collected due to dry conditions at the time of sampling. A sediment was collected from this location. Sample date, description, locations, and analyses are provided in Table 2-12.

5.6.1 Surface Water Sampling

Surface water samples CRSW-1, CRSW-3, CRSW-6, and CRSW-9 were analyzed for TCL VOCs, TCL SVOCs, TCL pesticides and PCBs, TAL metals, hexavalent chromium, cyanide, and hardness; surface water samples CRSW-2, CRSW-4, CRSW-5, CRSW-7, CRSW-8, and CRSW-9; and CRSW-11 and CRSW-12 were tested for PAHs, Pest/PCBs, TAL metals, hexavalent chromium, cyanide, and hardness (see Table 5-12). Field chemistry measurements of pH, temperature, conductivity, and turbidity are summarized in Table 2-11. The positive analytical results for the surface water samples are summarized in Table 5-5.

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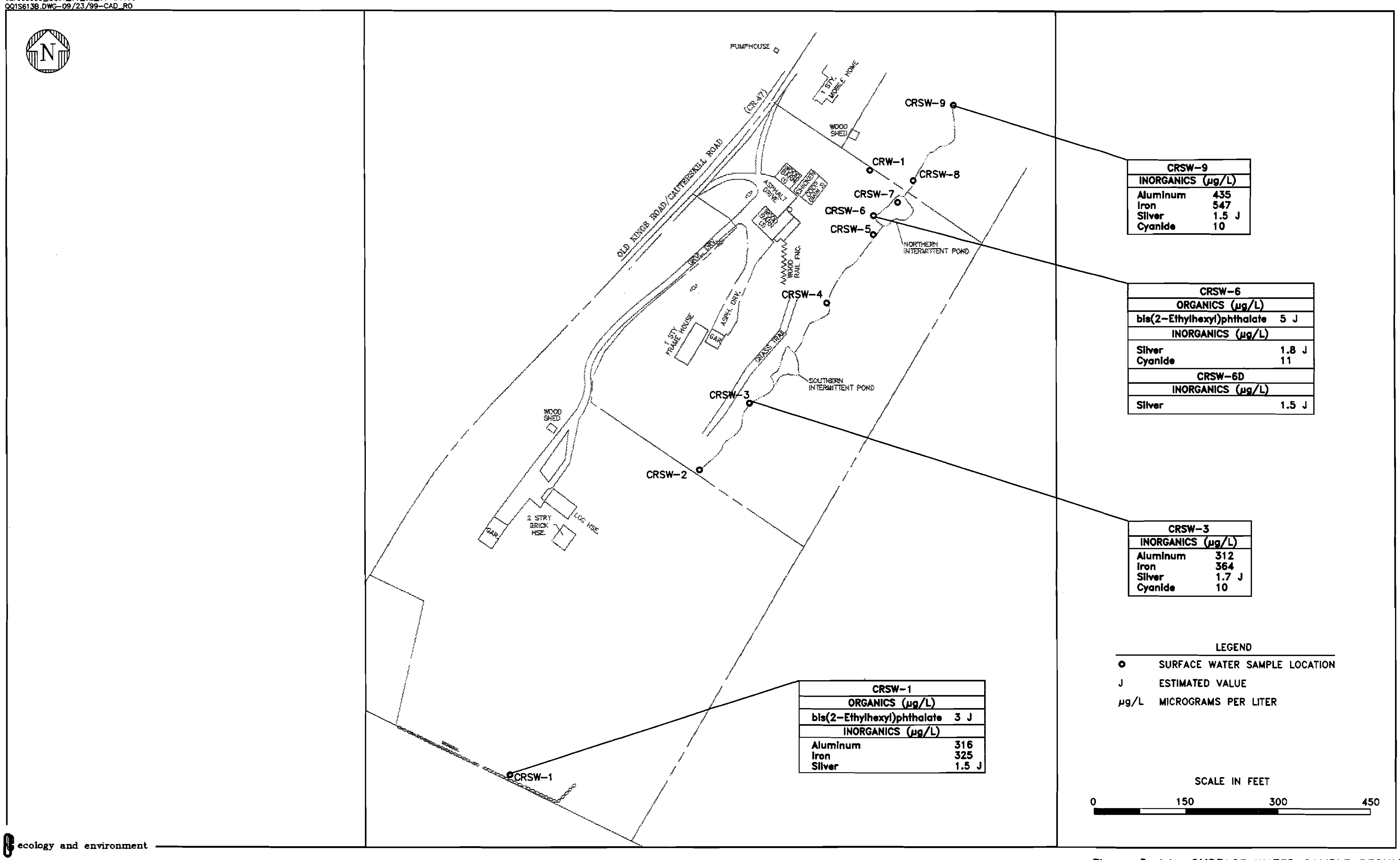

Figure 5-14a SURFACE WATER SAMPLE RESULTS EXCEEDING SCREENING CRITERIA (PHASE I RI)
CAUTERSKILL ROAD
CATSKILL, NEW YORK

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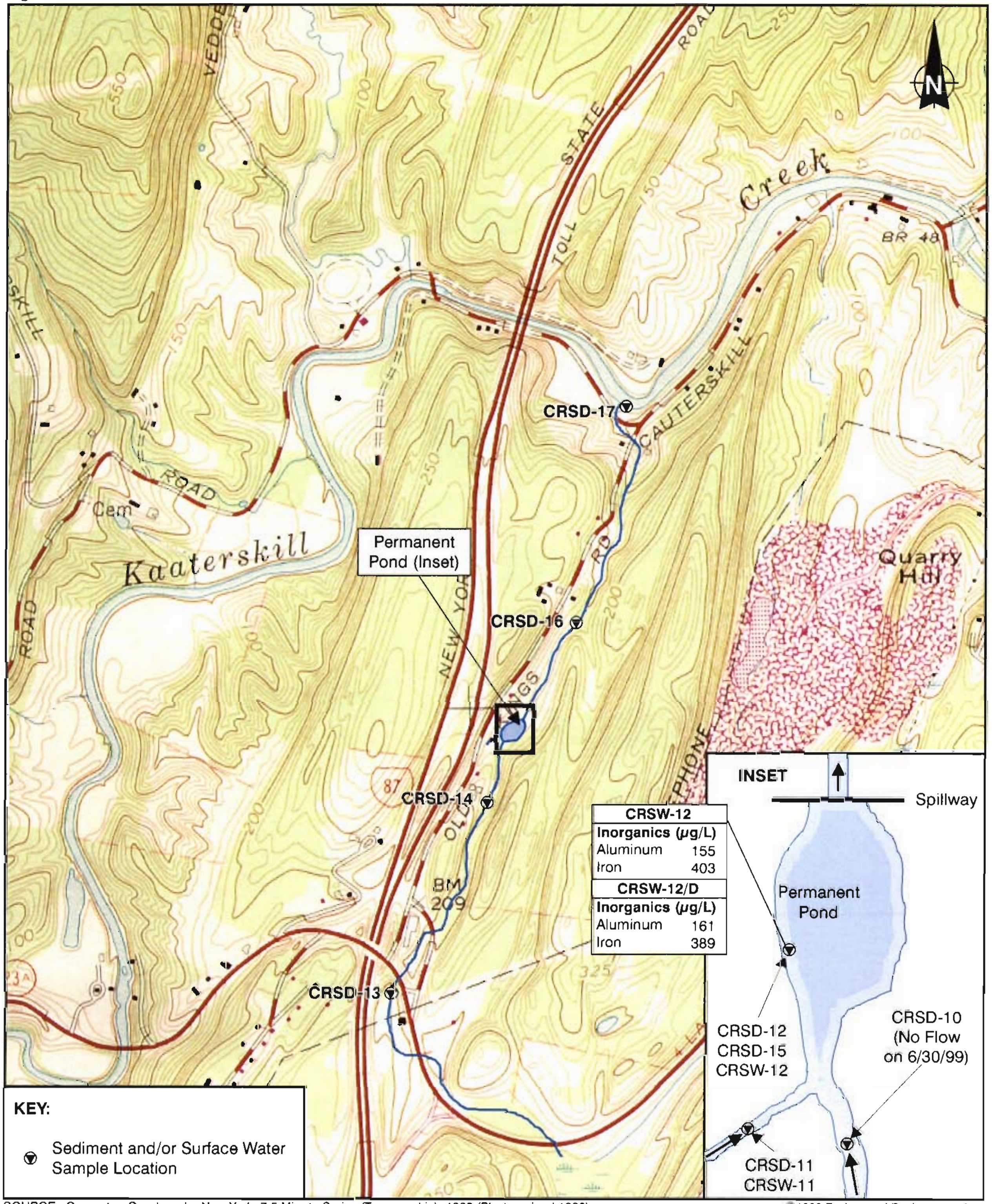


SOURCE: Cementon Quadrangle, New York, 7.5 Minute Series (Topographic), 1963 (Photorevised 1980).

APPROXIMATE SCALE

0 ¼ ½ Mile

0 0.25 0.5 Kilometer

Figure 5-14B SURFACE WATER SAMPLE RESULTS EXCEEDING SCREENING CRITERIA (PHASE II RI)
CAUTERSKILL ROAD
CATSKILL, NEW YORK

Volatiles

No VOCs and volatile TICs were detected in the four surface water samples tested for these parameters (see Table 5-5 and Appendix D).

Semivolatiles

Two SVOCs, butylbenzylphthalate and bis(2-ethylhexyl)phthalate, were detected in the surface water samples tested for these parameters (see Table 5-5). Butylbenzylphthalate was detected in sample CRSW-6 at a concentration of 1 μg/L; no standard is available for this phthalate. Bis(2-ethylhexyl)phthalate was detected in two of the four samples tested, CRSW-1 and CRSW-6/D (duplicate of CRSW-6), at concentrations (3 μg/L and 5 μg/L respectively) above the Class C ambient water standard of 0.6 μg/L (June 1998). CRSW-1 was collected from a location upstream of the site and CRSW-6 was collected from a seep upstream of the north site pond. Bis(2-ethylhexyl)phthalate was also detected below its standard in four groundwater samples and in most of the soil samples tested. Since phthalates are common field and laboratory contaminants, the low levels detected in the surface water samples are not of concern.

In Phase II, low level PAHs were detected in the surface waters, but the compounds also were present in the laboratory method blank. The laboratory re-analyzed the samples and no PAH compounds were found.

No semivolatile TICs were detected in the four surface water samples tested (see Appendix D).

Pesticides and PCBs

No pesticides or PCBs were detected in the surface water samples tested (see Table 5-5).

Inorganics

A total of 16 inorganics were detected in the surface water samples (see Table 5-5). All 11 samples were analyzed for cadmium, chromium, copper, lead, nickel, zinc, and cyanide. Nickel was detected in five of the 11 samples; zinc was detected in four samples; cyanide was detected in two samples; and lead was detected in one sample. In addition to these inorganic analytes, six of the samples (CRSW-1, CRSW-3, CRSW-6, CRSW-9, CRSW-11, and CRSW-12) were also analyzed hexavalent chromium and for the remaining metals included in the TAL metals scan. Aluminum, calcium, iron, magnesium, manganese, potassium, and sodium were detected in all six samples; barium was detected in five samples; silver was detected in four samples; vanadium was detected in two samples; and antimony and hexavalent chromium were detected in one sample.

Four inorganics (aluminum, iron, silver, and cyanide) were detected above Class C ambient water standards (see Table 5-5). Aluminum, iron, and silver levels exceeded standards in samples CRSW-1, CRSW-3, and CRSW-9.

Aluminum and iron also exceeded standards in CRSW-12 and CRSW-12D, and silver also exceeded standards in CRSW-6 and CRSW-6D. Cyanide concentration exceeded the standard in CRSW-3, CRSW-6, and CRSW-9 (see Figure 5-14a). However, cyanide was not detected in the duplicate of CRSW-6 (CRSW-6/D). Iron is a naturally occurring component of the watershed soils and rocks; therefore, it is not of concern. However, aluminum concentrations exceeded the standard up to four times; silver levels were more than 100 times above the standard; and cyanide concentrations were approximately two times greater than the standard. The exceedances, with the exception of seep sample CRSW-6, were detected in samples collected from areas where the water was ponded. Cyanide was also detected in the soil samples, including background samples, and in groundwater sample CRMW-5; silver was also detected in a number of soil samples, in some cases above background, and in seven of the 10 groundwater samples.

5.6.2 Sediment Sampling

Sediment samples CRSD-1, CRSD-3, CRSD-6, and CRSD-9 were analyzed for TCL VOCs, TCL SVOCs, TCL pesticides and PCBs, TAL metals, hexavalent chromium, cyanide, and total organic carbon (TOC); sediment samples CRSD-2, CRSD-4, CRSD-5, CRSD-7, and CRSD-8 were only tested for cadmium, copper, chromium, nickel, lead, zinc, cyanide, hexavalent chromium, and TOC and sediment samples CRSD-10 through CRSD-17 were analyzed for PAHs, Pest/PCBs, TAL metals, hexavalent chromium, cyanide, and TOC. Additionally, as part of the ecological risk assessment (see Section 6), CRSD-13 through CRSD-17 were analyzed for Hyalella azteca, acid volatile sulfides (AVS), and simultaneously extracted metals (SEM) (Cd, Cu, Pb, Ni, and Zn) (see Table 5-12). Positive analytical results for the sediment samples are summarized in Tables 5-6a (organic compounds) and 5-6b (inorganic analytes). Sediment sample CRSD-9 was re-sampled (CRSD-9R) at the request of the ASC due to suspect detection of the PCB Aroclor 1260. The results of the analysis of sample CRSD-9R were used. Sediment samples CRSD-1 through CRSD-9 (except CRSD-6) were also resampled (CRSD-1R through CRSD-9R2) for TOC at the request of the ASC because TOC analysis was inadvertently left off the list of requested analysis on the chain-of-custody form when the samples were collected. Samples CRSD-2, CRSD-4, CRSD-5, CRSD-7, and CRSD-8 also were re-sampled for hexavalent chromium due to a laboratory scheduling error that resulted in the samples not being analyzed originally.

Volatiles
No VOCs and volatile TICs were detected in the four sediment samples tested (see Table 5-6a and Appendix D).

Semivolatiles
Eighteen SVOCs, including bis(2-ethylhexyl)phthalate, and 17 PAHs, were detected in the sediment samples tested (see Table 5-6a). Bis(2-ethylhexyl)phthalate was detected in two samples at low concentrations well below the standard. Benzo(a) pyrene, benzo(b) fluoranthene, chrysene, fluoranthene, and phenanthrene were detected in 12 of the samples tested; benzo(a) anthracene, benzo(g,h,i) perylene, benzo(k), fluoranthene, ideno (1,2,3-cd) pyrene, and pyrene were detected in 11 samples; anthracene was detected in eight samples; fluorene was detected in seven samples; acenaphthene, acenaphthylene, and dibenzo(a,h) anthracene were detected in four samples; and carbazole was detected in two samples.

The NYSDEC wildlife bioaccumulation sediment criteria were used, when available, to screen the sediment samples. The sediment criteria are uniquely calculated for each sediment sample using the measured TOC. TOC was not measured for sample CRSD-6; however, criteria calculated using the average TOC measured for the other eight samples are used as an approximate level of comparison for this sample. Seven PAHs, benzo(a)anthrazene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, and 2-methylnaphthalene were detected above the screening levels in five (CRSD-1, CRSD-3, CRSD-10, CRSD-11, and CRSD-12) of the 12 sediment samples tested. Moreover, several of these PAHs were detected in sample CRSD-6 above the respective average values. CRSD-1 was collected from a location upstream of the site; CRSD-3 was collected from the southern pond; CRSD-6 in the northern pond; and CRSD-10, -11, and -12 were collected downgradient of the site (see Figures 5-15a and 5-15b).

A maximum of 31 semivolatile TICs were detected in the four sediment samples tested, including unknown semivolatiles, unknown PAHs, unknown hydrocarbons, unknown oxygenated and chlorinated hydrocarbons, unknown aromatics, unknown carboxylic acids, hexadecanoic and phenylacetic acids, vitamin E, stigmast-4-en-3-one, hydroxylbenzaldehyde isomer, gamma-sitosterol, and straight alkanes (see Appendix D). Thirty TICs were detected in samples CRSD-1 and CRSD-3 with total estimated concentrations of 15,310 μg/kg and 14,500 μg/kg respectively; 29 TICs were detected in sample CRSD-6 at a total estimated concentration of 19,850 μg/kg; and 23 TICs were detected in sample CRSD-9R at a total estimated concentration of 15,770 μg/kg. Additionally, straight alkanes were detected in samples

CRSD-1, CRSD-3, CRSD-6, and CRSD-9R at concentrations of 1,100μg/kg, 900 μg/kg, 500 μg/kg, and 1,300 μg/kg, respectively.

Pesticides and PCBs

One pesticide, heptachlor epoxide, was detected in samples CRSD-6 and CRSD-9R at concentrations (4.0 μg/kg and 4.9 μg/kg) below the sediment screening criterion of 6.75 μg/kg calculated for sample CRSD-9R (see Table 5-6a). However, the level of heptachlor epoxide in CRSD-6 is above the screening criterion of 1.87 μg/kg calculated using the average TOC.

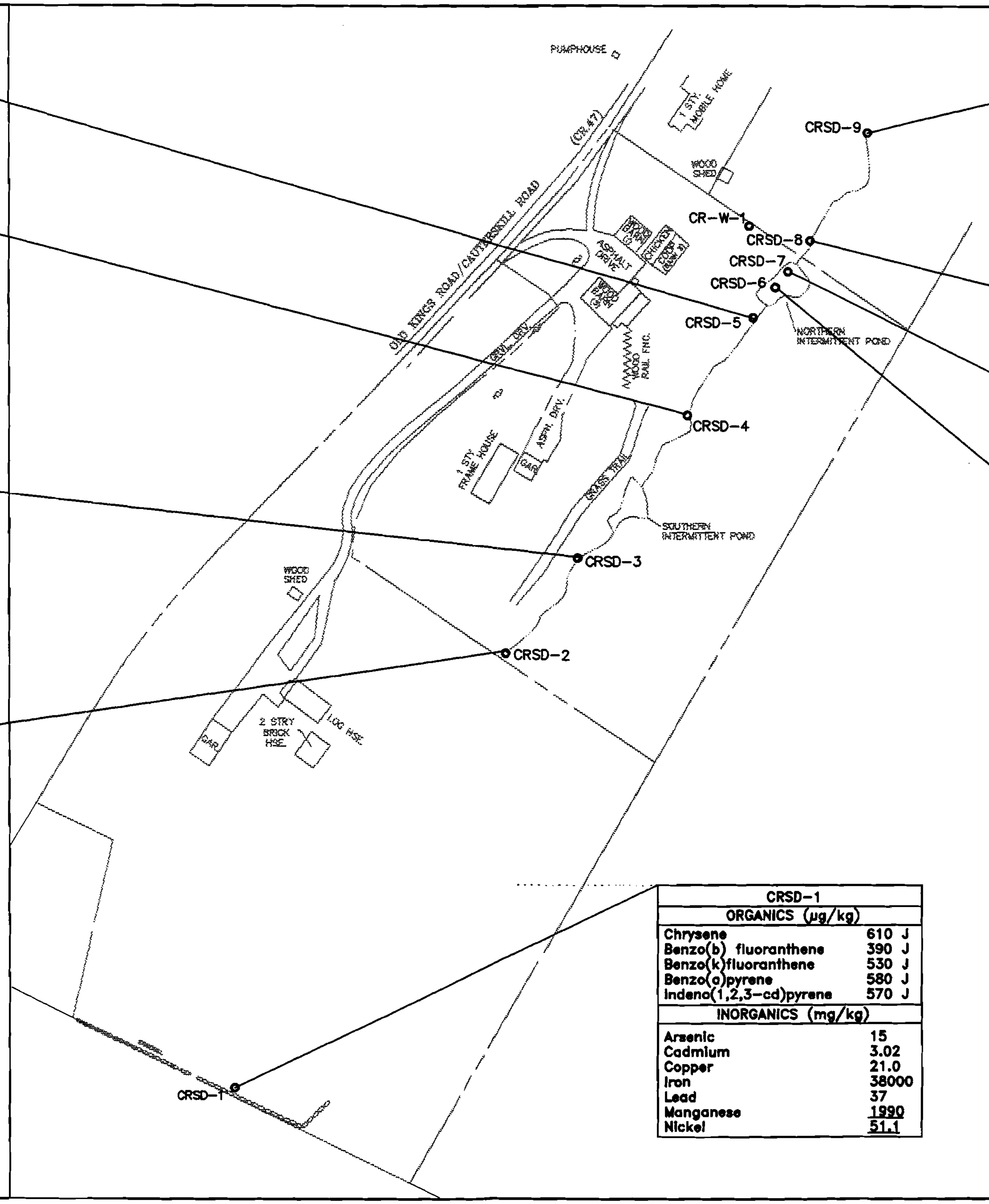
One PCB, Aroclor 1254, was detected in sample CRSD-6 at a concentration of 84 μg/kg (see Table 5-6a), below the screening criterion of 87 μg/kg (calculated using the average TOC) (see Figure 5-15a).

Inorganics

Up to 23 inorganics were detected in the sediment samples (see Table 5-6b). Chromium, copper, lead, nickel, and zinc were detected in all 17 samples tested; cadmium in 16 of the 17 samples; and cyanide in one sample. Aluminum, arsenic, barium, beryllium, calcium, cobalt, iron, magnesium, manganese, potassium, sodium, and vanadium were detected in all of the 12 samples tested; selenium was detected in nine of the samples; antimony and thallium were detected in four of the samples and mercury was detected in three of the samples. Hexavalent chromium was not detected in any of the sediment samples.

Pursuant to NYSDEC guidance for screening contaminated sediments (January 1999), the metals levels were screened against the severe and lowest effect levels listed in the guidance. If both criteria are exceeded, the sediment is considered severely impacted. If only the lowest effect level criterion is exceeded, the impact is considered moderate.

Ten metals (antimony, arsenic, cadmium, chromium [total], copper, iron, lead, manganese, nickel, and zinc) were detected above lowest effect levels (see Table 5-6b and Figures 5-15a and 5-15b). Three of these nine metals (iron, manganese and nickel) also exceeded the severe effect levels. Iron exceeded both screening levels in CRSD-12 and CRSD-15; manganese exceeded both screening levels in samples CRSD-1, CRSD-3, CRSD-9R, and CRSD-10; nickel exceeded both levels in samples CRSD-1, CRSD-6, CRSD-9R, CRSD-10 and CRSD-11. Additionally, nickel levels in the remaining samples were up to 4.3 times greater than the lowest effect level. With the exception of iron, none of the metals exceeding screening criteria were detected above Class C standards in the corresponding surface water samples.



CRSD-5	
INORGANICS (mg/kg)	
Cadmium	1.51
Copper	27.6
Nickel	47.0
Cyanide	4.51

CRSD-4	
INORGANICS (mg/kg)	
Cadmium	3.65
Copper	20.8
Nickel	46.9

CRSD-3	
ORGANICS (µg/kg)	
Chrysene	560
Benzo(b) fluoranthene	360 J
Benzo(k) fluoranthene	500 J
Benzo(a)pyrene	480 J
Indeno(1,2,3-cd)pyrene	500 J
INORGANICS (mg/kg)	
Arsenic	7.6
Copper	19.7
Iron	30300
Lead	38
Manganese	1250
Nickel	40.2

CRSD-2	
INORGANICS (mg/kg)	
Cadmium	2.77
Copper	22.4
Lead	50.3
Nickel	67.0
Zinc	159

CRSD-1	
ORGANICS (µg/kg)	
Chrysene	610 J
Benzo(b) fluoranthene	390 J
Benzo(k)fluoranthene	530 J
Benzo(a)pyrene	580 J
Indeno(1,2,3-cd)pyrene	570 J
INORGANICS (mg/kg)	
Arsenic	15
Cadmium	3.02
Copper	21.0
Iron	38000
Lead	37
Manganese	1990
Nickel	51.1

CRSD-9R	
INORGANICS (mg/kg)	
Antimony	2.7 J
Arsenic	13.1
Cadmium	3.8
Copper	41.3
Iron	34100
Lead	44.1
Manganese	1200
Nickel	62.9
Zinc	143

CRSD-8	
INORGANICS (mg/kg)	
Cadmium	1.89
Copper	18.6
Nickel	48.9

CRSD-7	
INORGANICS (mg/kg)	
Cadmium	3.26
Copper	25.8
Nickel	36.0

CRSD-6	
ORGANICS (µg/kg)	
Chrysene	300 J
Benzo(b) fluoranthene	200 J
Benzo(k) fluoranthene	270 J
Benzo(a)pyrene	260 J
Indeno(1,2,3-cd)pyrene	250 J
Heptachlor Epoxide	4.0 J
INORGANICS (mg/kg)	
Cadmium	2.86
Copper	26.8
Iron	30900
Nickel	52.5
Zinc	144

LEGEND

o	SEDIMENT SAMPLE LOCATION
J	ESTIMATED VALUE
mg/kg	MILLIGRAMS PER KILOGRAM
µg/kg	MICROGRAMS PER KILOGRAM
10 (underlined)	REPORTED VALUE EXCEEDS BOTH (SEVERE AND LOWEST) NYSDEC CRITERIA FOR SCREENING CONTAMINATED SEDIMENTS

SCALE IN FEET

0 100 200 300

ecology and environment

Figure 5-15a SEDIMENT SAMPLE RESULTS EXCEEDING SCREENING CRITERIA (PHASE I RI) CAUTERSKILL ROAD

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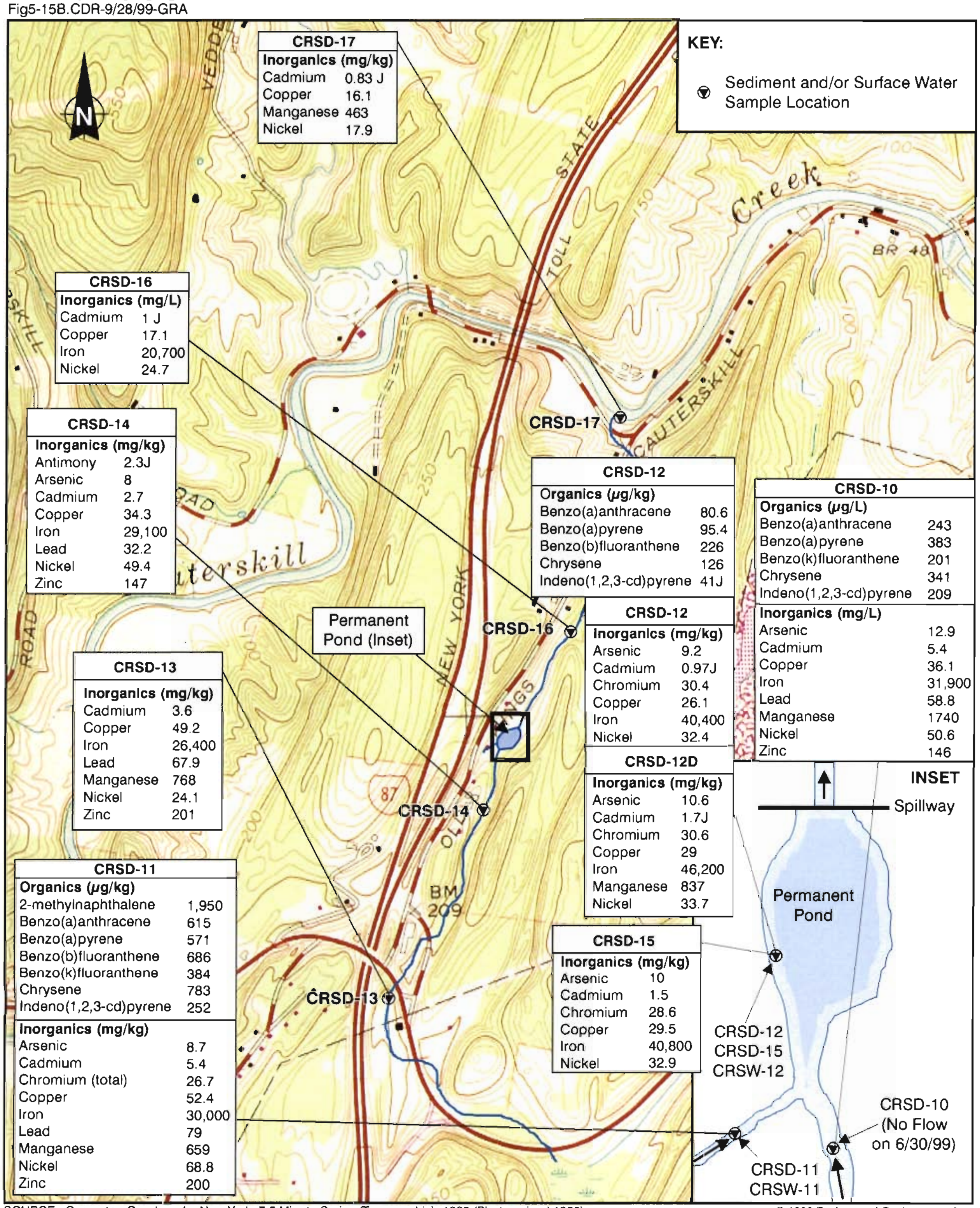
Fig5-15B.CDR-9/28/99-GRA



SOURCE: Cementon Quadrangle, New York, 7.5 Minute Series (Topographic), 1963 (Photorevised 1980).

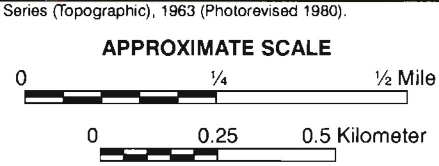


Figure 5-15B SEDIMENT SAMPLE RESULTS EXCEEDING SCREENING CRITERIA (PHASE II RI)
CAUTERSKILL ROAD
CATSKILL, NEW YORK

5.7 Exposed Waste Investigation

TCLP
toxicity characteristic leaching procedure

Two samples of exposed waste samples were collected and analyzed for toxicity characteristic leaching procedure (TCLP) metals, cyanide reactivity. Both waste materials originated from plastic-lined fiberboard drums exposed along the toe of the fill area. Sample date, analyses, and sample description are presented in Table 2-13, and positive analytical results are summarized in Table 5-7.

TCLP Metals

Barium, chromium, lead, and selenium were detected at very low concentrations (see Table 5-7) in waste sample CRW-1, a white powder-like material still in its original burial place in the embankment on the west side of the tributary to Kaaterskill Creek.

Arsenic, cadmium, chromium, and lead were detected at very low concentrations in sample CRW-2, a white granular (sugar-like) material, which has since been placed in a polyethylene drum.

Cyanide Reactivity

Cyanide was detected only in the duplicate of waste sample CRW-1 at a concentration of 1.0 mg/kg. No cyanide was detected in waste sample CRW-2. The waste was originally from the embankment on the west side of the tributary to Kaaterskill Creek.

5.8 Contaminant Fate and Transport

5.8.1 Introduction

A variety of primarily inorganic contaminants are present above screening levels in the soil, surface water, and sediment at the Cauterskill Road Site. The elements and compounds discussed in this section represent those elements/compounds above the established screening levels. Some of the metals may still be naturally occurring and/or pose little threat to human health and the environment (e.g. calcium, iron, and magnesium). Still others are detected only sporadically. A complete determination of which elements/compounds (and which portions of which media) require possible remediation will be performed in the feasibility study. However, several elements/compounds that may drive such remedial measures are selected here for evaluation of their typical migration behavior. Specifically, this section looks at the possible fate and transport of cyanide, cadmium, chromium, copper, nickel, zinc, and PAHs.

Some or all of the above-listed elements/compounds are present in all the media studied. Surface soils present mainly cyanide, cadmium, chromium, and zinc exceedances, while subsurface soils add PAHs. Sediments are noted for nickel and copper levels above screening values, and surface water is primarily characterized by its cyanide content.

5.8.2 Metals

Analyses for hexavalent chromium revealed that chromium was not present in this oxidation state. Thus, chromium would be present primarily in the cationic +3 oxidation state. The other metals of concern would also be expected to be present as cations, and exhibit similar transport behavior. These cationic metals can migrate primarily through wind and water-based erosion, and to a lesser extent through aqueous (dissolved-phase) transport. Because many of the metals of concern are found in surface soil, they can be transported downgradient and into the creek by erosion. Although nickel and copper are only found in elevated levels in isolated soil samples (i.e., there is no pattern of contamination for these elements in the soil), their presence in the creek sediments may have resulted from erosion from hot spots in the upland soil.

Transport by air is also possible during dry conditions. However, due to the humid climate and vegetative cover over most of the site, this route of transport is less important.

All the metals listed above are soluble to a limited degree in water. Actual solubilities are influenced by pH. Solubilities themselves, however, do not describe the extent of migration through leaching and surface water/groundwater transport. Rather, it is the degree of partition between the soil/sediment matrix and the leaching water. In most cases, these metals would strongly adsorb to the soil/sediment matrix and not preferentially partition into surface and groundwater. This behavior is bourne out in the surface water and groundwater samples that show little to no presence of these metals above screening values.

5.8.3 Cyanide

Cyanide was found at low levels throughout the surface and subsurface soil. It was not found in the groundwater, but was observed in three of nine surface water samples taken. Although cyanide can be present as a stable ligand bonded to a metal, the cyanide present at this site is most likely present as cyanide salt based on its apparent source from plating wastes. As the anionic part of a salt, cyanide is subject to the same transport mechanisms as described above for metals. Cyanide is more soluble than most metals (as with the metals, actual solubilities depend on the companion salt component), and this may explain its observance in surface waters, even though soil concentrations are quite low. Cyanide in surface water would eventually be removed through sedimentation, microbial degradation, and volatilization. No cyanide was detected in groundwater above standards, however.

5.8.4 PAHs

PAHs are rather large, hydrophobic organic molecules. Because of their high molecular weight, they do not readily volatilize. As such, they are also subject mainly to the erosional transport mechanisms as described above for metals. Because of their low solubility, and high affinity for adsorption onto environmental media, especially those with higher organic content, PAHs are not transported by leaching into groundwater or surface water to an appreciable degree.

6 Toxic Effect Analysis

6.1 Introduction

This section presents an ecological toxic effect analysis for site-related chemicals at the Cauterskill Road site. The analysis follows applicable parts of New York State guidance for characterizing threats to fish and wildlife at hazardous waste sites (*Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites*, October 1994, NYSDEC Division of Fish and Wildlife) and is a continuation of the *Fish and Wildlife Impact Analysis (FWIA)* presented in the draft RI (E&E 1999). Other guidance used for the analysis include:

- *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conduct-ing Ecological Risk Assessments,* (USEPA 1997), for general technical requirements for the assessment;

- *Ecological Assessment of Hazardous Waste Sites, A Field and Laboratory Reference* (USEPA 1989), for field and laboratory assessment methods;

- *Wildlife Toxicity Assessment of Cadmium in Soils* (NYSDEC 1999), for assessment of potential terrestrial impacts of cadmium;

- *Final Guidance for Data Usability in Risk Assessment* (USEPA 1992), for data usability issues; and,

- *Wildlife Exposure Factors Handbook* (USEPA 1993a, b), for methods and data for wildlife exposure assessment.

In addition, E&E utilized publications from Oak Ridge National Laboratory (e.g. Sample *et al.* 1996) and recent articles from the peer-reviewed literature, as appropriate.

The objective of the analysis was to evaluate environmental samples for site-related contaminants and estimate any potential risks these contaminants may pose to the natural environment. The analysis is focused on the terrestrial habitat provided by the site and nearby surrounding area, and on the tributary to Kaaterskill Creek, which borders the site on the east. The analysis includes four main sections: (i) ecological characterization, (ii) problem formulation, (iii) toxic effect analysis, and (iv) conclusions and recommendations.

6.2 Ecological Characterization

This ecological characterization describes the ecological environment of the site and surrounding areas. Included is a detailed characterization of the terrestrial and aquatic ecosystems present within a 0.5-mile radius of the site, and a description of important fish and wildlife resources present within a 2.0-mile radius of the site.

6.2.1 Methodology

Prior to the initiation of the field survey, federal and state natural resource agencies were contacted regarding endangered, threatened, and special-concern plants and animals; significant fish and wildlife resources; and state-designated freshwater wetlands present within 2 miles of the site. A National Wetland Inventory (NWI) map for the Cementon, New York quadrangle has not been completed for distribution to the public. To assess the potential for federal jurisdictional wetlands, the soil survey of Greene County was evaluated.

NWI
National Wetland Inventory

The field survey for the ecological characterization was performed by an E & E biologist on March 8, 1999. During the field survey, the entire 0.5-mile radius detailed study area was examined to the extent possible to describe the distinct vegetation cover types present. Due to limited access, portions of the cover type map and the associated characteristics are based on aerial photo interpretation to supplement the survey results. Cover type boundaries were drawn on an enlargement of a 1983 aerial photograph. Field surveys were conducted during the winter with some snow cover present. Community composition, therefore, is based primarily on evaluation of woody species, herbaceous vegetation with readily identifiable winter characteristics, and review of existing literature.

Where possible, plant cover types were classified according to *Ecological Communities of New York State* (Reschke 1990). For a few cover types, vegetation descriptions were not sufficiently similar to observed field conditions. These cover types were named according to its current land use. Cover types in the project area were distinguished in terms of plant species composition, vegetation cover, edaphic conditions, and land use.

Wildlife use of each cover type was noted during the field surveys. Wildlife sightings included direct observations as well as identifications based on vocalizations, tracks, burrows, and browse.

Additional wildlife species expected to occur in the 0.5-mile detailed study area based on geographic range and habitat requirements are also discussed. General wildlife values (e.g., food and cover availability) were also noted.

Aquatic resources present within the detailed study area were examined during the field survey. Streams were inspected for size, flow rate, and ability to support aquatic invertebrates. No biological sampling was conducted.

No field surveys were conducted outside of the detailed study area. Important ecological resources within a 2.0-mile radius general study area were identified from agency contacts, U.S. Geological Survey (USGS) topographic quadrangle maps, United States Department of Agriculture (USDA) Soil Conservation Service (SCS) soil surveys, and Farm Service Agency (FSA) aerial photographs.

USGS
U.S. Geological Survey

USDA
United States Department of Agriculture

SCS
Soil Conservation Service

FSA
Farm Service Agency

6.2.2 Terrestrial Resources

No endangered, threatened, or special concern species are known to occur within the 0.5-mile detailed study area (Flood 1999; Hickey 1999) and none were observed during the field survey. For purposes of this discussion, the cover types represent both upland and wetland communities.

Ten distinct terrestrial cover types were identified within the 0.5-mile detailed study area. Four of them: hemlock-northern hardwood forest, successional northern hardwoods, successional old field, and pastureland are classified in accordance with Reschke. The cover type map for the 0.5-mile detailed study area is presented on Figure 6-1. As shown on this figure, there is significant acreage comprising natural areas within 0.5 mile of the site. Each cover type is described below.

Hemlock-Northern Hardwood Forest

This cover type comprises mature forested areas, occurring primarily on rock slopes. This is a climax forest community characterized by a mature overstory and containing a mixture of coniferous and deciduous trees. The co-dominant trees found in the majority of the area include eastern hemlock (*Tsuga canadensis*), northern red oak (*Quercus rubrum*), and eastern red cedar (*Juniperus virginiana*). Also present in the overstory are white pine (*Pinus strobus*), sugar maple (*Acer saccharum*), American elm (*Ulmus Americana*), black oak (*Quercus velutina*), white oak (*Quercus bicolor*), scarlet oak (*Quercus coccinea*), chestnut oak (*Quercus prinus*), American basswood (*Tilia americana*), black cherry (*Prunus serotina*), red maple (*Acer rubrum*), eastern hophornbeam (*Ostrya virginiana*), and American hornbeam (*Carpinus caroliniana*). The sparse understory consists mainly of sapling sugar maple, eastern-hophornbeam, American hornbeam, raspberry (*Rubus spp.*) and honeysuckle (*Lonicera spp.).*

Within the study area, the species composition of the dominant coniferous trees is quite variable. Eastern hemlocks are more prevalent on higher elevations of slopes and eastern red cedar are generally the dominant tree along the lower elevations and bases of these slopes. Eastern hemlock is more suited to grow on slopes with limited topsoil, whereas the cedars require slightly more topsoil. The prevalence of white pine is also variable, with areas where it is co-dominant to areas where it is scarce. The ratio of deciduous to coniferous trees also varies throughout the cover type. Eastern hemlock, white pine, and eastern red cedar, are generally more abundant on the higher steeper slopes, whereas the hardwoods tend to more plentiful in the lower and flatter areas. Northern red oak is consistent as a dominant deciduous tree throughout this cover type.

Successional Old Field 1

This cover type consists of a well-vegetated herbaceous field in an early successional stage, which consists almost entirely of blue vervain (*Verbena hastata*). Other species present include teasel (*Dipsacus sylvestris*), goldenrod (*Solidago spp.*) and thistle (*Cirsium spp.*). A patch of gray dogwood (*Cornus foemina*) exists in the northern portion of the field. Based on species composition, and the underlying Covington soils, which are listed as a New York hydric soil, this successional old field would likely meet the criteria of being a jurisdictional wetland. A wetland delineation was not conducted as part of the toxic effect analysis.

Successional Old Field 2

This cover type is a large disturbed area of a limestone quarry reverting back to a vegetated state. It comprises a sparsely vegetated herbaceous community. The predominant species present includes grasses, blue vervain, teasel, goldenrod, thistle, and some scattered patches of common reed (*Phragmites communis*) and dogwood (*Cornus spp.*). Eastern red cedar is sparsely scattered throughout the successional old field.

Successional Northern Hardwoods

This cover type is characterized as a transitional community of hardwoods or mixed forest that occur in areas that have been previously cleared or otherwise disturbed. The dominant trees observed during the field survey include white pine, sugar maple, black cherry, and American elm. Other tree species found in this cover type include American basswood, red oak, black oak, eastern red cedar, and big tooth aspen (*Populous grandidentata*). Vegetation found in the shrub layer includes American hornbeam, black oak, white pine, American basswood, honeysuckle, and eastern

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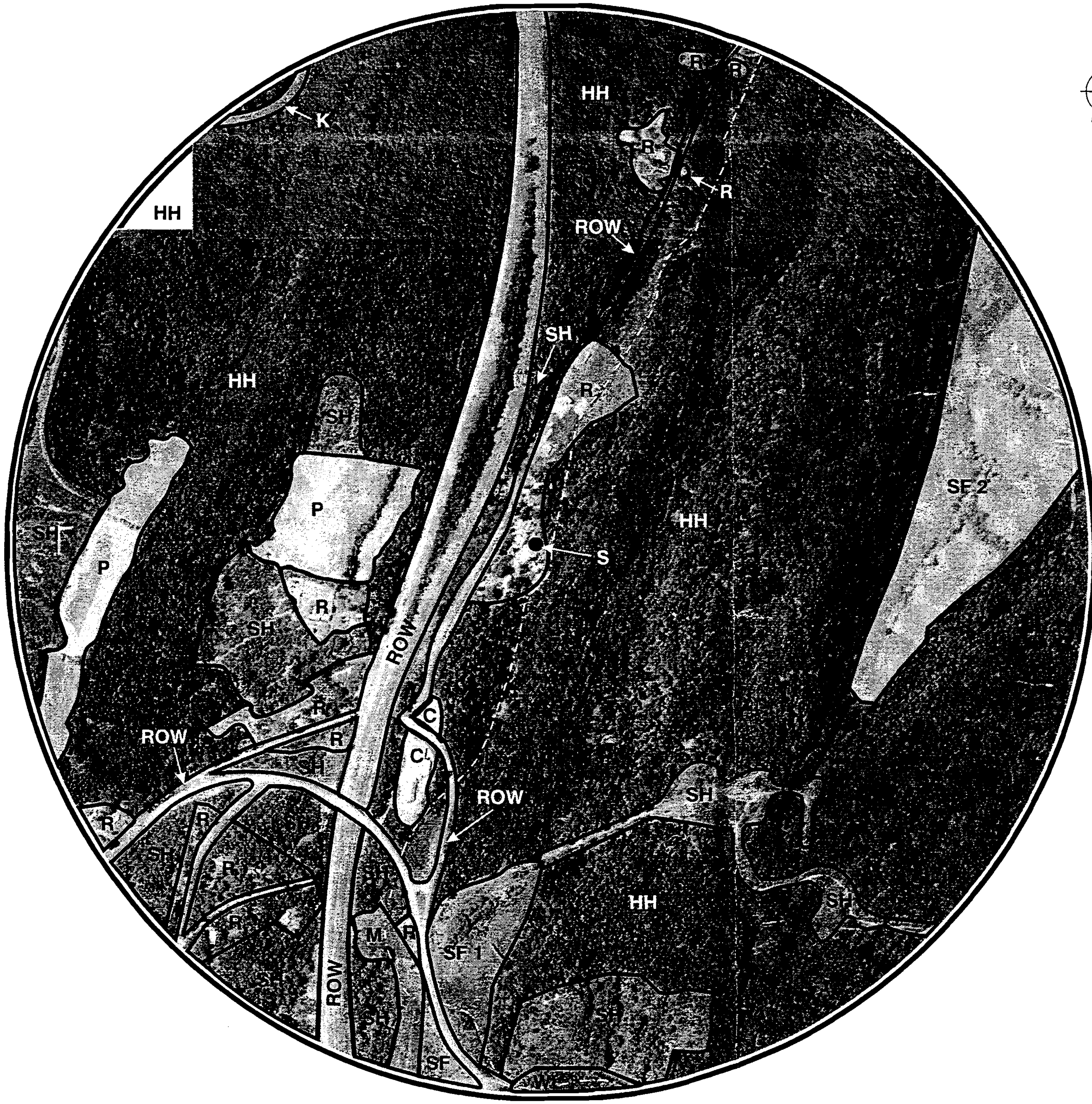
Fig6-1.CDR-3/15/99-GRA



KEY:

HH	Hemlock-northern hardwood forest
SH	Successional northern hardwoods
SF1	Successional old field 1
SF2	Successional old field 2
M	Emergent marsh
P	Pastureland
R	Residential
C	Commercial
WL	Palustrine forested wetland
ROW	Right of way
(line symbol)	Intermittent tributary
K	Kaaterskill Creek
S	Cauterskill road site

SOURCE: Ecology and Environment, Inc. 1999.

SCALE
0 600 1200 Feet

Figure 6-1 COVER TYPE MAP FOR CAUTERSKILL ROAD SITE

hophornbeam. Goldenrods and thistle were noted in the ground layer in some areas of this cover type.

Emergent Marsh

Within the project area, this cover type is restricted to a small area located approximately 0.4 mile south of the site. Common reed is the dominant species present. Also present within the marsh are patches of cattails (*Typha spp.*) and dogwoods. According to the Soil Survey of Green County, the soils present are Covington and Madalin soils, which consist of poorly drained and very poorly drained mineral soils with slopes ranging from 0 to 3%. Both soils are classified as hydric soils.

Pastureland

This cover type is pasture and includes various grasses and flowering herbaceous plants. Based on field surveys, it is believed the pastures are used as grazing areas for horses which were observed in the vicinity of the study area.

Residential

This cover type consists of general groups of residences and the land associated with them. Much of the land consists of maintained lawns and buildings. The lawns are mowed grasses and many contain scattered trees and shrubs. In addition to the trees found in the maintained areas, this cover type incorporates patches of trees and shrubs between the residences that may include plantings as well as native species associated with the surrounding natural habitat.

Commercial

This cover type is characterized as highly disturbed areas containing municipal buildings and storage areas. Essentially all vegetation has been cleared to allow for the lands current use.

Palustrine Forested Wetland

This wetland cover type is a portion of a New York State-regulated wetland containing a deciduous forest with standing water. The soils present are mapped as Galway-Farmington gravelly silt loams consisting of soils on irregularly sloping limestone ridges and hills. However, based on the field survey and interpretation of the aerial photograph and soil survey, it is more likely that the soils present are of the Covington or Madalin Series which are hydric soils that exist adjacent to the Galway-Farmington mapping unit. This cover type differs from the emergent marsh due to its forested nature. Palustrine forested wetlands are typically dominated by red maple, green ash (*Fraxinus pensylvanica*), and American elm. Because of the flooded conditions, understory and herbaceous communities are often sparse.

Rights-of-way

This cover type broadly covers the NYS Thruway along with all of the paved roads within the 0.5-mile detailed study area. All of the vegetation within this cover type has been cleared and rights-of-way serve little to no value to wildlife.

6.2.3 Aquatic Ecosystems

The Cauterskill Road site is located in the watershed of a small headwater stream to Kaaterskill Creek. The site's watershed is shown on Figure 6-2. Relatively few aquatic resources are present within the 0.5-mile radius detailed study area. Surface drainage from the site appears to be to an intermittent tributary to Kaaterskill Creek located immediately east and downslope of the site. The tributary flows northward to its confluence with Kaaterskill Creek approximately 0.7 mile from the site (see Figure 6-2). The tributary is listed by NYSDEC as Tributary 2 of Kaaterskill Creek (McBride 1999). The tributary's Stream Index Number is H-193-2-2, and the tributary is classified as a Class C stream. Class C streams are described as streams suitable for fish propagation and survival. The tributary is approximately 10-feet wide with a predominantly cobble substrate. Some silt accumulation within the tributary is evident, but it supports little submergent or emergent plant growth. Moss is present in some areas. The banks are shallow ranging from 3 to 6 inches. At the time of the biological field survey, the flow in the tributary was variable, with areas of perceived flow as well as dry areas with no flow at all. This is believed to be due to the rocky substrate providing areas of subterranean flow. Significant ponding occurs along the length of the tributary. In areas with flow, the depth ranged from 1 to 3 inches. The ponded areas varied from having approximately 2.5 feet of standing water to containing very little and being frozen over. No fish or aquatic organisms were observed during the field survey. The tributary was further characterized in June 1999 when additional sediment samples were collected for the toxic effect analysis at the site. A permanent, spring-fed pond occurs in the tributary channel 200 yards downstream from the site. In June 1999, there was no flow in the tributary upstream from the permanent pond, and no aquatic macroinvertebrates were observed in this portion of the tributary. Downstream from the permanent pond, flow in the tributary appears to perennial, due in part to outflow from the pond. Flow in the tributary downstream from the pond was visually estimated at approximately 1 to 2 cubic feet per second. Water depth was 3 to 5 inches. Sediment in the tributary was mucky in some places and gravelly in other places. In a few areas, the tributary flowed directly over bedrock and no sediment was present. Frogs, salamanders, and aquatic macroinvertebrates were abundant in the tributary downstream from the pond and in the pond. Aquatic macroinvertebrates observed in these habitats included water striders (Family Gerridae), predaceous diving beetle larvae and adults (Family Dytiscidae), water boatman (Family

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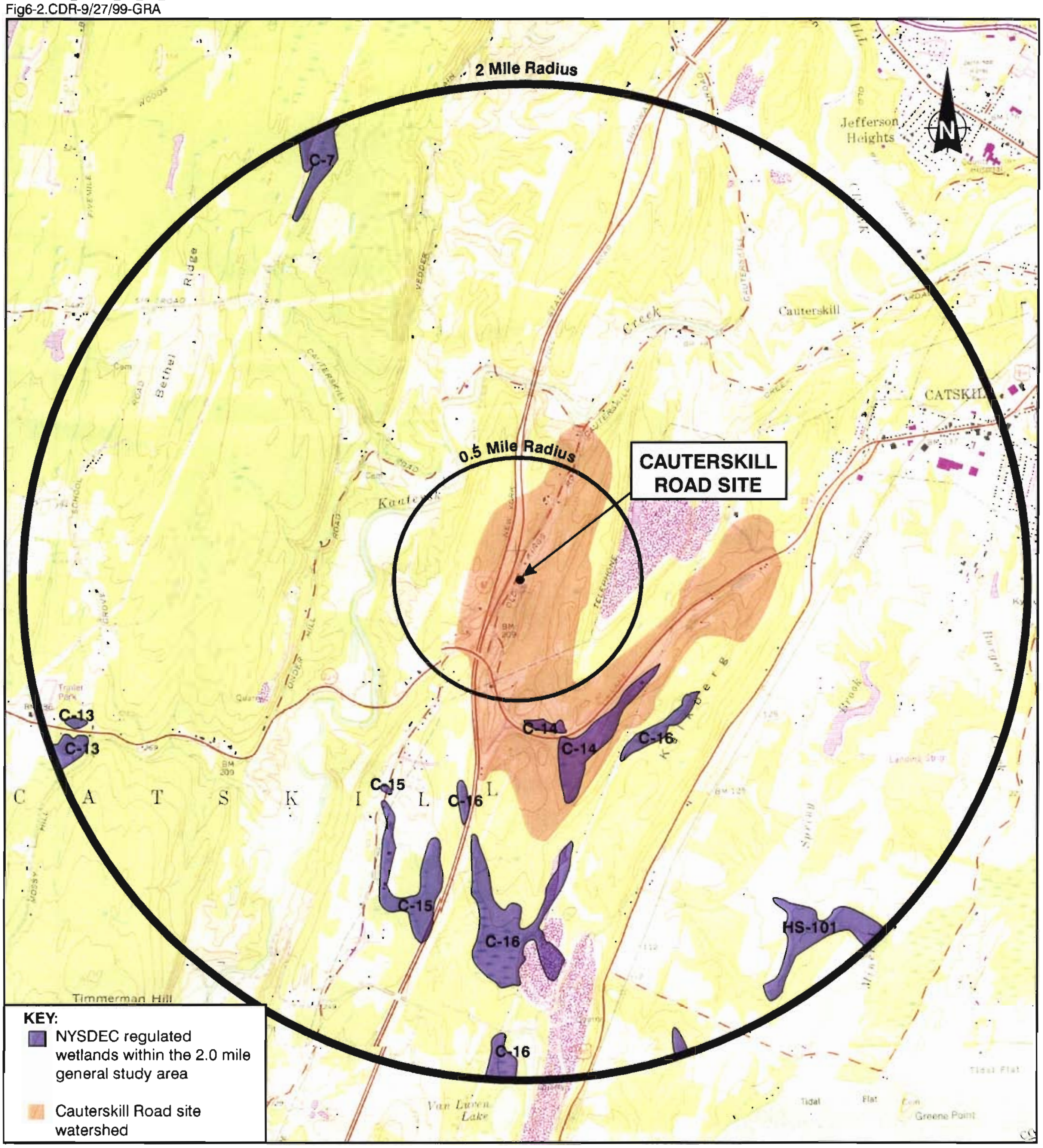
Fig6-2.CDR-9/27/99-GRA



SOURCE: Cementon Quadrangle, NY; 7.5 Minute Series (Topographic) 1963;
NYSDEC Division of Fish, Wildlife and Marine Resources, Region 4, 1999.

SCALE
0 ½ 1 Mile
0 .5 1 Kilometer

Figure 6-2 CAUTERSKILL ROAD SITE GENERAL STUDY AREA MAP

Corixidae), damselfly and dragonfly larvae and adults (Order Odonata), snails, and crayfish. No small fish or minnows were observed in the pond or in the tributary downstream from the pond.

It was also noted during the field survey that large amounts of metal debris and garbage are exposed on the slope coming down from the eastern edge of the site immediately upgradient of the tributary. This condition provides a potential impact by the site to the tributary. Refer to Section 2.8 for water quality data collected from the tributary.

The riparian vegetation along the tributary includes eastern hemlock, eastern red cedar, northern red oak, American elm, common cottonwood, and sugar maple in the overstory, and American elm, red maple, sugar maple, common elderberry (*Sambucus canadensis*), wild grape (*Vitis spp.*), greenbrier (*Smilax spp.*), and prickly brambles (*Rubus spp.)* in the shrub and vine layers. In general, the overstory of the riparian vegetation has the same species composition as the adjacent forested area. However, the riparian area has a more developed shrub layer.

The section of Kaaterskill Creek, Stream Index Number H-193-2, which falls within the 0.5-mile radius detailed study area is located approximately 0.5 mile northwest and is upstream of the site. The stream is approximately 35 to 50 feet in width and was flowing at the time of the field survey. The stream depth was not determined during the field survey. The section of Kaaterskill Creek located downstream and within the 2.0-mile radius general study area of the site is classified as a Class B stream and is known to support an abundant and diverse warm water fishery (McBride 1999). Class B streams are described as streams with waters that can best be used as primary and secondary contact recreation and fishing. These waters are suitable for fish propagation and survival. Additionally, Kaaterskill Creek flows into Catskill Creek, Stream Index Number H-193, at a point approximately 2.0 miles downstream of the Cauterskill Road site. Catskill Creek is also a Class B stream known to support an abundant warm water fishery as well as being an anadromous fish run (McBride 1999). Catskill Creek flows into the Hudson River at a point approximately 4.5 miles downstream of the site.

6.2.4 Freshwater Wetlands

Six New York State freshwater wetland complexes (see Figure 6-2) are located within the 2.0-mile radius general study area with only one in the 0.5-mile detailed study area. The characteristics of these six wetlands are summarized in Table 6-1. All wetlands are of high quality (DEC Class II and III). Each comprises deciduous trees and/or shrubs and some contain wet meadows and open water. Five of these wetlands, C-7, C-13, C-15, and C-16, are located upgradient of the site and C-7, C-13, C-15, and C-16 are

Table 6-1 State-Designated Freshwater Wetlands Located Within the General Study Area of the Cauterskill Road Site

NYSDEC Code	Vegetation Type	NYSDEC Classification	Location	Distance from Site	Within Site's Watershed	Direction from Site
C-7	Flooded deciduous trees	III	Upgradient	1.8 miles	No	NNW
C-13	Flooded deciduous trees Flooded shrubs Wet meadow	III	Upgradient	1.8 miles	No	WSW
C-14	Flooded deciduous trees Flooded shrubs Wet meadow	III	Upgradient	0.5 mile	Yes	S
C-15	Flooded deciduous trees Flooded shrubs	III	Upgradient	0.9 mile	No	SSW
C-16	Flooded deciduous trees Flooded shrubs Open water Wet meadow	II	Upgradient	0.8 mile	No	SE
HS-101	Flooded deciduous trees Open water	II	Downgradient	1.6 miles	No	SE

located outside of the site's watershed. The sixth wetland, HS-101, is located 1.6 miles downgradient of the site but is outside of the site's watershed.

A portion of one of the wetlands, C-14, is located within the 0.5-mile radius detailed study area. It is located approximately 0.5-mile directly south and upgradient of the site. Within the 0.5-mile radius detailed study area, this wetland is mapped as deciduous forest.

Because most of these wetlands are located upgradient of the Cauterskill Road site or outside of the site's watershed, the likelihood of impact to the wetlands by the site is minimal. Wetland HS-101, however, is located within the site's watershed, approximately 4.5 miles downstream of the site where Catskill Creek flows into the Hudson River. This wetland complex is unlikely to be impacted by the site due to its distance from the site.

USFWS
United States Fish and Wildlife Service

An NWI map for the Cementon, New York quadrangle has not been completed. However, correspondence with the United States Fish and Wildlife Service (USFWS) indicates that aside from wetlands identified as state regulated, there are no known federally regulated wetlands within the 2.0-mile general study area (Stoll 1999). Aside from successional old field 1 and NYSDEC wetland C-14, the field survey did not confirm the presence of any additional wetlands within the 0.5-mile detailed study area. Based on the soil survey, soils series represented in the 0.5-mile detailed study area include the Arnot, Barbour, Basher, Covington, Farmington, Galway, Hudson, and Tunkhannock Series. With the exception of the Covington Series, all of these soil series have somewhat exceptionally drained to well-drained soils and provide poor or very poor habitat for wetland plants and wildlife. The Covington Series contains poorly and very poorly drained hydric soils and provides fair habitat for wetland plants and wildlife (USDA 1993).

6.2.5 Fish and Wildlife Resources

The Cauterskill Road site is within the Hudson Valley ecozone (Reschke 1990). Fish and wildlife resources in the 0.5-mile detailed study area are expected to be typical of those naturally found within this ecozone. The 0.5-mile detailed study area appears to support a low diversity of fish and aquatic organisms due to the limited aquatic resources present. However, sections of Kaaterskill Creek and Catskill Creek are within the 2.0-mile general study area and are known to support large and diverse warm water fish populations. Species collected by NYSDEC at a test station located approximately 3,000 feet downstream of where Tributary 2 flows into Kaaterskill Creek include chain pickerel (*Esox niger*), common carp (*Cyprinus carpio*), fallfish (*Semotilus atromaculatus*), white catfish (*Ictalurus catus*), white perch (*Morone americana*), white sucker (*Catostomus commersoni*), northern hog sucker (*Hypentelium nigricans*), golden shiner (*Notemigonus crysoleucas*), rock bass (*Ambloplites rupestris*), sunfish (*Lepomis sp.*), pumpkinseed (*Lepomis gibbosus*), bluegill (*Lepomis macrochirus*), smallmouth bass (*Micropterus dolomieus*), largemouth bass (*Micropterus salmoides*) and yellow perch *(Perca flavescens*). In addition to being a warm water fishery, Catskill Creek is also an anadromous fish run supporting species such as stripped bass (*Morone saxatilus*), blueback herring (*Alosa aestivalis*), and alewife (*Alosa pseudoharengus*). American eel (*Anguilla rostrata*) and white perch are also known to occur in this part of the creek. Largemouth bass utilize the lower part of Catskill Creek as a wintering area (McBride 1999).

A relatively high diversity and abundance of wildlife is expected to exist in the 0.5-mile detailed study area because of the relative abundance of natural forests and old fields. With the exception of some residences, commercial properties, and paved roads, the majority of the 0.5-mile detailed study area consists of natural communities capable of supporting many species of wildlife. No endangered, threatened, or special concern species are known to occur within the 0.5-mile detailed study area, and aside from the freshwater wetlands previously discussed, no significant resources occur within the 0.5-mile radius detailed study area or the 2.0 mile radius general study area (Flood1999; Hickey 1999).

Two forested cover types within the detailed study area support populations of amphibians, reptiles, birds, and mammals by providing food, cover and nesting habitat. These are the hemlock-northern hardwood forest and the successional northern hardwoods. Characteristic birds include wild turkey (*Meleagris galloparo*), pileated woodpecker (*Dryocopus pileatus*), golden-crowned kinglet (*Regulus satrapa*), and black-throated green warbler (*Dendroica virens*). Numerous birds such as the wood thrush (*Hylocichla mustelina*) and ovenbird (*Seiurus aurocapillus*) are restricted in distribution to large contiguous forested areas. Mature trees provide cavities that are important for birds such as the eastern screech owl (*Otus asio*) and white-breasted nuthatch (*Sitta carolinensis*) and mammals such as the raccoon (*Procyon lotor*) and the southern flying squirrel (*Glaucomys volans*). Large trees are also essential for raptor nests. During the field survey of the hemlock-northern hardwood communities, wildlife sightings included white-tailed deer (*Odocoileus virginianus*), American crows (*Corvus brachyrhynchos*), and red-shouldered hawks (*Buteo lineatus*). Evidence of woodpeckers was also present in the forested areas.

The successional old fields and pastureland located in the detailed study area allow small wildlife openings that provide edge habitat and food. Grasses and forbs produce seed, which are eaten by songbirds such as the song sparrow (*Melospiza melodia*) and field sparrow (*Spizella pusilla*). Shrubs located along the edges of these old fields, and scattered throughout some of the old fields, produce fruit that is important in the diets of a variety of songbirds such as the American robin (*Turdus migratorius*) and gray catbird (*Dumetalla carolinensis*). Upland game birds, such as the ring-necked pheasant (*Phasianus colchicus*), also feed on these fruits. These shrubs provide browse for white-tailed deer and eastern cottontail (*Sylvilagus floridanus*).

The wetland plant communities present within the 0.5-mile detailed study area provide excellent habitat for many animals because of the seasonal or permanent presence of water. This water is used directly for drinking by animals in the area, and pooled water is essential for breeding populations of various amphibians such as the wood frog, spring peeper, and spotted salamander, as well as many insects. Moist soil conditions within wetland plant communities support lush vegetation growth, which is valuable for supporting an abundance and diversity of animal life.

With the exception of some edge habitat, the residential, commercial, and right-of-way cover types provide little habitat for wildlife. Additionally, the NYS Thruway acts as an effective barrier for terrestrial vertebrates, essentially dividing the 0.5-mile detailed study area in half.

6.2.6 Value of Fish and Wildlife Resources

Hunting in the vicinity of the site is expected to be good due to the populations of small game and deer that are likely to exist there. Obviously, hunting is limited near the residences, paved roads, and commercial land uses that exist within the 0.5-mile detailed study area. There are no known significant recreational areas located in the detailed study area.

The deciduous wetland (NYSDEC C-14) located within the detailed study area represents a high quality habitat. The deciduous swamp itself potentially provides nesting and feeding habitat for waterfowl as well as other wildlife species. The juxtaposition of the wetland with the adjacent upland forested area, provides a valuable resource for species which require a variety of different habitat types (e.g., white-tailed deer) and species which utilize edge habitat [e.g., ruffed grouse (*Bonasa umbellus*)].

As previously mentioned, aquatic resources are limited within the 0.5-mile detailed study area. However, there is an abundance of warm water fish populations within the 2.0-mile general study area. Both Kaaterskill Creek and Catskill Creek located downstream of the site support diverse populations of warm water fish and fishing in these waters is common.

6.3 Problem Formulation

A fish and wildlife impact analysis was conducted for the Cauterskill Road site and was presented in the draft RI report (E&E 1999). The analysis concluded that valuable fish and wildlife resources at the site were potentially at risk from exposure to toxic levels of site-related chemicals. The chemicals of potential concern (COPCs) at the site included six metals – cadmium, chromium, copper, lead, nickel, and zinc – related to disposal of plating wastes at the site, and possibly selected PAHs and PCBs.

COPCs
chemicals of potential concern

Although the site is within an area defined as residential (see Figure 6-1), the area is characterized by reverting field and early successional vegetation in addition to more maintained areas. Common wildlife, such as small mammals (mice, voles, cottontails, etc.) and songbirds (e.g., robins, chickadees, cardinals), could inhabit these types of cover. They would be exposed to contaminants at the site. In addition, the site is bordered by mature hemlock-northern hardwood forest to the east. Wildlife common in the forest habitat (see Section 6.2.2) could utilize the site for foraging or other activity. The intermittent creek east of the site could be attractive to local wildlife for drinking water and feeding, as well as providing habitat for benthic invertebrates and amphibians.

Aquatic habitats at the site are limited. Because the tributary to Kaaterskill Creek that borders the site is shallow and intermittently flowing near the site, no fish are present in this portion of the tributary. Further downstream, flow in the tributary is perennial due to groundwater inputs. However, this portion of the tributary also is shallow (2 to 4 inches depth) and there are several waterfalls of moderate height (2 to 6 feet) that would deter fish from moving upstream more than a few hundred yards from Kaaterskill Creek. Therefore, minimal impact on fish is expected in the tributary. Kaaterskill Creek, located 0.7 mile downstream, contains significant fishery resources and could potentially be affected by contaminants from the site. However, due to the distance downstream, the limited flow in the tributary relative to Kaaterskill Creek, and the relatively low levels of contamination measured in the tributary creek, it is very unlikely that fish or wildlife in Kaaterskill Creek would be adversely impacted by site-related contamination.

Elevated levels of chemicals have been observed in surface soils at the site and in sediments and surface water from the tributary east of the site. Wildlife could be exposed to these chemicals directly through incidental ingestion of soils or sediments or through drinking surface water. In addition, chemicals in soil could be taken up by plants or soil invertebrates that are then eaten by insectivorous or herbivorous wildlife. These food chain effects could also occur in the aquatic system for wildlife feeding on invertebrates from the tributary. However, near the site, the tributary supports little aquatic life because of its intermittent nature, and COPC levels are much lower in sediment in the tributary than in on-site soil. Consequently, wildlife exposure to COPCs in sediment from the tributary likely are low compared with exposure from on-site soil.

In summary, the ecological resources deemed to be at risk at the site included plants, soil invertebrates, and terrestrial wildlife exposed to soil contamination, and aquatic life (i.e., invertebrates, amphibians, etc.) in the tributary that borders the site on the east. The risks to these resources are evaluated in the following sections.

6.4 Toxic Effect Analysis

The toxic effect analysis for the Cauterskill Road site is discussed under three main headings: (i) wildlife risks, (ii) plant and soil-invertebrate risks, and (iii) aquatic-life risks.

6.4.1 Wildlife Risk Analysis

This section presents an evaluation of potential risks to wildlife at the Cauterskill Road site. The assessment was performed in accordance with USEPA and other guidance for ecological risk assessment (USEPA 1997, Sample *et al.* 1996) to determine whether levels of metals and organic chemicals in site soils pose a risk to local wildlife. The wildlife risk analysis consists of three parts: (i) exposure assessment, (ii) ecological effects assessment, and (iii) risk characterization. The exposure assessment estimates wildlife exposure to site COPCs from levels in environmental media and exposure parameters for the wildlife species. The potential toxic effects of site COPCs on wildlife are summarized in the ecological effects assessment. Finally, the wildlife risk characterization combines the results of the exposure and ecological effects assessments to provide an estimate of risk to wildlife receptors at the site.

6.4.1.1 Exposure Assessment

This section provides a discussion of the potential pathways of exposure to COPCs for wildlife species using the site area. It also describes the wildlife exposure scenarios, estimates COPC levels in exposure media, and calculates quantitative exposure estimates.

Wildlife Receptors

Based on the ecological characteristics of the site (see Section 6.2) and potential exposure pathways (see Section 6.3), two terrestrial wildlife species representing different taxonomic and functional groups were selected as receptors for the analysis. Because the contamination is present at much higher levels in surface soil than in sediment, and because Cauterskill Creek is an intermittent stream and provides limited aquatic habitat adjacent to the site, this assessment focuses on terrestrial wildlife exposure to contaminated soil. Wildlife feeding on plants or soil invertebrates could potentially be exposed by eating contaminated prey and/or through incidental ingestion of contaminated soil. Therefore, a small mammal, the short-tailed shrew, and a bird, the American robin, that feed extensively on soil invertebrates and vegetation were selected for the assessment.

The short-tailed shrew (*Blarina brevicauda*) is a small, carnivorous mammal that is common in many habitats, especially those with abundant vegetative cover (EPA 1993). The shrew feeds primarily on invertebrates, including insects, earthworms, slugs, and snails. Vertebrates and plants typically make up a minor component of the diet. The species is active year-round. Shrews have a relatively small home range (USEPA 1993) and potentially could reside entirely within the area of the site.

The American robin (*Turdus migratorius*) is a common resident of open areas, woodland edges, and early successional habitats (EPA 1993). The makeup of the diet varies seasonally, with invertebrates making up the majority of food items during the spring and early summer. Robins feed on the ground, searching the soil and leaf litter for invertebrates. Robins establish small territories during the breeding season and could reside entirely on the site. Although northern populations typically winter in southern locations, individuals in the site area could remain year-round.

Exposure Point Concentrations

The ecosystem of concern in the wildlife risk assessment is the wooded and grassy areas located on the northern and southeastern portions of the site (see Figure 6-2). These areas were chosen since they represent the most suitable habitat area for the robin and the shrew at the site. Exposure point concentrations (EPCs) for COPCs in soil were calculated from sampling data collected from December 1998 to March 1999. For metals, EPCs were determined by calculating the 95% upper confidence limit (UCL) of the geometric mean concentration for the soil samples (USEPA 1992c). EPCs for organic chemicals were determined using the maximum concentrations in site soil. The maximum concentration was used since there were so few samples containing organics (PCBs, five samples; PAHs, four samples). This approach results in a conservative estimate of average exposure to organic chemicals for animals using the site area. The calculated EPCs are presented in Tables 6-2 and 6-4.

EPC
exposure point concentration

UCL
upper confidence limit

BCF
bioconcentration factor

COPC levels in soil invertebrates were estimated using a bioconcentration factor (BCF) that relates the soil chemical concentration to the concentration in invertebrates. Earthworms were chosen as a representative soil invertebrate because they are abundant in most soils, are important in the diets of shrews and robins, and have been well studied. A model presented in Menzie *et al.* (1992) was used to calculate BCFs for the PAHs and PCBs in the earthworm. This model predicts BCFs based on the organic content of the soil (f_{oc}) and lipid content of the invertebrate (Y_L) using the following equation:

$$BCF = Y_L/(0.66f_{oc}).$$

The organic content of the soil (f_{oc}) was assumed to be 1% and the lipid content of earthworms is assumed to be 2% (Menzie *et al.* 1992). Using these assumptions, the above equation yields an earthworm BCF of 3.03 for organic chemicals at the site. For the metals, the bioaccumulation models for earthworms from Sample *et al.* (1998) were used to calculate invertebrate EPCs from the soil data. The BCFs and EPCs for soil invertebrates are presented in Tables 6-2 and 6-3.

Soil contamination could also be available to wildlife through uptake by plant species in their diet. Levels of metals in plants were estimated using soil-to-plant bioconcentration factors for reproductive plant parts from Baes *et al.* (1984). The levels of PCBs and PAHs in plants were calculated using the uptake model of Travis and Arms (1988). The plant BCFs and EPCs are presented in Tables 6-2 and 6-3.

Table 6-2 Summary of 95% UCL Calculations for Metals in Soil

			Values for Untransformed Data				Values for Transformed Data			
Chemical	Number of samples	distribution	Avg	stdev	T	95 %UCL untransformed	ln-avg	ln stdev	H	95% UCL LN
Cadmium	42	lognormal	4.79	9.62	1.69	7.33	0.5341	1.136	2.548	5.11
Chromium	42	lognormal	43.14	130.743	1.684	77.52	3.072	0.794	2.136	38.54
Copper	42	lognormal	224.92	742.065	1.684	420.08	3.876	1.277	2.733	187.89
Lead	42	lognormal	112.73	197.401	1.684	164.65	4.079	0.997	2.343	139.81
Nickel	42	lognormal	341.95	1524.179	1.684	742.80	3.925	1.328	2.728	215.30
Zinc	42	lognormal	412.44	486.279	1.684	540.33	5.082	0.9119	2.404	343.62

Key:
stdev = standard deviation
H = H statistic
T = T statistic
Avg = average
UCL = upper confidence limit
LN = natural log transformed data

Table 6-3 Bioconcentration Factors for COPCs in Exposure Media

Chemical	BCF - earthworm	BCF - plants (reproductive tissues)
Chromium	0.306	0.0045
Copper	0.113	0.25
Lead	0.266	0.009
Nickel	1.059	0.06
Zinc	1.683	0.9
PCBs		
Aroclor 1254	3.03	0.396
Aroclor 1260	3.03	0.396
PAH's		
Benzo(a)pyrene	3.03	0.403

Key:
BCF = Bioconcentration factor

BCF for metals and PCBs in earthworm calculated using site specific soil data and uptake model from Sample *et al.* 1998
BCF for PAHs calculated using Menzie *et al.* 1992
BCF for metals in plants from Baes*et al.* 1984
BCF for PCBs and PAHs in plants caluclated using Travis & Arms 1988

Table 6-4 Exposure Point Concentrations for COPCs in Exposure Media

Chemical	EPC Soil (mg/kg)	EPC Earthworm (mg/kg)	EPC Plants (mg/kg)
Inorganics			
Cadmium	5.11	30.14	0.7665
Chromium	38.54	11.79	0.1734
Copper	187.89	21.26	46.97
Lead	139.81	37.18	1.26
Nickel	215.29	227.99	12.92
Zinc	343.62	578.24	309.26
PCBs			
Aroclor 1254	1.2	3.636	0.4752
Aroclor 1260	4.9	14.847	1.9404
PAHs			
Benzo(a)pyrene	1.8	5.454	0.7254

Key:
EPC = Exposure Point Concentration

EPC for metals and PCBs in earthworms calculated using Sample *et al.* 1998
EPC for PAHs in earthworms calculated using Menzie *et al.* 1992
EPC for metals in plants calculated using Baes *et al.* 1984
EPC for PCBs and PAHs in plants calculated using Travis & Arms 1988

Exposure Estimates

The total chemical exposure for wildlife receptors is the sum of exposures from various components of the diet and from incidental soil or sediment ingestion. The dietary exposure is calculated by multiplying the COPC levels in each prey item by its fraction of the total diet and summing the contribution from each prey item. This sum is then multiplied by the receptor's area use factor (FR), and ingestion rate (IR), and divided by the receptor's body weight (BW), as shown in the following equation:

FR
area use factor

IR
ingestion rate

BW
body weight

ha
hectare

$$ADD_{diet} = ([(P_1 \times T_1) + (P_2 \times T_2) + \ldots (P_n \times T_n)] \times FR \times IR) / BW$$

where:

ADD_{diet} = Average daily dosage from diet (mg/kg/day);
P_n = Percentage of diet represented by prey item ingested;
T_n = Tissue concentration in prey item n (mg/kg dry weight);
FR = Area use factor, for the fraction of time in contact with the site (unitless);
IR = Ingestion rate of receptor (kg/day in dry weight); and
BW = Body weight of receptor (kg in fresh weight).

Home range, body weight, and dietary makeup for the robin and shrew were taken from USEPA (1993) and Sample et al. (1997). The values are presented in Table 6-5. Contaminant levels in prey items were calculated as discussed above. The area use factor (FR) indicates the portion of an animal's home range that would be represented by the site. If the home range is larger than the site, the FR equals the site area divided by the home range area. If the site area is greater than or equal to the home range, the FR is equal to 1. Based on available maps and observations made during site visits, the site area was estimated to represent approximately 2 hectares (ha) of habitat. Because the shrew and the robin have home ranges of 3 ha or less, the FR for both was set equal to 1.

Wildlife exposure to COPCs through incidental soil ingestion was estimated in a manner similar to dietary exposure: the soil EPC was multiplied by soil ingestion and then multiplied by the FR and IR and divided by BW. Soil ingestion estimates for the endpoint species were taken from Sample *et al.* (1997) and Beyer *et al.* (1994) and are presented in Table 6-5.

The total exposure for a receptor is the sum of exposure from diet and soil ingestion, as represented by the following equation:

$$ADD_{total} = ADD_{diet} + ADD_{soil/sediment}$$

Table 6-5 Exposure Parameters for Wildlife Species

Species	Diet: Terrestrial Invert	Diet: Plants	Soil Intake (kg/d)dw	Home Range (ha)	FR	Ingestion Rate (kg/d) ww	Percent Water in Diet	Ingestion Rate (kg/d) dw	Body Mass (kg)
American Robin	50%	50%	0.0019	0.42	1	0.068	73%	0.0184	0.077
Short Tailed Shrew	100%		0.00117	0.39	1	0.009	70%	0.002	0.015

Size of site : 2 (ha)

References:
Diet - Exposure Factors Handbook, EPA, 1993
Soil Intake - Sample *et al.* 1998
Home Range - Exposure Factors Handbook, EPA, 1993
Food Ingestion - Sample *et al.* 1998
Percent Water in Diet - Sample *et al.* 1998, and Exposure Factors Handbook, EPA, 1993
Body Weight - USEPA 1993

where:

ADD_{total} = Total exposure (mg/kg/day);
ADD_{diet} = Estimated exposure from diet (mg/kg/day); and
$ADD_{soil/sediment}$ = Estimated exposure from soil/sediment ingestion (mg/kg/day).

The calculated exposure estimates and their significance are discussed in the following sections.

6.4.1.2 Wildlife Ecological Effects Assessment

TRV
Toxicity Reference Value

NOAEL
no observed adverse effect level

LOAEL
lowest observed adverse effect level

This section summarizes the potential toxic effects of the COPCs in an ecological setting. The toxicity assessment establishes Toxicity Reference Values (TRVs) for each endpoint species identified at the site. These TRVs represent "no observed adverse effect levels" (NOAEL) or "lowest observed adverse effect levels" (LOAELs) for each contaminant for each endpoint species.

TRVs are derived from published toxicity studies. Literature toxicity values judged most relevant for the ecological assessment were used to derive the TRVs used in the assessment. The species and conditions in a laboratory study often differ from those found in the field; therefore, some uncertainty is involved in extrapolating from the laboratory toxicity data to the TRVs. Because of this uncertainty, a conservative approach is used to calculate TRVs and the most sensitive, ecologically significant toxicological effect is used.

Toxicity values that represent chronic NOAEL exposures are preferred in deriving TRVs. If only a LOAEL is available, or if no chronic studies are available, the toxicity value is multiplied by an uncertainty factor ranging from 0.01 to 1 to extrapolate a chronic NOAEL.

Toxicity results form laboratory studies are often expressed as a concentration in food (e.g., ppm). This concentration must be converted to a dose (as mg chemical/kg body weight/day) to allow for a comparison among species of various body sizes. This conversion is performed by multiplying the concentration in diet by the food ingestion rate (which may come from measurements made in the toxicity study or from published values for the test species), and dividing by the test organism's body weight (also taken from the study or estimated from literature).

For mammals, differences in body size between the test species and the receptor species can also be a source of uncertainty. Therefore, the test species NOAEL is modified by a body scaling factor to calculate the receptor species NOAEL (Sample *et al.* 1996). Receptor species NOAELs were calculated using the following equation:

$$TRV = NOAEL_R = NOAEL_T \times (BW_T/BW_R)^{1/4}$$

where:

$NOAEL_R$ = No observed adverse effect level for receptor species (mg/kg/day);
$NOAEL_T$ = No observed adverse effect level for test species (mg/kg/day);
BW_T = Body weight of test species (kg);
BW_R = Body weight of receptor species (kg); and
$(BW_T/BW_R)^{1/4}$ = Body scaling factor.

For birds, recent research has indicated that the body size scaling is not appropriate; therefore, toxicity values for the robin were not adjusted using this technique (Mineau *et al.* 1996).

A description of the toxicity studies selected to derive the endpoint species TRVs is provided in Table 6-6. Table 6-7 provides the derivation of the wildlife TRVs for the endpoint species from the literature TRVs. No suitable toxicity value for benzo(a)pyrene was found for avian receptors, so the potential toxicity of this compound to the American robin could not be evaluated.

6.4.1.3 Wildlife Risk Characterization

HQ
hazard quotient

The potential risks posed by COPCs were evaluated by calculating a hazard quotient (HQ) for each contaminant for each endpoint species. The HQ for all pathways was determined by dividing the total exposure from all pathways (ADD_{total}) by the appropriate TRV for the endpoint species and contaminant, as shown in the following equation:

$$HQ = ADD_{total}/TRV$$

If the resultant HQ is greater than 1.0, a potential risk for adverse effects from exposure to the chemical exists. Tables 6-7 and 6-8 present the estimated exposure from food and soil ingestion, the total exposure, and the calculated HQs for the American robin and short-tailed shrew, respectively. An HQ for both the NOAEL and LOAEL were calculated to address the uncertainty that results from using only one endpoint. Both values represent a threshold above which adverse effects could occur. However, a dose that lies between these two values may or may not cause adverse effects (i.e., the true effects threshold is somewhere between the experimentally determined NOAEL and LOAEL). By examining both, one can determine whether or not the contaminants at the site are above the LOAEL, indicating a high probability of adverse effects, or below the NOAEL, indicating a high likelihood for the absence of adverse effects.

Table 6-6 Summary of Toxicity Benchmark Values for Mammalian and Avian Species

Chemical	Test Animal	Exposure Duration	Endpoint	Critical Effects	Toxicity Benchmark (mg/kg/d)
Inorganics					
Cadmium	mallard duck	90 days	NOAEL	reproductive	1.45
	rat	6 weeks	NOAEL	reproductive	1
Chromium	black duck	10 months	NOAEL	reproductive	1
	rat	90 days	NOAEL	reproductive	2737
Copper	1 day old chicks	10 weeks	NOAEL	mortality	47
	mink	357 days	NOAEL	reproductive	11.7
Lead	Japanese quail	12 weeks	NOAEL	reproductive	1.13
	rat	>1 year	NOAEL	reproductive	8
Nickel	mallard duckling	90 days	NOAEL	mortality	77.4
	rat	>1 year	NOAEL	reproductive	40
Zinc	white leghorn hen	44 weeks	NOAEL	reproductive	14.5
	rat	16 days	NOAEL	reproductive	160
PCBs					
Aroclor 1254	ring-necked pheasant	17 weeks	NOAEL	reproductive	0.18
	oldfield mouse	18 weeks	NOAEL	reproductive	0.068
Aroclor 1260[a]	ring-necked pheasant	17 weeks	NOAEL	reproductive	0.18
	oldfield mouse	12 months	NOAEL	reproductive	0.068
PAHs					
Benzo(a)pyrene	mouse	16 days	NOAEL	reproductive	1.19

[a]Toxicity data for Aroclor 1254 used for Aroclor 1260
Toxicity data from Sample *et al.* 1996

Table 6-7 Toxicity Values for Endpoint Species

Chemical	Test Animal	Body Weight Test Species (kg)	Receptor	Body Weight Receptor Species (kg)	LOAELToxicity Benchmark (mg/kg/day)	NOAEL Toxicity Benchmark (mg/kg/day)	Scaling Factor	LOAEL SF	NOAEL SF
Metals									
Cadmium	mallard duck	1.153	american robin	0.077	20.80	1.45	1		
	rat	0.35	short tailed shrew	0.015	21.20	2.12	2.2	45.59	4.65
Chromium	black duck	1.25	american robin	0.077	5.00	1	1		
	rat	0.35	short tailed shrew	0.015	na	6015	2.2		13219.95
Copper	1 day old chicks	0.534	american robin	0.077	61.70	47	1		
	mink	1.85	short tailed shrew	0.015	44.00	33.4	4.98	125.72	95.43
Lead	Japanese quail	0.15	american robin	0.077	11.30	1.13	1		
	rat	0.35	short tailed shrew	0.015	175.83	17.58	2.2	386.44	38.63
Nickel	mallard duckling	0.782	american robin	0.077	107.00	77.4	1		
	rat	0.35	short tailed shrew	0.015	175.83	87.91	2.2	386.44	193.21
Zinc	white leghorn hen	1.766	american robin	0.077	131.00	14.5	1		
	rat	0.35	short tailed shrew	0.015	703.30	351.7	2.2	1545.73	772.97
PCBs									
Aroclor 1254	ring-necked pheasant	1	american robin	0.077	1.80	0.18	1		
	oldfield mouse	0.022	short tailed shrew	0.015	0.67	0.067	1.19	0.735	0.073
Aroclor 1260[a]	ring-necked pheasant	1	american robin	0.077	1.80	0.18	1		
	oldfield mouse	0.022	short tailed shrew	0.015	0.67	0.067	1.19	0.735	0.073
PAHs	**no avian data available**		american robin	0.077			1		
Benzo(a)pyrene	mouse	0.022	short tailed shrew	0.015	11.89	1.19	1.19	13.08	1.309

Toxicity data from Sample *et al.* 1996
[a]Toxicity data for Aroclor 1254 used for Aroclor 1260.
SF = scaling factor
na = not available

The wildlife risk analysis suggests that metal contamination in the site area may be a threat to local wildlife. HQ_{NOAEL} values for the American robin exceeded 1 for cadmium, chromium, lead, and zinc. HQ_{NOAEL} values for the short-tailed shrew exceeded 1 for cadmium. The wildlife risk analysis also suggests that PCB contamination in site area may be a threat to local wildlife; HQ_{NOAEL} values for both receptor species exceeded 1.

Although the HQ_{NOAEL} values for several chemicals exceed unity for the robin and shrew, this does not necessarily mean that songbirds and small mammals that use the site area are being adversely affected. The wildlife exposure assessment includes several conservative assumptions that may result in overestimates of risk. For example, because the exposure estimates in Tables 6-8 and 6-9 were calculated assuming 100% bioavailability, the estimates for the metals likely are biased high; metals occur in many complex forms that often are only sparingly available (Sposito and Page 1984). In addition, it is probably unlikely that 100% of the exposure for a robin or shrew would occur entirely at the site; the adjacent land is likely used by these receptors. Also, for the robin, an individual bird may not reside in the site area year-round; migratory individuals would receive about 50% lower exposure over the course of the year. Finally, it is worth noting that the HQs calculated using the LOAELs were less than 1 for all chemicals (see Tables 6-7 and 6-8). Thus, although adverse effects for receptors cannot be ruled out (i.e., several HQ_{NOAEL} values exceed 1), it cannot be confirmed that the true adverse effects thresholds are exceeded (i.e., no HQ_{LOAEL} values exceed 1).

6.4.1.4 Uncertainties in the Wildlife Risk Analysis

This section discusses uncertainties associated with the wildlife risk analysis. Uncertainties in the exposure assessment include:

Selection of the endpoint species: Uncertainty may be associated with selection of endpoint species because it is impossible to evaluate every species that may be impacted by contamination present. Nonetheless, the characteristics of the site limit the range of species that potentially may be impacted by site contamination. The chosen endpoint species, the robin and shrew, likely are representative of terrestrial species that would frequent the site.

Uptake of Contaminants by Soil Invertebrates: For organic compounds, the EPCs calculated for soil invertebrates are dependent upon the organic-carbon content of the soil. The organic-carbon content of soil at the Cauterskill Road site was not available, so 1% was assumed, which is less than the average concentration for the eastern United States (Shacklette and Boerngen 1984). A lower soil organic-carbon content results in a higher organic-chemical level in soil invertebrates using the Menzie *et al.* (1992)

Table 6-8 Cauterskill Road Site, Summary of Calculated Exposure Risks for the American Robin

Chemical	EPC soil (mg/kg)	Soil ingestion (mg/kg/d)	Food chain (mg/kg/d)	Total (mg/kg/d)	LOAEL (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL HQ	NOAEL HQ
Inorganics								
Cadmium	5.11	0.126	3.693	3.819	20.8	1.45	0.18	2.634
Chromium	38.54	0.951	1.429	2.380	5	1	0.48	2.380
Copper	187.89	4.636	8.152	12.789	61.7	47	0.21	0.272
Lead	139.81	3.450	4.593	8.042	11.3	1.13	0.71	7.117
Nickel	215.29	5.312	28.784	34.096	107	77.4	0.32	0.441
Zinc	343.62	8.479	106.039	114.518	131	14.5	0.87	7.898
PCBs								
Aroclor 1254	1.2	0.030	0.491	0.521	1.8	0.18	0.289	2.893
Aroclor 1260	4.9	0.121	2.006	2.127	**na**	--	--	--
PAHs								
Benzo(a)pyrene	1.8	0.044	2.729	2.773	**na**	--	--	--

Key:

EPC = exposure point concentration
BM = benchmark
HQ = hazard quotient
LOAEL = lowest observed adverse effect level
NOAEL = no observed adverse effect level
na = not available

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Table 6-9 Cauterskill Road Site, Summary of Calculated Exposure Risks for the Short-tailed Shrew

Chemical	EPC soil (mg/kg)	Soil ingestion (mg/kg/d)	Food chain (mg/kg/d)	Total (mg/kg/d)	LOAEL (mg/kg/d)	NOAEL (mg/kg/d)	LOAEL HQ	NOAEL HQ
Inorganics								
Cadmium	5.11	0.399	4.02	4.417	21.2	2.12	0.21	2.084
Chromium	38.54	3.006	1.57	4.578	**na**	6015		0.001
Copper	187.89	14.655	2.83	17.490	44	33.4	0.40	0.524
Lead	139.81	10.905	4.96	15.863	175.83	17.58	0.09	0.902
Nickel	215.29	16.793	30.40	47.191	175.83	87.91	0.27	0.537
Zinc	343.62	26.802	77.10	103.901	703.3	351.7	0.15	0.295
PCBs								
Aroclor 1254	1.2	0.0936	0.4848	0.578	0.668	0.067	0.866	8.633
Aroclor 1260	4.9	0.3822	1.9796	2.362	**na**	0	0	0
PAHs								
Benzo(a)pyrene	1.8	0.1404	0.7272	0.868	11.89	1.19	0.07297	0.729

Key:

EPC = exposure point concentration
BM = benchmark
HQ = hazard quotient
LOAEL = lowest observed adverse effect level
NOAEL = no observed adverse effect level
na = not available

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model. Consequently, the assumption of 1% organic carbon is viewed as conservative and likely means that the exposure estimates for the receptor species are biased high for PCBs and PAHs.

Use of Earthworm Model: Some uncertainty may be associated with the use of the earthworm model. It may not be representative for all soil invertebrates. Other organisms such as insects may be part of the diet for the shrew and the robin, but the uptake of chemicals from soil by these organisms is poorly understood. The model of Menzie *et al.* (1992) is dependent on the lipid content of soil organisms. If the lipid content of other soil invertebrates is markedly different than the value of 2% assumed for earthworms in this assessment, then the model may inaccurately estimate organic-chemical levels in these invertebrates.

Sampling Data Uncertainties: The data used to calculate EPCs was collected in an area that is partially wooded and partially grassy. These two habitat types may not be utilized equally by the endpoint species. Also, areas of known contamination were sampled more heavily than other areas. Consequently, it is likely that the EPCs overestimate the actual average chemical concentrations encountered by receptors at the site. Lastly, extremely high chemical concentrations (i.e., outliers) from contamination "hotspots" can inflate the average risk estimates; several such outliers were included in the calculation of EPCs for metals in this assessment.

The possible sources of uncertainty in the ecological effects assessment include:

Extrapolation from literature Toxicity Data to TRVs: Principal uncertainties associated with the extrapolation process are identified and discussed in Section 6.4.1.2.

Extrapolation from individual risk estimates to higher levels of organization: There are uncertainties in extrapolating individual risk estimates to the population or community level. A hazard quotient (HQ) provides an estimate of risk to an individual organism. For an individual, an HQ less than 1 signifies an insignificant risk, while an HQ that exceeds 1 suggests a potential for adverse effects. However, HQs do not indicate a specific risk level at the population or ecosystem level since various factors may mitigate or compound the effects at these higher levels of organization.

An alternative methodology for assessing the potential toxic effects on wildlife of cadmium in soils was presented by NYSDEC (1999). The method differs from the approach taken here primarily in the selection of bioaccumulation factors for invertebrates and plants, and the toxicity reference values for mammals and birds. For example, a LOAEL for concentrations of cadmium in mammalian kidneys is used in NYSDEC 1999 to evaluate potential risks to small mammals, rather than the dietary NOAELs and LOAELs used in this report. While the approach taken here is equally valid, based on available federal guidance, the NYSDEC approach results in generally more stringent soil concentrations which are protective of wildlife. A soil concentration of 1 mg/kg is presented by NYSDEC as a guidance value for wildlife. The average soil concentration of cadmium of 5.11 mg/kg at the Cauterskill Road site is well above this guidance value. The NYSDEC guidance suggests additional investigation such as tissue analysis, toxicity testing, community analysis, and population studies may be needed to address actual impacts of soils contaminated with greater than 1 mg/kg cadmium.

6.4.1.5 Summary of Wildlife Risks

The wildlife risk analysis suggests that metals and PCBs may pose an ecological risk at this site. The average exposure case for both the American robin and the short-tailed shrew identified risks. The robin may be adversely affected by cadmium, chromium, lead, zinc, and PCBs. The short-tailed shrew may be adversely affected by cadmium and PCBs. Overall, the analysis suggests that metals and PCBs in site soils may adversely affect songbirds and small mammals that use the area regularly, particularly those that may forage in the areas of highest contamination.

6.4.2 Vegetation and Soil Invertebrate Risks

Table 6-10 compares COPC levels in site soils with phytotoxicity and soil-invertebrate toxicity benchmarks. The comparison indicates that levels of cadmium, chromium, copper, lead, nickel, and zinc in site soils are high enough to adversely affect both plants and soil invertebrates. The maximum soil concentration of several metals exceed the benchmarks by several orders of magnitude. At the locations of these maxima, the soil invertebrate community may be impoverished or even absent. This possibility influences the interpretation of the wildlife risk analysis, which inherently assumes that soil invertebrates are equally present in site soil with low and high COPC levels. Conversely, if areas with high levels of soil contamination support little or no invertebrates, then songbirds and small mammals would obtain less prey from these areas and, thus, their exposure to site COPCs may be less than estimated in the previous section.

6.4.3 Aquatic Life Risks

Data presented in the draft RI report (E&E 1999) showed that sediment levels of several trace metals – arsenic, cadmium, copper, lead, nickel, and zinc, – and PAHs routinely exceeded benchmarks for benthic-life protection in the tributary to Kaaterskill Creek near the site. Possible sources of the contamination include past waste disposal at the site and/or runoff from highways and other upstream areas. In June 1999, additional sediment samples were

Table 6-10 Vegetation and Soil Invertebrate Benchmark Comparisons for the Cauterskill Road Site

Chemical	Min	Max	Phytotoxicity Benchmark[a]	Invertebrate Toxicity Benchmark[b]	Plant Benchmark Exceedances[c]	Invertebrate Benchmark Exceedances[c]
Metals (mg/kg)						
Cadmium	0.7	39.1	4	20	13	5
Chromium	7.3	865	1	10	42	39
Copper	13.2	4600	100	50	7	15
Lead	12	1160	50	500	22	2
Nickel	13	9840	30	200	25	7
Zinc	44.4	2840	50	200	41	11
PCBs (mg/kg)						
Aroclor 1254	0.066	1.2D	40	na	0	na
Aroclor 1260	0.058	4.9D	40	na	0	na
PAHs (mg/kg)						
Benzo(a)pyrene	.078J	1.8	na	na	na	na

Key:
na = not available
J = estimated value
D = estimated from diluted sample
[a] From Efrymson *et al.* 1997a
[b] From Efrymson *et al.* 1997b
[c] Exceedances of 42 surface soil samples

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collected from five locations in the tributary to evaluate the ecological effects of the contamination and to help identify its extent and possible sources. The locations included a new reference area upstream from the site (CRSD-13), one previously sampled location near the site (CRSD-14), and three new locations downstream from the site (CRSD-15 through -17) (see Figure 6-3). At these locations, sediment was collected for analysis of metals, PAHs, and parameters to help evaluate contaminant bioavailability and toxicity, including total organic carbon (TOC), acid volatile sulfide/simultaneously extracted metals (AVS/SEM), and toxicity to laboratory-reared benthic invertebrates. In this section, the new data are presented and discussed as they relate to aquatic-life risks and sources and extent of contamination.

TOC
total organic carbon

AVS/SEM
acid volatile sulfide/simultaneously extracted metals

LEL
low effect-level

SEL
severe effect-level

6.4.3.1 Possible Sources and Extent of Contamination

The June 1999 sediment data for arsenic, cadmium, copper, lead, nickel, zinc, and total PAHs are presented in Figure 6-4; sample locations are arranged from upstream (CRSD-13) to downstream (CRSD-17) in the figure (see also Figure 6-3). To help evaluate the data from a toxicological perspective, benchmarks for benthic-life protection also are shown in Figure 6-4. For the metals, low effect-level (LEL) and severe effect-level (SEL) benchmarks from NYSDEC (1997) are shown. For total PAHs, the LEL for freshwater sediments from Persaud *et al.* (1993) is shown. The SEL for total PAHs from Persaud *et al.* (1993) is approximately 500 mg/kg and lies well above the highest sample concentration in Figure 6-4G.

For copper, cadmium, lead, zinc, and total PAHs, the greatest sediment concentration was observed at the new upstream reference location (CRSD-13) near the intersection of Route 23 and Interstate-87, with a steady decrease in concentration in the downstream direction. The data suggest that sources of these analytes exist upstream from the site. One likely source is vehicular traffic on I-87. Sediment levels of nickel were highest adjacent to the site (CRSD-14) and steadily decreased in the downstream direction. This pattern of contamination suggests that the site may be a source of nickel to the tributary stream. Sediment arsenic levels did not appear to be influenced by the site or upstream sources.

6.4.3.2 Benthic Life Effects

Toxicity Testing Results

Toxicity tests were conducted with sediment from the tributary to determine if the elevated levels of metals and PAHs pose a risk to benthic life. A 10-day growth and survival test with *Hyalella azteca*, a common freshwater amphipod species, was conducted with sediment from each location. The test method is described in USEPA (1994) and ASTM (1995). Table 6-11 summarizes the test results. The test report is included in Appendix G.

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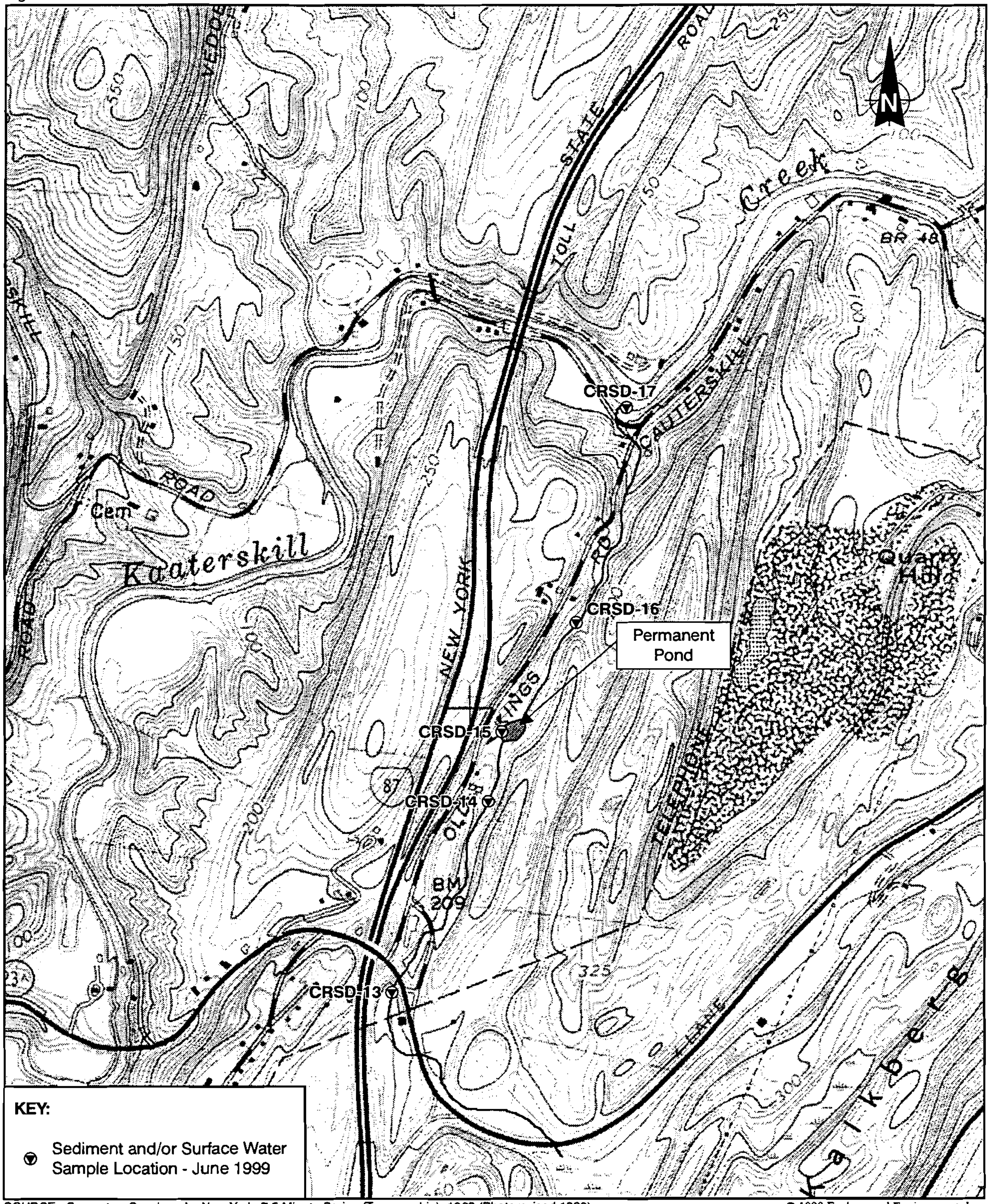
Fig6-3.CDR-9/22/99-GRA



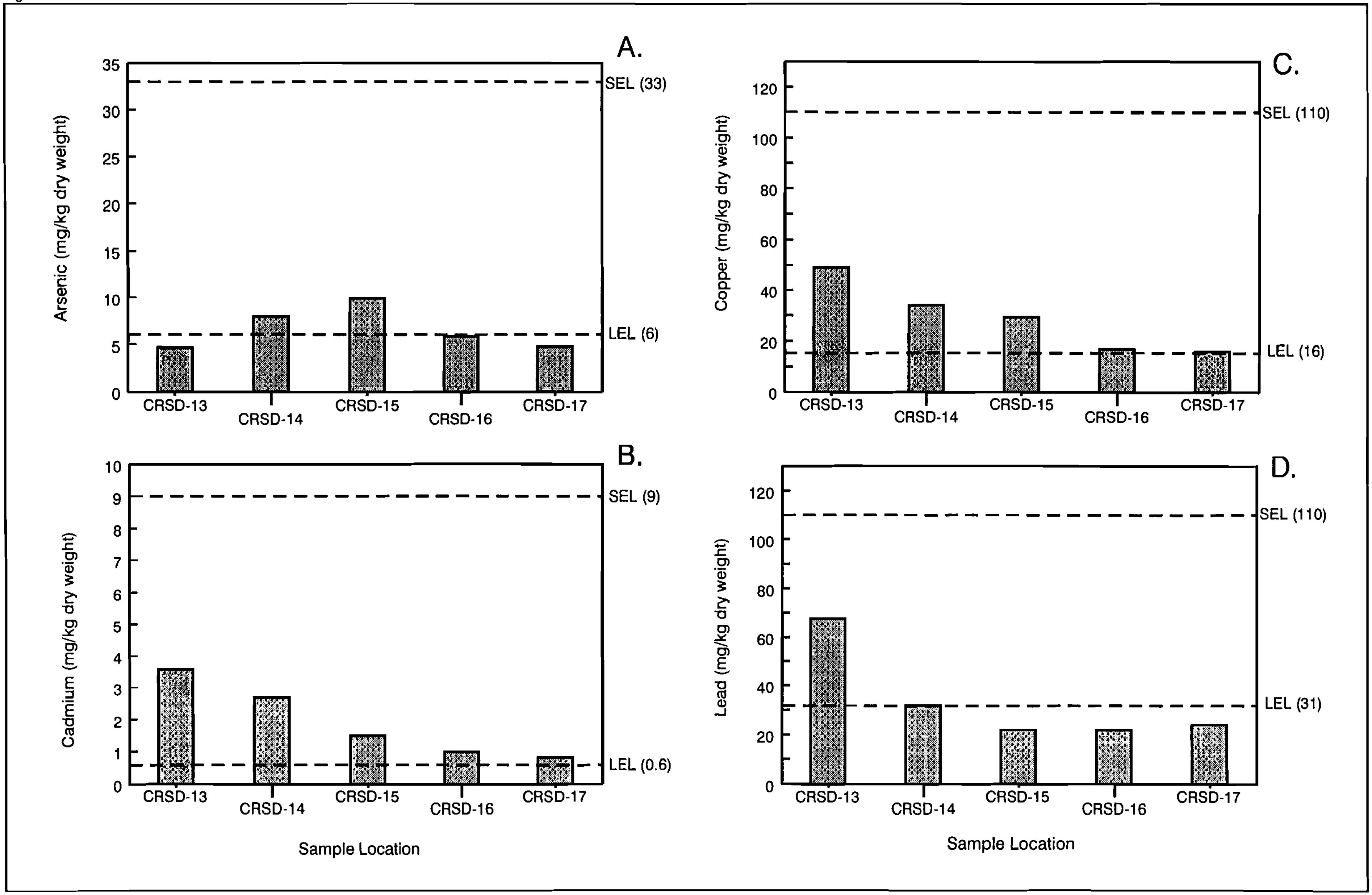
SOURCE: Cementon Quadrangle, New York, 7.5 Minute Series (Topographic), 1963 (Photorevised 1980).

APPROXIMATE SCALE

0 ¼ ½ Mile

0 0.25 0.5 Kilometer

Figure 6-3 JUNE 1999 SAMPLING LOCATIONS ON TRIBUTARY TO KAATERSKILL CREEK



SOURCE: Ecology and Environment, Inc. 1999

Figure 6-4 JUNE 1999 SEDIMENT COPC LEVELS AT LOCATIONS CRSD 13 TO 17 IN TRIBUTARY TO KAATERSKILL CREEK

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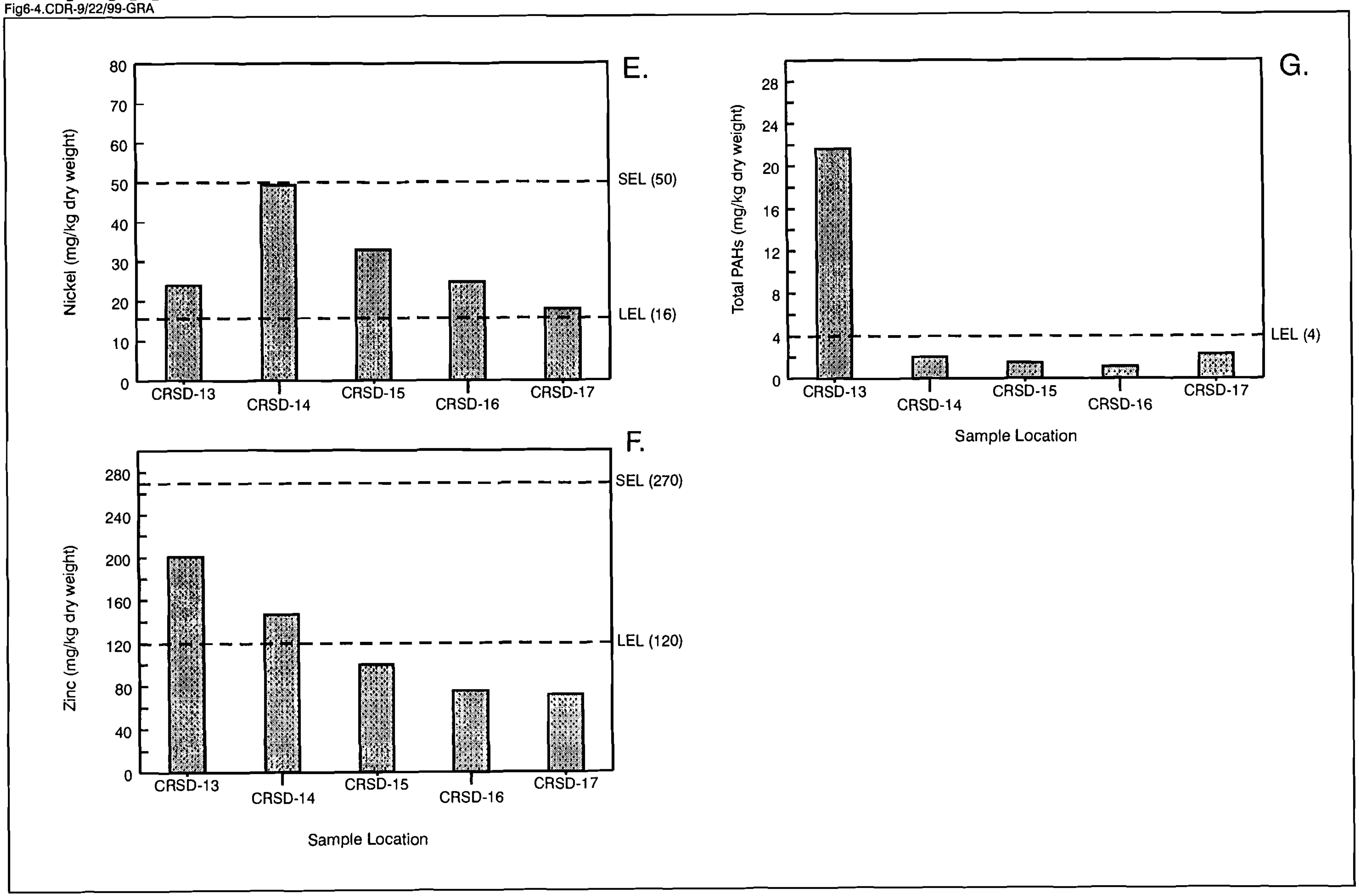
Fig6-4.CDR-9/22/99-GRA



SOURCE: Ecology and Environment, Inc. 1999

Figure 6-4(Cont.) JUNE 1999 SEDIMENT COPC LEVELS AT LOCATIONS CRSD 13 TO 17 IN TRIBUTARY TO KAATERSKILL CREEK

Table 6-11 Summary of Survival and Growth of *Hyalella azteca* after 10-day Exposure to Sediment from the Tributary to Kaaterskill Creek

Sample Location[a]	Mean Percent Survival (standard deviation)	Mean Dry Weight in mg/organism (standard deviation)	Significant Difference ($p<0.05$) from Lab Control for Survival or Growth
Laboratory Control	98 (5)	0.33 (0.03)	—
CRSD-13	96 (5)	0.40 (0.05)	no
CRSD-14	94 (7)	0.29 (0.03)	no
CRSD-15	84 (18)	0.34 (0.03)	no
CRSD-16	96 (7)	0.37 (0.03)	no
CRSD-17	93 (12)	0.32 (0.06)	no
CRSD-17 (duplicate)	89 (11)	0.31 (0.03)	no

[a] See Figure 6-3 for sample locations.

Amphipod survival in sediment from the tributary ranged from 84% to 96% and was not significantly different than survival in laboratory-control sediment (a clean mixture of sand, clay, and organic matter) (see Table 6-10). Likewise, amphipod growth in sediment from the tributary was not significantly different than growth in laboratory control sediment (see Table 6-10). The test results suggest that *in situ* levels of metals and PAHs in the tributary pose no hazard to benthic life.

Contaminant Bioavailability

A lack of adverse effects in the toxicity tests likely results from limited contaminant bioavailability. PAH bioavailability in sediment is strongly influenced by sediment total organic carbon (TOC) (Swartz 1999). High TOC levels tend to render PAHs unavailable to benthic life. Sediment TOC levels in the tributary were comparatively high for stream sediment, ranging from 2.4% to 11.7%. The highest TOC level (11.7%) was at the upstream reference area (CRSD-13), where PAHs levels were greatest (see Figure 6-4G), and probably accounts (in part) for the lack of adverse affects at this location.

In freshwater sediment, AVS has been shown to be important in ameliorating heavy-metal toxicity because it forms insoluble precipitates with several metals and, thus, limits their bioavailability. Six divalent metals in particular – cadmium, copper, lead, mercury, nickel, and zinc – form very insoluble complexes with AVS (DiToro *et al.* 1990, 1992). AVS is operationally defined as the solid-phase sediment sulfides that are soluble in cold acid (1 molar HCl). The metals that are simultaneously solubilized during the acidification step are termed "simultaneously extractable metals."

The molar ratio of SEM to AVS is useful in predicting the bioavailability of sediment metals. If the molar ratio of SEM to AVS is less than 1, the six divalent metals listed above most likely are bound to AVS and, thus, are not bioavailable. Conversely, if the molar ratio of SEM to AVS exceeds 1, there is insufficient AVS to bind the metals and, thus, some heavy-metal ions may be available for uptake. The SEM/AVS ratio was calculated for locations CRSD-13 to 17 to determine if the cadmium, copper, lead, nickel, and zinc in sediment from these locations was bioavailable (see Table 6-12). The ratio was less than 1 at four of the five locations, suggesting that the metals are not bioavailable in most areas of the tributary.

Table 6-12 AVS/SEM Results for Sediment From the Tributary to Kaaterskill Creek

Parameter	Units	Sample Location				
		CRSD-13	CRSD-14	CRSD-15	CRSD-16	CRSD-17
AVS	µmol/g	3.50	0.267	26.7	3.23	0.218
SEM-cadmium	µmol/g	0.002	0.010	0.003	0.003	0.001
SEM-copper	µmol/g	0.636	0.106	0.082	0.066	0.020
SEM-Lead	µmol/g	0.088	0.054	0.037	0.042	0.030
SEM-Nickel	µmol/g	0.040	0.191	0.082	0.089	0.020
SEM-Zinc	µmol/g	0.520	0.406	0.271	0.247	0.137
∑SEM metals	µmol/g	1.285	0.768	0.477	0.447	0.208
∑SEM/AVS	—	**0.367**	**2.875**	**0.0179**	**0.138**	**0.953**

Key:

AVS = Acid volatile sulfide,
SEM = Simultaneously extracted metals.

6.5 Summary of Toxic Effect Analysis

This toxic effect analysis for the Cauterskill Road site evaluated impacts to both terrestrial and aquatic species with potential exposure to site contaminants. Additional data were collected and a risk analysis was conducted to supplement previous data and analysis conducted for the draft RI. The conclusions of the toxic effect analysis are summarized in this section.

The risks of contaminant effects on aquatic life appear to be negligible. The results of sediment toxicity tests demonstrated that there are no adverse effects of stream sediment on growth and survival of sensitive species of benthic macroinvertebrates. Levels of various contaminants in sediment were elevated, but the contaminants appear to occur in forms that are not bioavailable or toxic to aquatic organisms. The stream itself provides minimal habitat for aquatic life adjacent to the site, where concentrations of contaminants are highest. The contaminant levels decrease further downstream, where stream habitat quality also improves. Therefore, no additional investigation or remedial action appears to be necessary to address risks of the site to aquatic life.

Terrestrial wildlife, plants, and invertebrates could be impacted by soil contamination at the site, particularly PCBs and certain metals such as cadmium, chromium, lead, and zinc. These impacts were identified using a wildlife risk analysis and by screening contaminant data against available benchmarks. None of the predicted wildlife risks exceeded a lower threshold for toxic effects (LOAEL), but the thresholds for no effects (NOAELS) are exceeded. It is also possible that some soils at the site are toxic to plants and invertebrate life, based on the available benchmarks. However, no site-specific biological data are available to verify the risks to terrestrial species, which are predicted using these calculation methods. Because of the relatively small size of the contaminated areas at the site, and the conservative assumptions used for the risk assessment, it does not seem likely that toxic effects on terrestrial species are widespread or could severely impact communities or populations of organisms resident in the area. No endangered, threatened, or rare species are known to occur at the site and the site itself is not a significant ecological resource. Given the limited value of wildlife resources likely to be impacted, it is not clear that additional study of contaminant uptake and toxicity to terrestrial species is warranted. Remediation of the most contaminated portions of the site would likely eliminate the ecological risks identified in this report.

7 Summary and Conclusions

7.1 Project Summary

7.1.1 Summary of Site Investigation

The site investigation involved an initial site reconnaissance; development of a work plan; a records search; geophysical survey; surface soil, subsurface soil, groundwater, surface water and sediment, and exposed waste investigations and sampling; base map development; a fish and wildlife impact analysis; and submittal of this draft RI report. The investigations began in September 1998 with the site reconnaissance, the work plan was submitted in November 1998, and fieldwork was performed between December 1998 and March 1999.

Based on the results of the Phase I RI report, additional sampling was performed on July 1, 1999. This Phase II fieldwork was performed in accordance with a scoping letter dated June 21, 1999.

The site reconnaissance, work plan development, records search, geophysical survey, fish and wildlife impact analysis, and generation of this report were performed by E & E; field investigations were performed by an E & E and JCL team; the base map was developed by JCL; laboratory analyses were performed by E & E's ASC, Frield Laboratory, Inc., and SciLab, Inc.; and data validation was performed by ChemWorld Environmental, Inc.

7.1.2 Nature and Extent of Contamination

In general, the nature and extent of contamination at the Cauterskill Road site has been reasonably defined by the data collected during the RI. The buried disposal area has been defined by the geophysical survey and test pit excavations; surface soil contamination is limited to the site; subsurface soils have been impacted by the disposal materials; groundwater contamination is not evident; and only minor amounts of contamination have spread off site through the tributary to Kaaterskill Creek.

The following is a summary of the contaminants of concern detected at the site:

Surface Soils

- No VOCs exceeded guidance values;

- Seven SVOCs exceeded guidance values: six were PAHs which included benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and dibenz(a,h)anthracene; and one was di-n-butylphthalate from soils collected at the base of the disposal area and from a small area of stressed vegetation on the dirt in the southeast corner of the site;

- No pesticides exceeded guidance values;

- One PCB, Aroclor 1260, was detected above its guidance value from the same stressed vegetation area mentioned above; and

- Cadmium, chromium, copper, iron, lead, magnesium, mercury, nickel, and zinc were detected at levels greater than twice the mean background value from soils north of Barn 1; northeast and east of the chicken coop; inside, under the overhang, and to the east of Barn 3; at the stressed vegetation area on the dirt road; and from the disposal area on the west side of the dirt road in the southeast corner of the site.

Subsurface Soils

- Only an isolated occurrence of toluene was detected slightly above its guidance values from a subsurface soil sample collected from the CRMW-6 borehole at a depth of 4 to 5 feet BGS;

- Six SVOCs (all PAHs) exceeded NYSDEC guidance values: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, and dibenzo(a,h) anthracene (the same SVOCs that exceeded guidance values in surface soils) from test pits located in the disposal area northeast and east of the barns; and benzo(a)pyrene in the CRMW-5 borehole exceeded cleanup objectives from a depth of 2 to 6 feet BGS;

- One pesticide, heptachlor epoxide, exceeded its guidance value from a test pit located east of the chicken coop;

- No PCBs exceeded guidance values; and

- Aluminum, calcium, cadmium, chromium, copper, iron, magnesium, mercury, nickel, potassium, selenium, silver, sodium, and thallium were detected at levels greater than twice the mean background value from test pits located in the disposal area northeast and east of the barns, and a test pit along the dirt road, at the base of the surficial disposal area; and high levels of selenium, silver, and thallium were detected in the CRMW-5 borehole from a depth of 2 to 6 feet BGS.

Groundwater

Monitoring Wells

- No VOCs exceeded NYSDEC Class GA standards;
- No SVOCs exceeded NYSDEC Class GA standards;
- No pesticides or PCBs were detected in any of the monitoring wells; and
- Iron, sodium, and thallium were detected above NYSDEC Class GA Standards. All three metals exceeded in the upgradient well (CRMW-1), and only iron and sodium exceeded in the downgradient wells.

Residential Wells

- No VOCs exceeded NYSDEC Class GA standards;
- No SVOCs exceeded NYSDEC Class GA standards;
- No pesticides or PCBs were detected in any of the residential wells tested; and
- Iron and sodium exceeded NYSDEC Class GA standards in two wells (5048B and 5056); sodium and mercury exceeded standards in one well (5048H); and sodium alone exceeded standards in one well (5040).

Surface Water

- No VOCs were detected;
- One SVOC, bis(2-ethylhexyl)phthalate, was detected above NYSDEC Class C ambient water standards from an upstream location and from a seep from the disposal area.
- No pesticides or PCBs were detected; and
- Aluminum, iron, silver, and cyanide were detected above NYSDEC Class C ambient water standards. Aluminum, iron, and silver exceeded in an upstream sample, the south pond, and a downstream sample; silver exceeded a seep from the disposal area; and aluminum and iron exceeded in the west pond.

Cyanide exceeded in the south pond, in a seep from the disposal area, and in a downstream sample.

Sediment

- No VOCs were detected;
- Four SVOCs, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, and indeno(1,2,3-cd)pyrene exceeded screening levels in an upstream sample and a sample from the south pond;
- Seven SVOCs, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, ideno(1,2,3-cd)pyrene, and 2-methylnaphthalene, were detected above screening levels in downstream samples and a pond further to the north (off site);
- One pesticide, heptachlor epoxide, slightly exceeded the screening criterion in a sample from the north pond;
- No PCBs exceeded criteria; and
- Antimony, arsenic, cadmium, chromium, iron, lead, manganese, nickel, and zinc were above the NYSDEC lowest effect levels. Iron, manganese and nickel also exceeded the severe effect levels in upstream, on site, and downstream samples.

Waste

- The two waste samples did not exceed TCLP metals or cyanide reactivity standards.

7.1.3 Fish and Wildlife Impact Analysis

A fish and wildlife impact analysis was conducted for the Cauterskill Road site and was presented in the draft RI report (E & E 1999). The analysis concluded that aquatic habitat and wildlife resources at the site were potentially at risk from exposure to toxic levels of site-related chemicals. The chemicals of potential ecological concern at the site included six metals (cadmium, chromium, copper, lead, nickel, and zinc) related to disposal of plating wastes at the site, and possibly selected PAHs and PCBs. Terrestrial habitats at the site are suitable for a variety of wildlife species. Aquatic habitat in the site vicinity is limited and appears to support benthic invertebrates and amphibians, but not fish. As per NYSDEC guidance, a toxic effect analysis was undertaken to evaluate the risks that site contaminants pose to these resources. Findings included:

- The risks of contaminant effects on aquatic life appear to be negligible. The results of sediment toxicity tests demonstrated that there are no adverse effects of stream sediment on growth and survival of sensitive species of benthic macroinvertebrates. Levels of various contaminants in sediment were elevated, but the contaminants appear to occur in forms that are not bioavailable or toxic to aquatic organisms. Therefore, no additional investigation or remedial action appears to be necessary to address risks to aquatic life.

- Terrestrial wildlife, plants, and invertebrates could be impacted by soil contamination at the site, particularly PCBs and certain metals such as cadmium, chromium, lead, and zinc. These impacts were identified using wildlife risk-assessment methods and by screening soil contaminant levels against available benchmarks for plants and soil invertebrates. Although risks are predicted for these receptors, no site-specific biological data are available to determine if the predicted risks are real. Because of the relatively small size of the contaminated areas at the site, and the conservative assumptions used for the risk assessment, it does not seem likely that toxic effects on terrestrial species are widespread or could severely impact communities or populations of organisms resident in the area. No endangered, threatened, or rare species are known to occur at the site and the site itself is not a significant ecological resource. Given the limited value of wildlife resources likely to be impacted, it is not clear that additional study of contaminant uptake and toxicity to terrestrial species is warranted. Remediation of the most contaminated portions of the site would likely eliminate the ecological risks identified in this report.

7.2 Conclusions

7.2.1 Data Limitations and Recommendations for Future Work

Results of the RI activities and analytical data indicate the presence of surface soil contamination in the vicinity of the barns, along the dirt road, and in the surficial disposal area on the west side of the dirt road; subsurface soil contamination in the burial area along the embankment to the tributary; and in the surface water and sediment of the tributary. Groundwater contamination is minimal and does not appear to be site related (e.g., iron is a common natural constituent, sodium is generally from roadway deicing; and mercury and thallium were also detected in upgradient samples). The extent of contamination is limited due to the following reasons:

- The faulting and folding of the underlying bedrock, which is very near to the surface, has resulted in highly permeable bedding plane and vertical fractures which act as conduits for groundwater contamination migration. Since many fractures are unpredictable, the exact migration pathways are unknown. In addition, due to the presence of the fault line beneath the bed of the tributary, this high hydraulic conductivity zone has resulted in causing the tributary to be a losing stream. Therefore, if contaminants have migrated to the groundwater they do not necessarily discharge to the tributary, but instead migrate into the fault line and move deeper further to the north.

IRM
interim remedial measure

Due to the presence of exposed product (white powder in fiber board drums) and the presence of elevated cyanide in a seep from the site, interim remedial measures (IRMs) for the removal of exposed wastes along the embankment should be performed.

Additional wells are not recommended since the original wells are believed to be well placed, especially CRMW-4, CRMW-5, and CRMW-6, yet no significant contamination is present. Groundwater contaminants from the site have apparently been flushed through the very highly conductive fracture/fault system.

7.2.2 Indications of Contaminant Sources

The disposal areas at the site have been clearly defined based on testimonies from former Catskill Chrome employees; visible exposed wastes noted during the site reconnaissance; defined fill boundaries by the RI geophysical survey; and confirmation through test pit excavations and sampling of various site media (i.e., surface soils, subsurface soils, groundwater, surface water/ sediment, and exposed wastes). The buried wastes are limited to a 50-foot-wide band northeast and east of the chicken coop, and east of the main barn along the embankment on the west side of the tributary to Kaaterskill Creek. Surficial disposal is evident on a stressed vegetation area on the dirt road in the southeast corner of the site, and on the west side of the dirt road. Spilling/disposal of wastes has also occurred onto the surface soils immediately north, east, and south of the barns. Chemical storage inside the main barn and possibly under the overhang on the east side of the main barn has also resulted in soils contaminated with metals.

8 References

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A

Photographic Logs

Photographic Log, Cauterskill Road Site

Camera: Olympus D-600L Zoom
Photographer: G. Florentino/G. Andrus

Photo	Date	Description
CR-1	9/ /98	View to east of site entrance way.
CR-2	9/ /98	View to northeast of alleged disposal area.
CR-3	9/ /98	White-powder waste exposed along embankment on west side of creek.
CR-4	9/ /98	Empty sodium cyanide drum along embankment on west side of creek.
CR-5	1/7/99	View to northeast of pickup truck, front end from CRTP-9.
CR-6	1/8/99	Vat and auto engine parts from CRTP-9.
CR-7	1/8/99	View to east of vats and spoils from CRTP-9.
CR-8	1/27/99	HX rock core from CRMW-1 (4.6 to 15.7 feet BGS).
CR-9	1/27/99	HX rock core from CRMW-1 (15.7 to 21.5 feet BGS).
CR-10	1/27/99	HX rock core from CRMW-2 (5 to 16.5 feet BGS).
CR-11	1/27/99	View to south of CRSW-1 location.
CR-12	1/27/99	View to south of CRSW-2 location.
CR-13	1/27/99	View to north of CRSW-3 location from the southern site pond.
CR-14	1/27/99	View to north of CRSW-5 location.
CR-15	1/27/99	View to north of CRSW-6 location from the disposal area spring on the west bank of the tributary.
CR-16	1/27/99	View to south of the CRSW-7 location from northern site pond.
CR-17	1/27/99	View to north of CRSW-8 location.
CR-18	1/27/99	View to north of CRSW-9 location.
CR-19	1/29/99	View to east of strike/dip location No. 2 on the east side of Cauterskill Road.
CR-20	1/29/99	View to southeast of strike/dip location No. 12 on the ridge east of the site.

CR-1

CR-2

CR-3

CR-4

CR-5

CR-6

CR-7

CR-8

CR-9

CR-10

CR-11

CR-12

CR-13

CR-14

CR-15

CR-16

CR-17

CR-18

CR-19

CR-20

B Boring and Well Development Logs

B. Boring and Well Development Logs

Borehole Record for MW01

- Drilling Log
- Narrative Lithologic Description
- Well Development Record
- Well Development -- Parameter Measurements
- Investigation - Derived Waste Inventory Sheet

DRILLING LOG FOR MW-02

Project Name: CAUTERSKILL ROAD RI

Site Location: CAUTERSKILL ROAD, CATSKILL, NY

Date Started/Finished: 1/7/99 / 1-20-99

Drilling Company: SJB DRILLING

Driller's Name: ART KISKE

Geologist's Name: J. Nickerson / G. Andrus

Geologist's Signature:

Rig Type (s): CME-75 Track Rig

Drilling Method (s): Auger/Air Rotary/ROLLER BIT/CORING

ROLLER Bit Size (s): 3 7/8" O.D. Auger Size (s): 4 1/4" I.D.

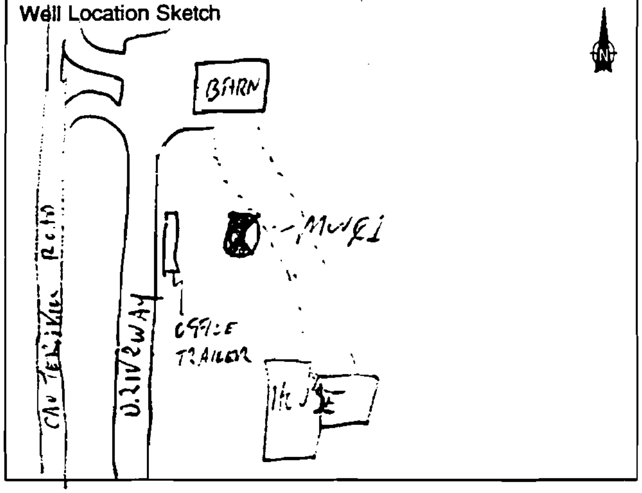
Auger/Split Spoon Refusal: 3.8'

Total Depth of Borehole Is: ~~40'~~ 37.5' bgs

Total Depth of Corehole Is: 21.3'

Water Level (TOIC)		
Date	Time	Level (Feet)
1/22/99	1014	28.14
1/27/99	1010	27.98
1/28/99	0950	28.20
1/21/99		

Well Location Sketch

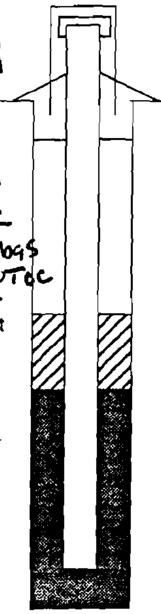


Depth(Feet)	SPLIT SPOON Sample Number	Blows on Sampler		Soil Components Rock Profile CL SL S GR	Penetration Times	CORE Run Number	Core Recovery	RQD	Fracture Sketch	~~HNu~~/OVA (ppm)	Comments
											Brown silty clay
1	1	2	2	CL/SL			0.5'	–		0	Rock Socket 3.8' to 4.8' w/HSA
2		2	2					–	–	0	
3	2	6	8	CL/SL w/GR			0.8'	–	–	0	BEDROCK REFUSAL (Augered socket
4		3	50							0	
AUGERED	–	–	–	–	5 mins	–	–			0.7	w/Augers 1' in rock 4.8')
5											
6						1	46"				tools dropped 1' +/- during coring (6-7' +/-)
7											
8								77			Carbon Steel Casing to 4.8'
9	9.6'										
10											
11											
12						2	61" (of 61.2")	98			
13											
14	14.7'										
15						3					

CR MW01

Lock Number 3476 Master

SCREENED WELL in bedrock



Stick-up ~~3.3~~ GF 2.62 ft carbon steel

Top of Grout 0 ft

Top of Seal at 18.30 TOC / 15.95 bgs ft

Top of Sand Pack ~~20.5~~ 20.5 TOC / 18.15 bgs ft

Top of Screen at 24.55 TOC / 22.5 bgs ft

Bottom of Screen at 39.85 TOC / 37.5 bgs ft

Bottom of Hole at 39.85 TOC / 37.5 bgs ft

Bottom of Sandpack at 39.85 TOC / 37.5 bgs

Inner Casing Material PVC

Inner Casing Inside Diameter 2" inches

GROUND SURFACE

Quantity of Material Used:

Bentonite ~~Pellets~~ chips 1/3 bag

Cement ____

Borehole Diameter 8 inches overburden/rocksocket

Cement/Bentonite ____

Grout ____

Screen Slot Size .01'

Screen Type

☒ PVC 2" ID

☐ Stainless Steel

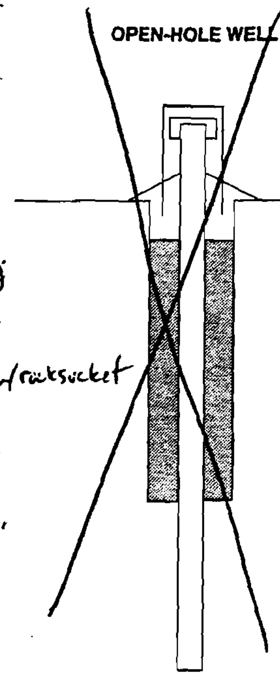
Pack Type/Size:

☒ Sand Morie #0

☐ Gravel

☐ Natural

OPEN-HOLE WELL



Stick-up 2.39 ft PVC

Inner Casing Material ____

Inner Casing Inside Diameter ____ inches

Outer Casing Diameter 4 inches

Borehole Diameter 8 ~~GF~~ ft 4" bedrock

Bedrock 3.8 ft

Bottom of Rock Socket/ Outer Casing 4.8 ft bgs

Bottom of Inner Casing 37.5 ft bgs

Corehole Diameter HX

Bottom of Corehole 21.3 ft

NOTE: See pages 136 and 137 for well construction diagrams

NARRATIVE LITHOLOGIC DESCRIPTION

Depth-ft.	Narrative Lithologic Description	Dry	Moist	Wet
1	Brown silty loam; top 0.2 ft. Roots. HNu monitor: open	☒	○	○
2	on 0'-2' and 2'-4' spoons	☒	○	○
3	Brown clay silt; med. plasticity; lower cohesion; gravel	○	☒	○
4	inclusions (angular) 2-10 mm. Rock inside gray	○	☒	○
5	weathered bedrock	☒	○	○
6	Medium to dark gray, massively bedded limestone, close to very close	☒	○	○
7	fractures (w/ 2ndary Ca mineralization), 2 cavities w/ Ca min., 1 @ 7",	☒	○	○
8	1 @ 24" – the one @ 24" may be the one taking all the water since the	☒	○	○
9	tools appeared to drop 1" +/- around this depth, little chert in upper	☒	○	○
10	2 ft, more + larger inclusions of chert in lower 2.5'. Fractures 35-45°	☒	○	○
11	similar rock no water-bearing fractures apparent, still losing	☒	○	○
12	all drilling water into hole 250 gallons this run ~~4" total~~	☒	○	○
13		☒	○	○
14		☒	○	○
15		☒	○	○

CRMW01

Depth(feet)	Sample Number	Blows on Sampler	Soil Components CL SL S GR	Rock Profile	Penetration Times	Run Number	Core Recovery	RQD	Fracture Sketch	~~HNu~~/OVA (ppm)	Comments
16							100%				HX core 4.9-21.3'
17						3		(43/63.6)		0	
18								0.68			
19	20.0'										
20											
21	21.1					4	100%			4ppm	
21.3	21.3										
21.3–22						5	0%				
22											
23										0	Air Hammer initially then switched to Air Rotary 21.3' to 37.5'
24											
25											
26											
27											
28											
29											
30					6 min/ft					0	
31											
32											
33											
34											
35										0	
36											
37											
38			TD at 37.5'								
39											
40											
41											
42											
43											
44											
45											

CRMW01

Depth(feet).	NARRATIVE LITHOLOGIC DESCRIPTION	Moisture Content (Dry / Moist / Wet)
	similer rock, more calcite no regular pattern to calcite	Dry ⊗
16	stringers, possible H_2O-bearing fracture @ 19.0' +/- containing	Dry ⊗
17	sediment	Dry ⊗
18		Dry ⊗
19		Dry ⊗
20	20' even	Dry ⊗
21	similer rock core berrel blocked @ 21.1'	
	~~core run # 5 0% no rock available for description~~	Dry ⊗
22	21.3 ft to ~~40~~ GF 37.5'	
23	Dark gray limestone chips	
24	Onondaga LS	
25		
26		Wet ⊗
27	27.5 ft water ~~turns~~ GF encountered	
28		
29		
30		
31		
32		
33		
34		
35		
36		
37		
38	TD at 37.5'	
39		
40		
41		
42		
43		
44		
45		

WELL DEVELOPMENT RECORD

SITE Cauterskill Road DATE 1/22/99

LOCATION Catskill WELL NO. MW Ø1

MEASUREMENT OF WATER LEVEL AND WELL VOLUME

- Prior to sampling, the static water level and total depth of the well will be measured with a calibrated weighted line. Care will be taken to decontaminate equipment between each use to avoid cross contamination of wells.
- The number of linear feet of static water (difference between static water level and total depth of well) will be calculated.
- The static volume will be calculated using the formula:

$$V = Tr^2 (0.163)$$

Where:
V = Static volume of well in gallons;
T = Depth of water in the well, measured in feet;
r = Inside radius of well casing in inches;
and 0.163 = A constant conversion factor which compensates for r^2h factor for the conversion of the casing radius from inches to feet, the conversion of cubic feet to gallons, and (pi).
1 well volume (v) = 1.83 gallons.

Volume of Water in Casing or Hole

Diameter of Casing or Hole (in)	Gallons per Foot of Depth	Cubic Feet per Foot of Depth	Liter per Meter of Depth	Cubic Meters per Meter of Depth
1	0.041	0.0055	0.509	0.509×10^{-3}
11/2	0.092	0.0123	1.142	1.142×10^{-3}
2	0.163	0.0218	2.024	2.024×10^{-3}
21/2	0.255	0.0341	3.167	3.167×10^{-3}
3	0.367	0.0491	4.558	4.558×10^{-3}
31/2	0.500	0.0668	6.209	6.209×10^{-3}
4	0.653	0.0873	8.110	8.110×10^{-3}
41/2	0.826	0.1104	10.260	10.260×10^{-3}
5	1.020	0.1364	12.670	12.670×10^{-3}
51/2	1.234	0.1650	15.330	15.330×10^{-3}
6	1.469	0.1963	18.240	18.240×10^{-3}
7	2.000	0.2673	24.840	24.840×10^{-3}
8	2.611	0.3491	32.430	32.430×10^{-3}
9	3.305	0.4418	41.040	41.040×10^{-3}
10	4.080	0.5454	50.670	50.670×10^{-3}
11	4.937	0.6600	61.310	61.310×10^{-3}
12	5.875	0.7854	72.960	72.960×10^{-3}
14	8.000	1.0690	99.350	99.350×10^{-3}
16	10.440	1.3960	129.650	129.650×10^{-3}
18	13.220	1.7670	164.180	164.180×10^{-3}
20	16.320	2.1820	202.680	202.680×10^{-3}
22	19.750	2.6400	245.280	245.280×10^{-3}
24	23.500	3.1420	291.850	291.850×10^{-3}
26	27.580	3.6870	342.520	342.520×10^{-3}
28	32.000	4.2760	397.410	397.410×10^{-3}
30	36.720	4.9090	456.020	456.020×10^{-3}
32	41.780	5.5850	518.870	518.870×10^{-3}
34	47.160	6.3050	585.680	585.680×10^{-3}
36	52.880	7.0690	656.720	656.720×10^{-3}

1 Gallon = 3.785 liters
1 Meter = 3.281 feet
1 Gallon water weighs 8.33 lbs. = 3.779 kilograms
1 Liter water weighs 1 kilogram = 2.205 pounds
1 Gallon per foot of depth = 12.419 liters per foot of depth
1 Gallon per meter of depth = 12.419×10^{-3} cubic meters per meter of depth

INITIAL DEVELOPMENT WATER

WATER LEVEL (TOIC) 28.14
WELL DEPTH (TD) 39.38
COLOR Lt Yellowish Brown
ODOR —
CLARITY turbid

FINAL DEVELOPMENT WATER

WATER LEVEL (TOIC) —
WELL DEPTH (TD) 39.38
COLOR Lt- Yellowish brown
ODOR —
CLARITY turbid

DESCRIPTION OF DEVELOPMENT TECHNIQUE HAND BAILED + SURGED WITH BAILER

WELL DEVELOPMENT - PARAMETER MEASUREMENTS

CRMW-1

TIME 1/22/99	TOTAL VOL. WITHDRAWN GALS.	TOTAL VOL. WITHDRAWN BORE VOL.	pH	COND. (µmhos/cm)	TEMP. (°C/°F)	TURB. (NTU)	COMMENTS
1021	0	0	7.45	923	44	687	
1029	2.5	1.37	7.61	890	45.4	>1000	
1037	5	2.73	7.33	878	46.4	>1000	
1055	10	5.46	7.31	823	44.3	>1000	
1107	15	8.2	7.37	825	45.6	>1000	
1122	20	10.93	7.21	778	43.9	>1000	
1206	30	16.39	7.38	808	46.7	>1000	
1221	35	19.13	7.40	805	48	>1000	
1236	40	21.86	7.48	796	47.7	>1000	
1412	45	24.59	7.38	809	47.1	>1000	
1431	50	27.32	7.34	787	47.1	740	
1/27/99 —	Purge Record (Pre-SAMPLE)						Depth to WATER 27.98
1010	0	~~1.610~~	7.31	784	45.6	46.6	
1020	3	~~3.23~~ 1.61	7.32	833	45.7	426	
1030	6	3.23	7.34	815	45.6	194	
1040	9	4.84	7.33	782	45.3	66.1	
1/27/99 —	SAMPLE READING —						by Jim mackecknie
1510	—	—	7.23	811	44.1	~~20~~ 17	Clear

DEVELOPED BY: Jim Mackecknie

DATE 1/22/99

Borehole Record for CR MW-Ø2

- Drilling Log
- Narrative Lithologic Description
- Well Development Record
- Well Development -- Parameter Measurements
- Investigation - Derived Waste Inventory Sheet

DRILLING LOG FOR CR MW-Ø2

Project Name: Catskill Ri.

Site Location: Catskill, NY

Date Started/Finished: 1/8/99 / 1-20-99

Drilling Company: SJB

Driller's Name: Art Koske (top hole) / Mike Lenigan (Bedrock drilling)

Geologist's Name: G. Andrus / G. Florentino

Geologist's Signature: [signature]

Rig Type (s): CME 75, track rig (top hole), then truck rig

Drilling Method (s): HSA / HQ / Air Rotary

Bit Size (s): HQ, 3 7/8" tricone

Auger Size (s): 4 1/4"

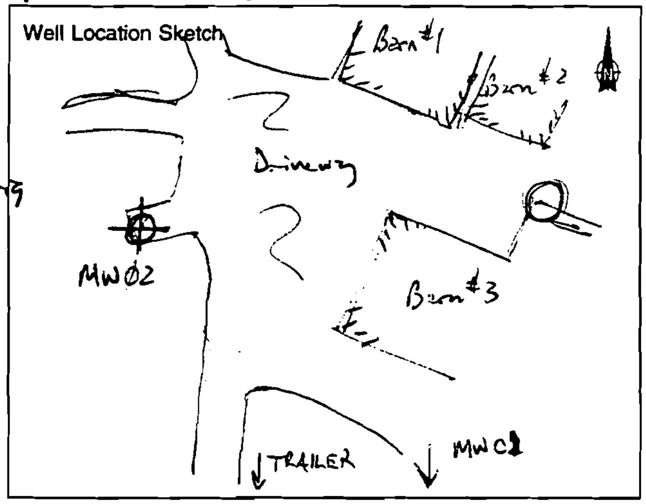
Auger/Split Spoon Refusal: 1.25' b.g.

Total Depth of Borehole Is: 37 bgs

Total Depth of Corehole Is: 16.5'

Water Level (TOIC)		
Date	Time	Level (Feet)
1-18-99	1530	14' bgs
1-22-99	0900	21.75 TOIC
1-26-99	0900	21.26 TOIC
1-27-99	0840	22.36 TOIC
1-28-99	0810	23.07 TOIC
1-29-99	0730	22.05 TOIC

Well Location Sketch



Depth (Feet)	Sample Number	Blows on Sampler	Soil Components Rock Profile CL SL S GR	Penetration Times	Run Number	Core Recovery	RQD	Fracture Sketch	~~HNu~~/OVA (ppm)	Comments
1	1	5 4 / 50/2"	SL/S			50%				insufficient soil to collect a sample; bedrock @ 1.25'
2										
3									0	4" steel casing set to 5.25' below grade (4' socket, 1.25' auger hole)
4										
5										
6–13	Core Run #1 5–14'			7.5 min/ft; 5.7 min/ft; 8 min/ft	1	91%	89.3% (5–14')		500 PPM in borehole w/out carbon; 300 PPM in borehole w/carbon; 40 w/o w/out carbon	Partial Circulation loss at 7 ft bgs; Total Circulation loss at 9 ft bgs
14–15	CORE RUN #2 14–16.5			6 min/ft	2	100%	97%			

CRMW-2

SCREENED WELL

Stick-up ~~3.35~~ 3.32 GF ft Carbon steel

Top of Grout 0 ft

Top of Seal at 16.3 ft

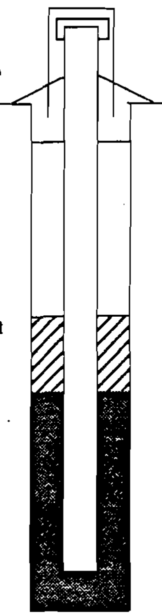
Top of Sand Pack 19.5 ft

Top of Screen at 22 ft

Bottom of Screen at 37 ft

Bottom of Hole at 37 ft

Bottom of Sandpack at 37 bgs



Lock Number 3476 Master

Inner Casing Material PVC

Inner Casing Inside Diameter 2 inches

GROUND SURFACE

Quantity of Material Used:

Bentonite Pellets ______

Cement ______

Borehole Diameter 8 inches overburden/rock socket

Cement/Bentonite ______

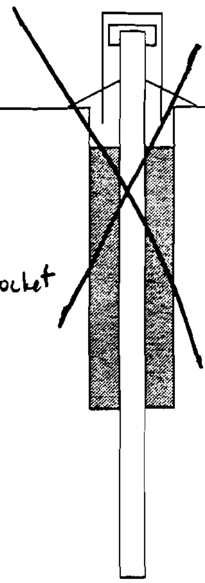
Grout ______

Screen Slot Size 010

Screen Type ______
- ☒ PVC 2" ID
- ☐ Stainless Steel ______

Pack Type/Size:
- ☒ Sand #0
- ☐ Gravel ______
- ☐ Natural ______

OPEN-HOLE WELL



Stick-up 3.04 ft PVC

Inner Casing Material ______

Inner Casing Inside Diameter ______ inches

Outer Casing Diameter 4 inches

Borehole Diameter ~~8~~ GF 8 → 4" bedrock

Bedrock 1.25 ft

Bottom of Rock Socket/Outer Casing 5.25 ft

Bottom of Inner Casing 37 ft

Corehole Diameter HX

Bottom of Corehole 16.5 ft

NOTE: See pages 136 and 137 for well construction diagrams

Depth-ft.	NARRATIVE LITHOLOGIC DESCRIPTION	Dry	Moist	Wet
1	1' Recovery, Dk. Brown fine SAND and SILT, trace (<4" gr (Topsoil) grading		X	
2	into Lt. Brown - yellowish similar soil - rock @ 1 foot bg. +/-		X	
3				
4	~~Dark~~ GF			
5		X		
6	5-14' Dark gray limestone with abundant black chert nodules and calcite	X		
7	veins. Fractures generally parallel to bedding, however,	X		
8	there is fracture at 11 ft bgs 45° ~~60~~ to bedding, and a fracture	X		
9	at 13 ft bgs 90° GF ~~80°~~ to bedding. Most fractures are	X		
10	hairline with iron staining. Significant fracture zones	X		
11	occur at 7 ft bgs, 11 ft bgs, 12.5 ft bgs and 13 ft bgs	X		
12	Calcite veins cross bedding planes. The large fractures	X		
13	have secondary calcite mineralization	X		
14	Fractures range from 25° to 45°	X		
15	14-16.5 Same Dark gray Limestone as above	X		

Onondaga LS

CRmw-2

Depth(feet)	Sample Number	Blows on Sampler	Soil Components CL SL S GR	Rock Profile	Penetration Times	Run Number	Core Recovery	RQD	Fracture Sketch	~~HNu~~/OVA (ppm)	Comments
16	CORE RUN #2	14-16.5			6 min/ft	2	100%	97%		980 w/+ w/out carbon	END HX Coring
17										1	Begin
18										4	3 7/8 Air
19										~~1GF~~	Rotary
20					9.2 min/ft						
21											
22										0	
23											
24											
25					9.4 min/ft						
26										0	
27											
28											
29											
30					12.2 min/ft						
31										0	
32											
33											
34											
35					11.1 min/ft						
36										3	
37											
38			TD at 37 ft								
39											
40											
41											
42											
43											
44											
45											

CRMW-2

Depth (feet)	NARRATIVE LITHOLOGIC DESCRIPTION	Moisture Content: Dry	Moist	Wet
16	16 ft Limestone chips are moist		X	
17				
18	16.5 to 37 ft	X		
19	Dark gray Limestone chips	X		
20	Onondaga LS	X		
21		X		
22		X		
23	22.5 ft - burst of water after ~~cha~~ GF adding drill rod			X
24	when air was turned on			
25				
26				
27				
28				X
29				
30				
31				
32				
33				
34				
35				
36				
37				X
38	TD at 37 ft			
39				
40				
41				
42				
43				
44				
45				

WELL DEVELOPMENT RECORD

SITE Cz tershill Road DATE 1/22 + 26/99

LOCATION near barn #3 WELL NO. MW-φ2

MEASUREMENT OF WATER LEVEL AND WELL VOLUME

- Prior to sampling, the static water level and total depth of the well will be measured with a calibrated weighted line. Care will be taken to decontaminate equipment between each use to avoid cross contamination of wells.
- The number of linear feet of static water (difference between static water level and total depth of well) will be calculated.
- The static volume will be calculated using the formula:

$$V = Tr^2(0.163)$$

Where:
V = Static volume of well in gallons;
T = Depth of water in the well, measured in feet;
r = Inside radius of well casing in inches;
and 0.163 = A constant conversion factor which compensates for r^2h factor for the conversion of the casing radius from inches to feet, the conversion of cubic feet to gallons, and (pi).
1 well volume (v) = 2.92 gallons.

Volume of Water in Casing or Hole

Diameter of Casing or Hole (in)	Gallons per Foot of Depth	Cubic Feet per Foot of Depth	Liter per Meter of Depth	Cubic Meters per Meter of Depth
1	0.041	0.0055	0.509	0.509×10^{-3}
11/2	0.092	0.0123	1.142	1.142×10^{-3}
2	0.163	0.0218	2.024	2.024×10^{-3}
21/2	0.255	0.0341	3.167	3.167×10^{-3}
3	0.367	0.0491	4.558	4.558×10^{-3}
31/2	0.500	0.0668	6.209	6.209×10^{-3}
4	0.653	0.0873	8.110	8.110×10^{-3}
41/2	0.826	0.1104	10.260	10.260×10^{-3}
5	1.020	0.1364	12.670	12.670×10^{-3}
51/2	1.234	0.1650	15.330	15.330×10^{-3}
6	1.469	0.1963	18.240	18.240×10^{-3}
7	2.000	0.2673	24.840	24.840×10^{-3}
8	2.611	0.3491	32.430	32.430×10^{-3}
9	3.305	0.4418	41.040	41.040×10^{-3}
10	4.080	0.5454	50.670	50.670×10^{-3}
11	4.937	0.6600	61.310	61.310×10^{-3}
12	5.875	0.7854	72.960	72.960×10^{-3}
14	8.000	1.0690	99.350	99.350×10^{-3}
16	10.440	1.3960	129.650	129.650×10^{-3}
18	13.220	1.7670	164.180	164.180×10^{-3}
20	16.320	2.1820	202.680	202.680×10^{-3}
22	19.750	2.6400	245.280	245.280×10^{-3}
24	23.500	3.1420	291.850	291.850×10^{-3}
26	27.580	3.6870	342.520	342.520×10^{-3}
28	32.000	4.2760	397.410	397.410×10^{-3}
30	36.720	4.9090	456.020	456.020×10^{-3}
32	41.780	5.5850	518.870	518.870×10^{-3}
34	47.160	6.3050	585.680	585.680×10^{-3}
36	52.880	7.0690	656.720	656.720×10^{-3}

1 Gallon = 3.785 liters
1 Meter = 3.281 feet
1 Gallon water weighs 8.33 lbs. = 3.779 kilograms
1 Liter water weighs 1 kilogram = 2.205 pounds
1 Gallon per foot of depth = 12.419 liters per foot of depth
1 Gallon per meter of depth = 12.419×10^{-3} cubic meters per meter of depth

INITIAL DEVELOPMENT WATER

WATER LEVEL (TOIC) 21.75' b.t.c. 21.26 b.t.c.
WELL DEPTH (TD) 39.7' well vol. = 3.0 gal
COLOR yellow-brown
ODOR none
CLARITY turbid

FINAL DEVELOPMENT WATER

WATER LEVEL (TOIC) Dry
WELL DEPTH (TD) 39.7
COLOR yellow-brown
ODOR None
CLARITY turbid

DESCRIPTION OF DEVELOPMENT TECHNIQUE bailing

WELL DEVELOPMENT - PARAMETER MEASUREMENTS

CRMW-2

TIME	TOTAL VOL. WITHDRAWN		pH	COND. (µmhos/cm)	TEMP. (°C/°F)	TURB. (NTU)	COMMENTS
	GALS.	BORE VOL.					
1/22/99	ø	–	–	~~455~~	–	–	well volume = 2.92 gallons
9:12	ø	ø	7.21	455	43.8	145	
9:27	3	1.03	7.35	574	45.4	>1000	
9:46	5.5	1.88	7.18	577	43.8	>1000	
11:32	6	2.05	7.45	591	47.5	>1000	
14:06	6.75	2.31	8.26	508	46.8	671	
1/26/99							
911	6.751	2.32	7.68	430	43.8	9.85	
921	8.75	3.0	7.65	458	44.6	147	
932	11	3.77	7.61	467	45.8	56.2	
941	12.5	4.28	7.42	490	45.6	122	
1/27	0840	WL =	22.36' TOIC	– Well Purge			
0845	12.5		7.63	747	44.8 °F	12.8	clear
0850	13.5		7.75	616	48.1	398	sl. cloudy
0855	14.5		7.94	619	48.6	248	sl. cloudy
0900	15.5		7.88	614	48.1	198	sl, cloudy
09:05	16.5		7.81	684	48.5	85.5	sl, cloudy ~~Dry~~ GF
0910	17		7.83	786	47.7	423	sl, cloudy Dry
1/27/99	Sampled	at	14:22 by	Jim	Mackechnie		
14:22			7.46	509	50.6	22.2	

DEVELOPED BY: JDM & GLA

DATE 1/22 & 26/99

Borehole Record for CZ MWØ3

- Drilling Log
- Narrative Lithologic Description
- Well Development Record
- Well Development -- Parameter Measurements
- Investigation - Derived Waste Inventory Sheet

DRILLING LOG FOR CR MW∅3

Project Name: CAUTERSKILL ROAD

Site Location: CATSKILL

Date Started/Finished: 1/11/99 / 1-22-99

Drilling Company: SJB

Driller's Name: ART KOSKE

Geologist's Name: Greg Andrus

Geologist's Signature:

Rig Type (s): CME 75 track Rig

Drilling Method (s): HSA / Air Hammer

Bit Size (s): 3 7/8" Auger Size (s): 4 1/4"

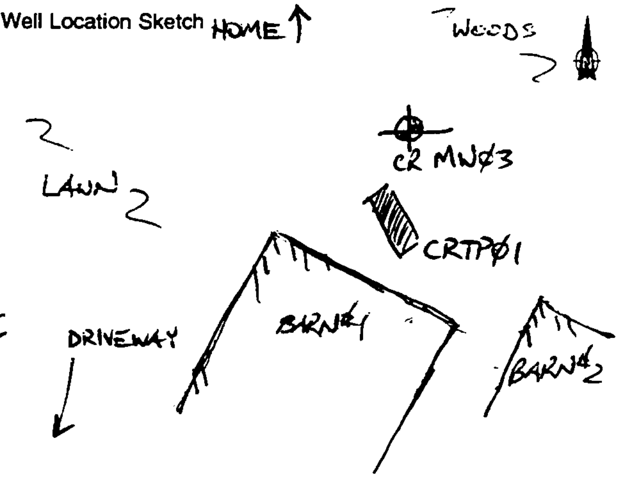
Auger/Split Spoon Refusal: ~~1.5' bg~~ 0.75 GF

Total Depth of Borehole Is: ~~55.0~~ 55.5 bgs

Total Depth of Corehole Is: —

Water Level (TOIC)		
Date	Time	Level(Feet)
1/25/99	1507	17.68 TOIC
1/26/99	07:53	19.35 TOIC
1/27/99	1030	15.24 TOIC
1/28/99	0900	18.05 TOIC
1/29/99		

Well Location Sketch



Depth(Feet)	Sample Number	Blows on Sampler	Soil Components Rock Profile CL SL S GR	Penetration Times	Run Number	Core Recovery	RQD	Fracture Sketch	~~HNU~~/OVA (ppm)	Comments
		23 21				<10%			0	0.75'
1	1	35 50/1"	SL/S							rock @ ~~1.5' bg~~
2										HSA
3									0	Rock Socket, 0.75 – 4.75'
4										
5										Air Rotary ~~Hammer~~
6										Drilling
7				7.6min/ft						
8									0	
9										
10										
11										
12										
13										
14										
15										

CRMW03

SCREENED WELL

Stick-up ~~2.5~~ 1.9' Carbon steel ft

Top of Grout 0 ft

Top of Seal at 25.1 ft ~~TOC~~

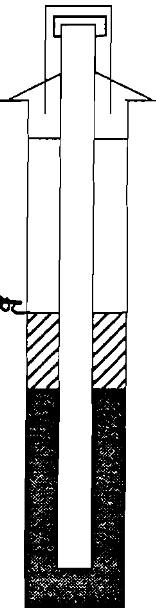
Top of Sand Pack 27.1 ft ~~TOC~~

Top of Screen at 30.5 ft ~~TOC~~

Bottom of Screen at 55.5 ft ~~TOC~~

Bottom of Hole at 55.5 ft ~~TOC~~

Bottom of Sandpack at 55.5 bgs ~~TOC~~ GT



Lock Number 3476 master

Inner Casing Material PVC

Inner Casing Inside Diameter 2 inches

GROUND SURFACE

Quantity of Material Used:

Bentonite Pellets ______

Cement ______

Borehole Diameter 8 inches overburden/Rock Socket

Cement/ Bentonite ______

Grout ______

Screen Slot Size 0.010

Screen Type

☒ PVC 2"

☐ Stainless Steel ______

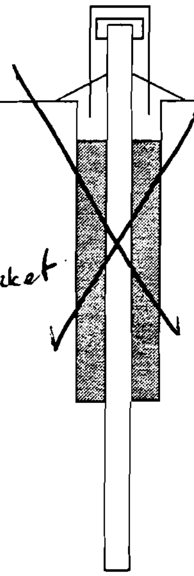
Pack Type/Size:

☒ Sand Morie #0

☐ Gravel ______

☐ Natural ______

OPEN-HOLE WELL



Stick-up 1.71 ft PVC

Inner Casing Material ______

Inner Casing Inside Diameter ______ inches

Outer Casing Diameter 4 inches

Borehole Diameter 4" bedrock ~~ft~~

Bedrock 0.75 ft

Bottom of Rock Socket/ Outer Casing 4.75 ft

Bottom of Inner Casing 55.5 ft

Corehole Diameter —

Bottom of Corehole — ft

NOTE: See pages 136 and 137 for well construction diagrams

Depth-ft.	NARRATIVE LITHOLOGIC DESCRIPTION	Dry	Moist	Wet
1	Dark brown topsoil with limestone rock fragments	○	⊗	○
2	Topsoil consists of dk. br. SILT, ~~some~~ little m-f SAND, trace CLAY	⊗	○	○
3		⊗	○	○
4		⊗	○	○
5	4.75 to 16 ft : Dark grey LS chips	⊗	○	○
6	Onondaga LS	⊗	○	○
7	7-8' soft spot (possibly a fracture)	⊗	○	○
8		⊗	○	○
9		⊗	○	○
10		⊗	○	○
11		⊗	○	○
12		⊗	○	○
13		⊗	○	○
14		⊗	○	○
15		⊗	○	○

CRMW03

Depth(feet)	Sample Number	Blows on Sampler	Soil Components CL SL S GR	Rock Profile	Penetration Times	Run Number	Core Recovery	RQD	Fracture Sketch	~~HNu~~/OVA (ppm)	Comments
16											Air Rotary Drilling
17										0	
18											
19										0	Began Air Hammer Drilling
20											
21											
22					8.4 min/ft						
23										0	
24											
25											
26											
27					7.4 min/ft					0	
28											
29											
30											
31											
32					6 min/ft					1	
33											
34											
35											
36											OVA readings both with and w/out carbon filter
37					8 min/ft					30	
38											
39											
40											
41											
42					6 min/ft					0	
43											
44											
45											

CRMW03

Depth(feet).	NARRATIVE LITHOLOGIC DESCRIPTION	Dry	Moist	Wet
16	16 ft to 45 ft Dark gray LS Chips	X		
17	Onondaga LS	X		
18		X		
19		X		
20		X		
21		X		
22		X		
23		X		
24		X		
25		X		
26		X		
27		X		
28		X		
29		X		
30		X		
31		X		
32		X		
33		X		
34		X		
35		X		
36		X		
37		X		
38		X		
39		X		
40		X		
41		X		
42		X		
43		X		
44	44' less dust, however, no indication of water on tools	X		
45		X		

CRMW03

Depth(feet)	Sample Number	Blows on Sampler	Soil Components CL SL S GR	Rock Profile	Penetration Times	Run Number	Core Recovery	RQD	Fracture Sketch	~~HNu~~/OVA (ppm)	Comments
46											
47					6 min/ft					0	
48											
49											
50											
51											
52					8 min/ft					0	
53											
54											
55			TD at 55.5 feet								
56											
57											
58											
59											
60											
61											
62											
63											
64											
65											
66											
67											
68											
69											
70											
71											
72											
73											
74											
75											

CRMW03

Depth(feet)	NARRATIVE LITHOLOGIC DESCRIPTION	Moisture Content: Dry	Moist	Wet
	46ft to 55.5ft	X		
46	Dark gray LS chips	✓		
47	Onondaga LS	X		
48		X		
49		X		
50		X		
51		X		
52		X		
53		X		
54				X
55	TD at 55.5ft			
56				
57				
58				
59				
60				
61				
62				
63				
64				
65				
66				
67				
68				
69				
70				
71				
72				
73				
74				
75				

WELL DEVELOPMENT RECORD

SITE Cauterskill Road DATE 1/25+26/99

LOCATION Catskill WELL NO. MW Ø3

MEASUREMENT OF WATER LEVEL AND WELL VOLUME

- Prior to sampling, the static water level and total depth of the well will be measured with a calibrated weighted line. Care will be taken to decontaminate equipment between each use to avoid cross contamination of wells.
- The number of linear feet of static water (difference between static water level and total depth of well) will be calculated.
- The static volume will be calculated using the formula:

$$V = Tr^2 (0.163)$$

Where:
V = Static volume of well in gallons;
T = Depth of water in the well, measured in feet;
r = Inside radius of well casing in inches;
and 0.163 = A constant conversion factor which compensates for r^2h factor for the conversion of the casing radius from inches to feet, the conversion of cubic feet to gallons, and (pi).
1 well volume (v) = 7.31 gallons.

Volume of Water in Casing or Hole

Diameter of Casing or Hole (in)	Gallons per Foot of Depth	Cubic Feet per Foot of Depth	Liter per Meter of Depth	Cubic Meters per Meter of Depth
1	0.041	0.0055	0.509	0.509×10^{-3}
11/2	0.092	0.0123	1.142	1.142×10^{-3}
2	0.163	0.0218	2.024	2.024×10^{-3}
21/2	0.255	0.0341	3.167	3.167×10^{-3}
3	0.367	0.0491	4.558	4.558×10^{-3}
31/2	0.500	0.0668	6.209	6.209×10^{-3}
4	0.653	0.0873	8.110	8.110×10^{-3}
41/2	0.826	0.1104	10.260	10.260×10^{-3}
5	1.020	0.1364	12.670	12.670×10^{-3}
51/2	1.234	0.1650	15.330	15.330×10^{-3}
6	1.469	0.1963	18.240	18.240×10^{-3}
7	2.000	0.2673	24.840	24.840×10^{-3}
8	2.611	0.3491	32.430	32.430×10^{-3}
9	3.305	0.4418	41.040	41.040×10^{-3}
10	4.080	0.5454	50.670	50.670×10^{-3}
11	4.937	0.6600	61.310	61.310×10^{-3}
12	5.875	0.7854	72.960	72.960×10^{-3}
14	8.000	1.0690	99.350	99.350×10^{-3}
16	10.440	1.3960	129.650	129.650×10^{-3}
18	13.220	1.7670	164.180	164.180×10^{-3}
20	16.320	2.1820	202.680	202.680×10^{-3}
22	19.750	2.6400	245.280	245.280×10^{-3}
24	23.500	3.1420	291.850	291.850×10^{-3}
26	27.580	3.6870	342.520	342.520×10^{-3}
28	32.000	4.2760	397.410	397.410×10^{-3}
30	36.720	4.9090	456.020	456.020×10^{-3}
32	41.780	5.5850	518.870	518.870×10^{-3}
34	47.160	6.3050	585.680	585.680×10^{-3}
36	52.880	7.0690	656.720	656.720×10^{-3}

1 Gallon = 3.785 liters
1 Meter = 3.281 feet
1 Gallon water weighs 8.33 lbs. = 3.779 kilograms
1 Liter water weighs 1 kilogram = 2.205 pounds
1 Gallon per foot of depth = 12.419 liters per foot of depth
1 Gallon per meter of depth = 12.419×10^{-3} cubic meters per meter of depth

INITIAL DEVELOPMENT WATER

WATER LEVEL (TOIC) 12.68' 15.24' (1/27/99)
WELL DEPTH (TD) 57.51 57.51
COLOR Gray
ODOR none
CLARITY turbid

FINAL DEVELOPMENT WATER

WATER LEVEL (TOIC) Dry
WELL DEPTH (TD) 57.51
COLOR gray
ODOR none
CLARITY turbid

DESCRIPTION OF DEVELOPMENT TECHNIQUE Hand Bail + Surge with Bailer

WELL DEVELOPMENT - PARAMETER MEASUREMENTS

CRMW-3

TIME	TOTAL VOL. WITHDRAWN		pH	COND. (µmhos/cm)	TEMP. (°C/°F)	TURB. (NTU)	COMMENTS
	GALS.	BORE VOL.					
1/25/99							
1507	0	0	10.67	452	46	822	
1536	5	0.68	7.89	570	44.2	>1000	
1557	10	1.37	7.54	618	43	>1000	
1614	14	1.91	7.85	544	42.2	>1000	BAILED DRY
1707	16	2.19	7.66	555	40	>1000	BAILED DRY
1/26/99							WATERLEVEL 19.35
814	20	2.74	7.33	665	41.7	>1000	
831	24	3.28	7.16	636	39.9	>1000	
848	28	3.83	7.38	609	41	>1000	BAILED DRY
957	29.5	4.04	7.35	625	45.8	>1000	
1/27/99	Purge		# Record				Water Level 15.24'
10:30	29.5	4.04	7.30	781	46.1	3.47	
11:05	31.5		7.38	699	41.3	11.8	
11:28	34.0		7.32	755	45.6	283	
11:54	37.5		7.41	744	46.2	251	dry
1/27/99	Sampled		at 1530	by G. Florentino			
1530			6.92	866	44.4	6.26	Clear

DEVELOPED BY: Jim MacKechnie & Greg Andrus

DATE 1/25 + 1/26

Borehole Record for CL MW-04

- Drilling Log
- Narrative Lithologic Description
- Well Development Record
- Well Development -- Parameter Measurements
- Investigation - Derived Waste Inventory Sheet

DRILLING LOG FOR CR MW-Ø4

Project Name: Catskill Road

Site Location: Catskill, NY

Date Started/Finished: 01/11/98 / 1-25-99

Drilling Company: SJB

Driller's Name: Art Koske

Geologist's Name: ~~Art Koske~~ G. Andrus

Geologist's Signature:

Rig Type (s): CME 75 Track Rig

Drilling Method (s): HSA / Air Hammer

Bit Size (s): 3 7/8 Auger Size (s): 4 1/4

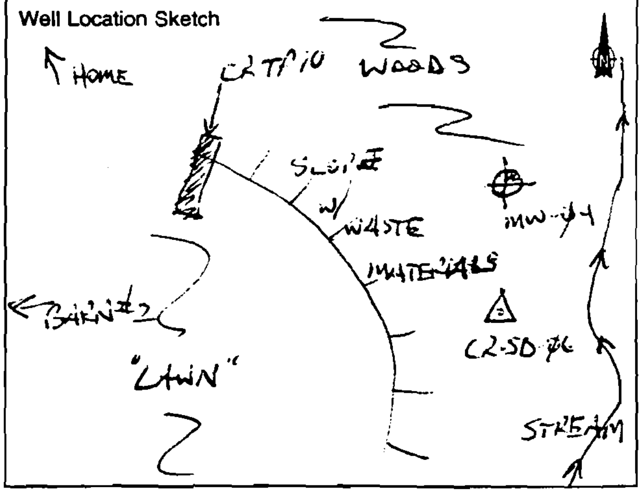
Auger/Split Spoon Refusal: 5.5' b.g.

Total Depth of Borehole Is: 50 ft bgs

Total Depth of Corehole Is:

Water Level (TOIC)		
Date	Time	Level(Feet)
1/26/99	1345	4.16 TOIC
1/27/99		
1/28/99	0804	3.74' TOIC
1/29/99		

Well Location Sketch



Depth(Feet)	Sample Number	Blows on Sampler		Soil Components Rock Profile CL SL S GR	Penetration Times	Run Number	Core Recovery	RQD	Fracture Sketch	~~HNU~~/OVA (ppm)	Comments
1	1	4	4	CL/SL Topsoil			0%			N/D	
		3	2								
2											
3	2	4	4				0%			N/D	
		6	7								
4											not enough sample for analysis
5	5.5'	4	4				25%			2.5	
		9	50/r								Bed rock
6	rock										HSA Rock socket 5.5-9.5'
7										N/D	
8											
9											
10											
11											Air Hammer Drilling
12										N/D	
13					6 min/ft						
14											
15											

CRMW-4

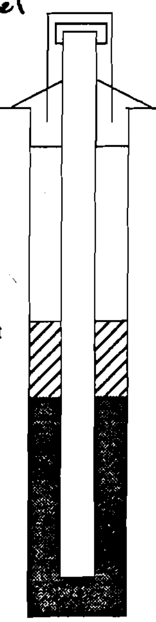
SCREENED WELL

Lock Number 3476 MASTER

Inner Casing Material PVC

Inner Casing Inside Diameter 2 inches

Stick-up ~~2.2~~ 2.41', carbon steel ft



GROUND SURFACE

Top of Grout 0 ft

Top of Seal at 23.4 ft

Top of Sand Pack 24.9' ft

Top of Screen at 30' ft

Bottom of Screen at 50' ft

Bottom of Hole at 50' ft

Bottom of Sandpack at 50' logs

Quantity of Material Used:

Bentonite Pellets ______

Cement ______

Borehole Diameter 8 inches overburden/rock socket

Cement/ Bentonite ______

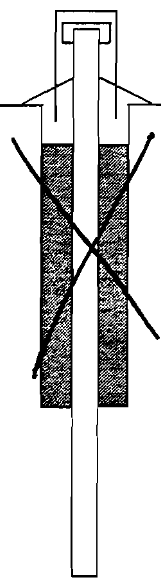
Grout ______

Screen Slot Size 0.010"

Screen Type ______
- [x] PVC 2"
- [ ] Stainless Steel ______

Pack Type/Size:
- [x] Sand Morie #0
- [ ] Gravel ______
- [ ] Natural ______

OPEN-HOLE WELL



Stick-up 2.22 ft PVC

Inner Casing Material ______

Inner Casing Inside Diameter ______ inches

Outer Casing Diameter 4 inches

Borehole Diameter 4" bedrock

Bedrock 5.5 ft

Bottom of Rock Socket/ Outer Casing 9.5 ft

Bottom of Inner Casing 50 ft

Corehole Diameter —

Bottom of Corehole — ft

NOTE: See pages 136 and 137 for well construction diagrams

Depth-ft.	NARRATIVE LITHOLOGIC DESCRIPTION	Moisture Content: Dry	Moist	Wet
1	Very small amt. of top soil and limestone rock fragments		X	
2				
3	Same		X	
4				
5	Dk. Brown (mottled w/ yellowish orange), SILT and CLAY, little amt			
6	SAND, trace amt GRAVEL ... rock frag @ bottom, roots		X	
7		X		
8		X		
9		X		
10		X		
11		X		
12		X		
13		X		
14		X		
15		X		

CRMW-4

Depth(feet)	Sample Number	Blows on Sampler	Soil Components CL SL S GR	Rock Profile	Penetration Times	Run Number	Core Recovery	RQD	Fracture Sketch	~~HNu~~/OVA (ppm)	Comments
16											
17											
18					9 min/ft					N/D	
19											
20											
21											
22											
23					5 min/ft					N/D	
24											
25											
26											
27											
28					4.6 min/ft					N/D	
29											
30											
31											
32											
33					6 min/ft					N/D	
34											
35											
36											
37										N/D	
38					8.2 min/ft						
39											
40											
41											Cleaned out hammer bit at 40'
42											
43					5 min/ft					N/D	
44											
45											

CRmw-4

Depth(feet).	NARRATIVE LITHOLOGIC DESCRIPTION	Moisture Content: Dry	Moist	Wet
16	16 ft to 45 ft	⊗	○	○
17	Dark gray LS chips	⊗	○	○
18	Onondaga LS	⊗	○	○
19		⊗	○	○
20		⊗	○	○
21		⊗	○	○
22		⊗	○	○
23		⊗	○	○
24		⊗	○	○
25		⊗	○	○
26		⊗	○	○
27		⊗	○	○
28		⊗	○	○
29		⊗	○	○
30		⊗	○	○
31		⊗	○	○
32		⊗	○	○
33		⊗	○	○
34		⊗	○	○
35		⊗	○	○
36		⊗	○	○
37		⊗	○	○
38		⊗	○	○
39		⊗	○	○
40		⊗	○	○
41	~~40.5~~ 41.5 ft soft zone	⊗	○	○
42		⊗	○	○
43	42.5 ft soft zone	⊗	○	○
44		⊗	○	○
45		⊗	○	○

CR MW-4

Depth(feet)	Sample Number	Blows on Sampler	Soil Components CL SL S GR	Rock Profile	Penetration Times	Run Number	Core Recovery	RQD	Fracture Sketch	~~HNu~~/OVA (ppm)	Comments
46											
47										N/D	
48					4.6 min/ft						
49											
50											
51			TD at 50 ft								
52											
53											
54											
55											
56											
57											
58											
59											
60											
61											
62											
63											
64											
65											
66											
67											
68											
69											
70											
71											
72											
73											
74											
75											

CRMW-4

Depth(feet)	NARRATIVE LITHOLOGIC DESCRIPTION	Moisture Content: Dry	Moist	Wet
46	Possible fracture 46 ft to 50 ft			X
47	46.5' no dust Dark gray LS chips			X
48				X
49	wet chips			X
50	Onondaga LS			X
51	TD at 50 ft			
52				
53				
54				
55				
56				
57				
58				
59				
60				
61				
62				
63				
64				
65				
66				
67				
68				
69				
70				
71				
72				
73				
74				
75				

WELL DEVELOPMENT RECORD

SITE Cauterskill Road DATE ~~[illegible]~~ 1/26/99

LOCATION Catskill WELL NO. MW 04

MEASUREMENT OF WATER LEVEL AND WELL VOLUME

- Prior to sampling, the static water level and total depth of the well will be measured with a calibrated weighted line. Care will be taken to decontaminate equipment between each use to avoid cross contamination of wells.
- The number of linear feet of static water (difference between static water level and total depth of well) will be calculated.
- The static volume will be calculated using the formula:

$$V = Tr^2(0.163)$$

Where:
V = Static volume of well in gallons;
T = Depth of water in the well, measured in feet;
r = Inside radius of well casing in inches;
and 0.163 = A constant conversion factor which compensates for r^2h factor for the conversion of the casing radius from inches to feet, the conversion of cubic feet to gallons, and (pi).
1 well volume (v) = 7.93 gallons.

Volume of Water in Casing or Hole

Diameter of Casing or Hole (in)	Gallons per Foot of Depth	Cubic Feet per Foot of Depth	Liter per Meter of Depth	Cubic Meters per Meter of Depth
1	0.041	0.0055	0.509	0.509×10^{-3}
11/2	0.092	0.0123	1.142	1.142×10^{-3}
2	0.163	0.0218	2.024	2.024×10^{-3}
21/2	0.255	0.0341	3.167	3.167×10^{-3}
3	0.367	0.0491	4.558	4.558×10^{-3}
31/2	0.500	0.0668	6.209	6.209×10^{-3}
4	0.653	0.0873	8.110	8.110×10^{-3}
41/2	0.826	0.1104	10.260	10.260×10^{-3}
5	1.020	0.1364	12.670	12.670×10^{-3}
51/2	1.234	0.1650	15.330	15.330×10^{-3}
6	1.469	0.1963	18.240	18.240×10^{-3}
7	2.000	0.2673	24.840	24.840×10^{-3}
8	2.611	0.3491	32.430	32.430×10^{-3}
9	3.305	0.4418	41.040	41.040×10^{-3}
10	4.080	0.5454	50.670	50.670×10^{-3}
11	4.937	0.6600	61.310	61.310×10^{-3}
12	5.875	0.7854	72.960	72.960×10^{-3}
14	8.000	1.0690	99.350	99.350×10^{-3}
16	10.440	1.3960	129.650	129.650×10^{-3}
18	13.220	1.7670	164.180	164.180×10^{-3}
20	16.320	2.1820	202.680	202.680×10^{-3}
22	19.750	2.6400	245.280	245.280×10^{-3}
24	23.500	3.1420	291.850	291.850×10^{-3}
26	27.580	3.6870	342.520	342.520×10^{-3}
28	32.000	4.2760	397.410	397.410×10^{-3}
30	36.720	4.9090	456.020	456.020×10^{-3}
32	41.780	5.5850	518.870	518.870×10^{-3}
34	47.160	6.3050	585.680	585.680×10^{-3}
36	52.880	7.0690	656.720	656.720×10^{-3}

1 Gallon = 3.785 liters
1 Meter = 3.281 feet
1 Gallon water weighs 8.33 lbs. = 3.779 kilograms
1 Liter water weighs 1 kilogram = 2.205 pounds
1 Gallon per foot of depth = 12.419 liters per foot of depth
1 Gallon per meter of depth = 12.419×10^{-3} cubic meters per meter of depth

INITIAL DEVELOPMENT WATER

WATER LEVEL (TOIC) 4.16
WELL DEPTH (TD) 52.8
COLOR Lt Gray
ODOR –
CLARITY Opaque

FINAL DEVELOPMENT WATER

WATER LEVEL (TOIC) Dry
WELL DEPTH (TD) 52-8
COLOR Lt gray
ODOR None
CLARITY turbid

DESCRIPTION OF DEVELOPMENT TECHNIQUE Hand bailed and surged with bailer

WELL DEVELOPMENT - PARAMETER MEASUREMENTS

CRMW-4

TIME	TOTAL VOL. WITHDRAWN		pH	COND. (µmhos/cm)	TEMP. (°C/°F)	TURB. (NTU)	COMMENTS
1/26/99	GALS.	BORE VOL.					
1337	0	0	7.28	671	47	>1000	
1401	4	0.5	7.36	649	46.1	>1000	
1420	8	1.01	7.37	700	48.8	>1000	
1440	12	1.51	7.20	721	47.2	>1000	
1455	15	1.89	7.37	644	48.9	>1000	BAILED DRY
1652	19	2.40	7.27	625	38.4	>1000	
1703	21	2.65	7.38	617	39.5	>1000	BAILED DRY
1/27/99							
834	25	3.15	7.16	608	40	768	
854	29	3.66	7.18	780	43.5	>1000	
912	33	4.16	7.35	776	45.2	>1000	
925	34.5	4.35	7.32	760	45.1	>1000	BAILED DRY
1/27/99 PURGE RECORD							
1606	0	0	7.09	861	41.8	4.5	
1612	2	0.25	7.18	898	43.6	10.1	
1618	4	0.50	7.09	919	44.8	106	
1624	6	0.76	7.10	919	44.5	283	
1630	8	1.01	7.10	916	44.2	184	
1637	10	1.26	7.13	931	44.3	516	
1642	11.5	1.45	7.39	883	43.5	>1000	BAILED DRY - VERY TURBID Lt. GRAY (Rock Powder)
1/28/99 Sample Collected Tim Mackecknie							
0804	—	—	6.79	687	40.3	40.3	Clear WL. = 3.74' PIC

DEVELOPED BY: TIM MACKECKNIE

DATE 1/26/99 + 1/27/99

BOREHOLE NO. MW-4

Borehole Record for CR-MW-Ø5

- Drilling Log
- Narrative Lithologic Description
- Well Development Record
- Well Development -- Parameter Measurements
- Investigation - Derived Waste Inventory Sheet

DRILLING LOG FOR CL-MW-Ø5

Project Name: Catterskill Road

Site Location: Catskill, NY

Date Started/Finished: 1/13/98 / 1-25-99

Drilling Company: SJB

Driller's Name: Art Koske

Geologist's Name: Gene Florentino/G.Andrus

Geologist's Signature: [signature]

Rig Type (s): CME 75 Track Rig (tophole) then truck Rig

Drilling Method (s): HSA / Air Rotary

Bit Size (s): 3 7/8" Auger Size (s): 4 1/4"

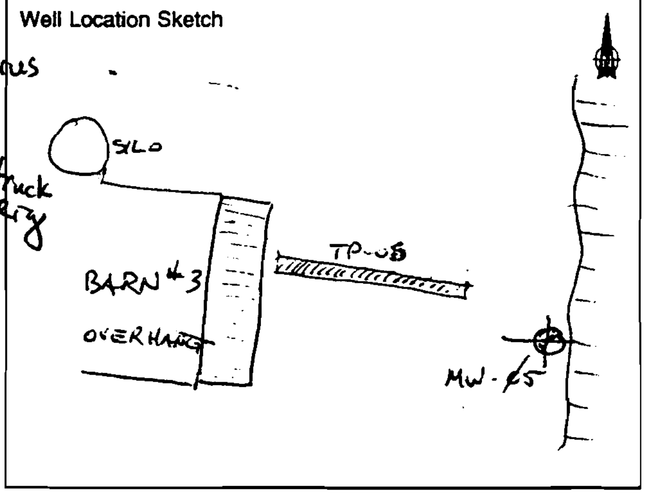
Auger/Split Spoon Refusal: 6.0' bg

Total Depth of Borehole Is: 32.5' bgs

Total Depth of Corehole Is: —

Water Level (TOIC)		
Date	Time	Level(Feet)
1/25/99	10:30	25.5 b.t.c. (Prior to well construction)
1/26/99	1139	17.15 TOIC
1/27/99	0847	25.58 TOIC
1/29/99	0807	27.10 TOIC
1/29/99	0740	26.24

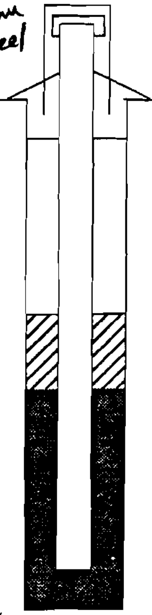
Well Location Sketch



Depth(Feet)	Sample Number	Blows on Sampler		Soil Components Rock Profile CL SL S GR	Penetration Times	Run Number	Core Recovery	RQD	Fracture Sketch	HNu/OVA (ppm)	Comments
1	1	3	3	SL/CL			50%			20ppm	
2		2	3								
3	2	3	2	S			75%			0.5ppm	
4		2	2								
5	3	1	4	S/CL			75%			0.5ppm	refusal @ 5.75' (6.0')
6		7	50/4"								HSA Rock socket 6 - 8.5'
7											
8											
9											Began Air Rotary Drilling
10					8min/ft						
11										0	
12											
13											
14					12min/ft					0	
15											

CRMW-5

SCREENED WELL



Stick-up ~~2.0~~ 1.98' ft Carbon Steel

Top of Grout 0 ft

Top of Seal at ~~18.4~~ ~~19~~ 13.4 ft

Top of Sand Pack ~~20.4'~~ ~~18.4~~ 15.4' ft

Top of Screen at ~~22.5'~~ ~~19.0~~ 17.5' ft

Bottom of Screen at ~~34.0 b.t.c.~~ 32.5' ft

Bottom of Hole at ~~34.0 b.t.c.~~ 32.5' ft

Bottom of Sandpack at 32.5 bgs

Lock Number 3476 master

Inner Casing Material PVC

Inner Casing Inside Diameter 2 inches

GROUND SURFACE

Quantity of Material Used:

Bentonite Pellets ____

Cement ____

Borehole Diameter 8 inches overburden + rock socket

Cement/Bentonite ____

Grout ____

Screen Slot Size 0.010 in

Screen Type

☒ PVC 2"

☐ Stainless Steel

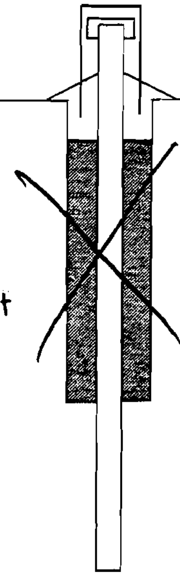
Pack Type/Size:

☒ Sand Morie #0

☐ Gravel

☐ Natural

OPEN-HOLE WELL



Stick-up 1.42 ft PVC

Inner Casing Material ____

Inner Casing Inside Diameter ____ inches

Outer Casing Diameter 4 inches

Borehole Diameter 4" bedrock

Bedrock 6 ft

Bottom of Rock Socket/Outer Casing 8.5 ft

Bottom of Inner Casing 32.5 ft

Corehole Diameter —

Bottom of Corehole — ft

NOTE: See pages 136 and 137 for well construction diagrams

Depth-ft.	NARRATIVE LITHOLOGIC DESCRIPTION	Dry	Moist	Wet
1	light brown CLAY, some mf GRAVEL, some cmf SAND, little SILT			
2	grades into gravel w/ decreasing depth, plastic		X	
3	medium brown medium SAND, trace SILT		X	
4	light brown CLAY, some mf GRAVEL, some cmf SAND, little SILT			
5	Rock (limestone) frags @ bottom, lens of medium SAND in upper		X	
6	portion (3" thick)	X		
7		X		
8	setting protective casing to 8.5' b.g.	X		
9	8.5 ft to 16 ft	X		
10	Dark gray Limestone chips	X		
11	Onondaga LS	X		
12		X		
13		X		
14		X		
15		X		

Depth(feet)	Sample Number	Blows on Sampler	Soil Components CL SL S GR	Rock Profile	Penetration Times	Run Number	Core Recovery	RQD	Fracture Sketch	HNu/OVA (ppm)	Comments
16					12 min/ft					0	
17											
18											
19											
20					12 min/ft					0	
21											
22											
23											
24											
25					14 min/ft					0	
26											
27											
28										0 then 70	70GF OVA = ~~75~~ ppm both with and w/o carbon filter After 2 Days
29										~~75~~	
30					12 min/ft						
31											
32											
33			TD 32.5 ft								
34											
35											
36											
37											
38											
39											
40											
41											
42											
43											
44											
45											

Depth(feet).	NARRATIVE LITHOLOGIC DESCRIPTION	Moisture Content: Dry	Moist	Wet

16 to 32.5 ft
Dark gray limestone Chips
Onondaga LS

27.5 ft grinding on something very hard.
Driller later removed auger tooth + socket from bottom of hole with a magnet. The auger tooth must have dislodged itself from the base of the carbon steel during the previous run

Onondaga LS

TD 32.5 ft

Depth (feet): 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45

Moisture content: Dry marked for all intervals from 16 to 32.5 ft.

WELL DEVELOPMENT RECORD

SITE Cartershill Rd. DATE

LOCATION WELL NO. MW-Ø5

MEASUREMENT OF WATER LEVEL AND WELL VOLUME

- Prior to sampling, the static water level and total depth of the well will be measured with a calibrated weighted line. Care will be taken to decontaminate equipment between each use to avoid cross contamination of wells.
- The number of linear feet of static water (difference between static water level and total depth of well) will be calculated.
- The static volume will be calculated using the formula:

$$V = Tr^2(0.163)$$

Where:
V = Static volume of well in gallons;
T = Depth of water in the well, measured in feet;
r = Inside radius of well casing in inches;
and 0.163 = A constant conversion factor which compensates for r^2h factor for the conversion of the casing radius from inches to feet, the conversion of cubic feet to gallons, and (pi).
1 well volume (v) = 2.63 gallons. (1.26' 1/27/99)
↑ NOT USED ↑ USED

Volume of Water in Casing or Hole

Diameter of Casing or Hole (in)	Gallons per Foot of Depth	Cubic Feet per Foot of Depth	Liter per Meter of Depth	Cubic Meters per Meter of Depth
1	0.041	0.0055	0.509	0.509 x10⁻³
11/2	0.092	0.0123	1.142	1.142 x10⁻³
2	0.163	0.0218	2.024	2.024 x10⁻³
21/2	0.255	0.0341	3.167	3.167 x10⁻³
3	0.367	0.0491	4.558	4.558 x10⁻³
31/2	0.500	0.0668	6.209	6.209 x10⁻³
4	0.653	0.0873	8.110	8.110 x10⁻³
41/2	0.826	0.1104	10.260	10.260 x10⁻³
5	1.020	0.1364	12.670	12.670 x10⁻³
51/2	1.234	0.1650	15.330	15.330 x10⁻³
6	1.469	0.1963	18.240	18.240 x10⁻³
7	2.000	0.2673	24.840	24.840 x10⁻³
8	2.611	0.3491	32.430	32.430 x10⁻³
9	3.305	0.4418	41.040	41.040 x10⁻³
10	4.080	0.5454	50.670	50.670 x10⁻³
11	4.937	0.6600	61.310	61.310 x10⁻³
12	5.875	0.7854	72.960	72.960 x10⁻³
14	8.000	1.0690	99.350	99.350 x10⁻³
16	10.440	1.3960	129.650	129.650 x10⁻³
18	13.220	1.7670	164.180	164.180 x10⁻³
20	16.320	2.1820	202.680	202.680 x10⁻³
22	19.750	2.6400	245.280	245.280 x10⁻³
24	23.500	3.1420	291.850	291.850 x10⁻³
26	27.580	3.6870	342.520	342.520 x10⁻³
28	32.000	4.2760	397.410	397.410 x10⁻³
30	36.720	4.9090	456.020	456.020 x10⁻³
32	41.780	5.5850	518.870	518.870 x 10⁻³
34	47.160	6.3050	585.680	585.680 x10⁻³
36	52.880	7.0690	656.720	656.720 x10⁻³

1 Gallon = 3.785 liters
1 Meter = 3.281 feet
1 Gallon water weighs 8.33 lbs. = 3.779 kilograms
1 Liter water weighs 1 kilogram = 2.205 pounds
1 Gallon per foot of depth = 12.419 liters per foot of depth
1 Gallon per meter of depth = 12.419 x 10^{-3} cubic meters per meter of depth

INITIAL DEVELOPMENT WATER

WATER LEVEL (TOIC) 17.15' (1/26/99) 25.58' (1/27/99) → (7.72) = 1.26 g/vol
WELL DEPTH (TD) 33.3' 2.632 g/volume (16.15)
COLOR yellow/brown
ODOR
CLARITY

FINAL DEVELOPMENT WATER

WATER LEVEL (TOIC)
WELL DEPTH (TD)
COLOR
ODOR
CLARITY

DESCRIPTION OF DEVELOPMENT TECHNIQUE

WELL DEVELOPMENT - PARAMETER MEASUREMENTS

CR MW-5

TIME	TOTAL VOL. WITHDRAWN		pH	COND. (µmhos/cm)	TEMP. (°C/°F)	TURB. (NTU)	COMMENTS
	GALS.	BORE VOL.★					
1/26/99							
11:39	Ø	Ø	7.47	1475	48.5 (°F)	>1000	yellow/orange silt
11:48	2.75	2.18	7.66	1523	51.2	>1000	significantly clearer
11:59	5.25	~~2.0~~ 4.17	7.56	1523	51.2	>1000	same dry
13:56	~~8~~5.75	~~2.25~~ 4.56	7.28	1509	49.4	>1000	clearer dry
1/27/99							H2O level: 25.50
0?:47	5.75	~~2.25~~ 4.56	7.14	1457	43.2	>1000	clearer
09:05	7.25	~~4.5~~ 5.75*	7.33	1551	46.6	193	"
09:15	8.0	~~2.25~~ 6.35**	7.38	1503	45.9	669	dry
Well Purge 1/27/99							
16:44	8.0	~~2.25~~ 6.35**	7.20	1000	42.1	46.3	28.80 DTW
16:54	9.5	~~3.25~~ 7.54**	7.24	932	46.5	169	dry
Well Sampling 1/27/99				Greg Andrus			
0807	—	—	6.78	1140	45.1	4.41	Clear w/ yellow tint

~~* 1/27/99 purge volume calculated based on 1/27/99 H2O level~~

~~** total 4.5 volumes purged as of 1/27/99 [illegible]~~

★ All boring/well volumes recalculated to 1/27/99 calc. volume (1.26 gal/vol.)

DEVELOPED BY: GREG ANDRUS

DATE 1/26-27/99

Borehole Record for CR MW-Ø6S and CRMW-06D

- Drilling Log
- Narrative Lithologic Description
- Well Development Record
- Well Development -- Parameter Measurements
- Investigation - Derived Waste Inventory Sheet

DRILLING LOG FOR CR-MW-Ø6

Project Name: Caterskill Road

Site Location: Catskill, NY

Date Started/Finished: 1/12/98 / 1-22-99

Drilling Company: STB

Driller's Name: Art Koske

Geologist's Name: G. Andrus / G. Florentino

Geologist's Signature:

Rig Type (s): CME 75 Track Rig (top hole) then Truck Rig

Drilling Method (s): HSA / Air Rotary

Bit Size (s): 3 7/8" Auger Size (s): 4 1/4"

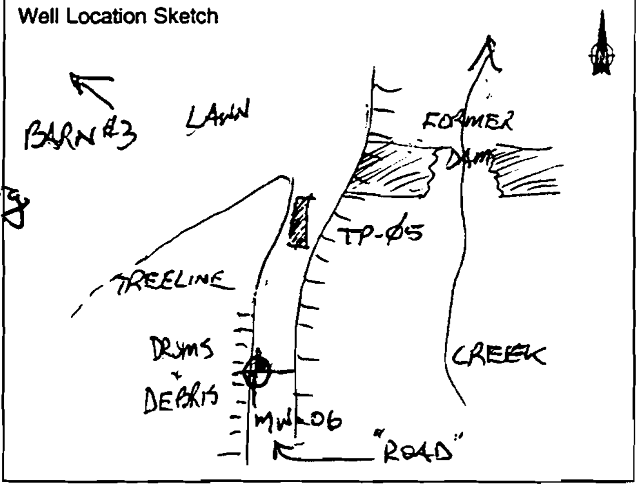
Auger/Split Spoon Refusal: 5.0' b.g.

Total Depth of Borehole Is: 58 bgs

Total Depth of Corehole Is: —

Water Level (TOIC)			
Date	Time	(6S) Level(Feet)	(6D)
1/25/99	1530		10.80 TOIC
1/26/99	0920		16.32 TOIC
1/27/99	0935		14.85 TOIC
1/28/99	0940	15.15 TOIC	15.10 TOIC
1/29/99			

Well Location Sketch



Depth(Feet)	Sample Number	Blows on Sampler		Soil Components Rock Profile CL SL S GR	Penetration Times	Run Number	Core Recovery	RQD	Fracture Sketch	~~HNu~~/OVA (ppm)	Comments
1	1	7 / 4	9 / 4	SL/GR			50%			2.5 ppm	
2											
3	2	3 / 4	3 / 11	—			0%			30 ppm	— OVA reading dissipated very quickly tuck w/ carbon tip
4		45	50/4"	SL/GR			100%				200ppm @ augers
5	3	–	–							250ppm	LEL n/a (250ppm on sample)
6											
7											Top of bedrock @ 5'
8											HSA Rock socket 5-9'
9											
10											Began Air Rotary Drilling
11					12.8 min/ft					0	
12											
13											
14											
15										0	

1" well (CRMW-6S) and 2" well (CRMW-6D) in Same Borehole

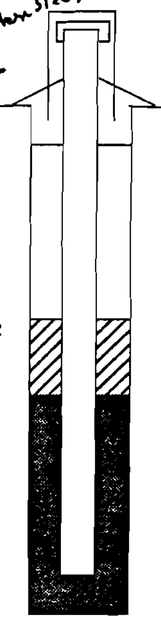
CRMW-6D — 2" SCREENED WELL

Lock Number 3476 MASTER

Inner Casing Material PVC

Inner Casing Inside Diameter 2 inches

Stick-up 2.03 ft carbon steel
1.77' PVC



Top of Grout 0 ft

Top of Seal at 29 ft

Top of Sand Pack 31 ft

Top of Screen at 33 ft

Bottom of Screen at 58 ft

Bottom of Hole at 58 ft

Bottom of Sandpack at 58

Quantity of Material Used:

Bentonite Pellets ______

Cement ______

Borehole Diameter 8 inches Overburden + Rock socket

Cement/Bentonite ______

Grout ______

Screen Slot Size 0.010

Screen Type

☒ PVC 2"

☐ Stainless Steel ______

Pack Type/Size:

☒ Sand Morie #0

☐ Gravel ______

☐ Natural ______

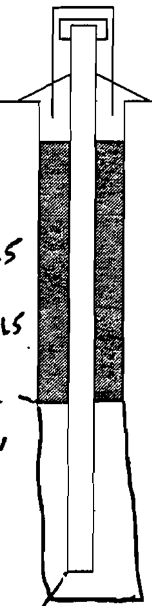
NOTE: See pages 136 and 137 for well construction diagrams

CRMW-6S — 1" Screened ~~OPEN-HOLE~~ WELL

Stick-up 2.03 ft carbon steel
1.93' PVC

Inner Casing Material PVC

Inner Casing Inside Diameter 1 inches



Outer Casing Diameter 4 inches

Borehole Diameter 8" ~~bedrock~~ overburden + Rocksocket

Bedrock 5.0 ft

Bottom of Rock Socket/Outer Casing 9 ft

Bottom of Inner Casing 58 ft

Corehole Diameter 4"

Bottom of Corehole 58 ft

Depth-ft.	NARRATIVE LITHOLOGIC DESCRIPTION	Moisture Content: Dry	Moist	Wet
1	Mod./ ~~Dk~~ Dark Br. Topsoil SILT and cmf GRAVEL, little CLAY, little cmf SAND		X	
2				
3	No recovery			
4				
5	Dk Br. cmf GRAVEL and SILT, some cmf SAND, trace CLAY,			
6	Gravel is l.s. rock frags, noted solvent/gasoline odor bedrock@5'		X	
7	Onondaga LS	X		
8		X		
9	9ft to 16ft	X		
10	Dark gray limestone chips	X		
11	Onondaga LS	X		
12		X		
13		X		
14		X		
15		X		

CRMW-6

Depth(feet)	Sample Number	Blows on Sampler	Soil Components CL SL S GR	Rock Profile	Penetration Times	Run Number	Core Recovery	RQD	Fracture Sketch	~~HNu~~/OVA (ppm)	Comments
16					12 min/ft					0	
17											
18											
19											
20					10 min/ft					0	
21											
22											
23											
24											
25					13 min/ft					0	
26											
27											
28											
29											
30										0	
31					9 min/ft						
32											
33											
34											
35					9 min/ft						
36										0	
37											
38											
39											
40											
41					10.5 min/ft						
42										0	
43											
44											
45											

CRMW-6

Depth(feet).	NARRATIVE LITHOLOGIC DESCRIPTION	Dry	Moist	Wet
16	16 ft to 45 ft	X	O	O
17	Dark gray limestone chips	X	O	O
18	Onondaga LS	X	O	O
19	18 ft some crystalline calcite chips	X	O	O
20		X	O	O
21		X	O	O
22		X	O	O
23		X	O	O
24		X	O	O
25	24.5ft to 25 ft coarse crystalline calcite fragments	O	O	X
26	and water return	X	O	O
27		X	O	O
28		X	O	O
29		X	O	O
30		X	O	O
31		X	O	O
32		X	O	O
33		X	O	O
34		X	O	O
35		X	O	O
36		X	O	O
37		X	O	O
38		X	O	O
39		X	O	O
40		X	O	O
41		X	O	O
42		X	O	O
43		X	O	O
44		X	O	O
45		X	O	O

CRMW-6

Depth(feet)	Sample Number	Blows on Sampler	Soil Components CL SL S GR	Rock Profile	Penetration Times	Run Number	Core Recovery	RQD	Fracture Sketch	~~HNu~~/OVA (ppm)	Comments
46					10.5 min/ft					0	
47											
48											
49											
50										0	
51					12 min/ft						
52											
53											
54											
55					12 min/ft					0	
56											
57											
58											
59			TD at 58 feet								
60											
61											
62											
63											
64											
65											
66											
67											
68											
69											
70											
71											
72											
73											
74											
75											

CRMW-6

Depth(feet)	NARRATIVE LITHOLOGIC DESCRIPTION	Moisture Content: Dry	Moist	Wet
46	45ft to	X		
47	Dark gray limestone chips	X		
48		X		
49		X		
50		X		
51		X		
52		X		
53		X		
54		X		
55		X		
56		X		
57	Dry during drilling. After 1 hr, turned on compressor and blew	X		
58	Onondaga LS out about 2 gal of water	X		X
59	TD at 58 feet			
60				
61				
62				
63				
64				
65				
66				
67				
68				
69				
70				
71				
72				
73				
74				
75				

WELL DEVELOPMENT RECORD

SITE Cauterskill Rd DATE 1-25-99 to 1-27-99

LOCATION Catskill, NY WELL NO. CRmw-6D

MEASUREMENT OF WATER LEVEL AND WELL VOLUME

- Prior to sampling, the static water level and total depth of the well will be measured with a calibrated weighted line. Care will be taken to decontaminate equipment between each use to avoid cross contamination of wells.
- The number of linear feet of static water (difference between static water level and total depth of well) will be calculated.
- The static volume will be calculated using the formula:

$$V = Tr^2(0.163)$$

Where:
V = Static volume of well in gallons;
T = Depth of water in the well, measured in feet;
r = Inside radius of well casing in inches;
and 0.163 = A constant conversion factor which compensates for r^2h factor for the conversion of the casing radius from inches to feet, the conversion of cubic feet to gallons, and (pi).
1 well volume (v) = 7.8 gallons.
3 well volumes = 23.5 gal

Volume of Water in Casing or Hole

Diameter of Casing or Hole (in)	Gallons per Foot of Depth	Cubic Feet per Foot of Depth	Liter per Meter of Depth	Cubic Meters per Meter of Depth
1	0.041	0.0055	0.509	0.509×10^{-3}
11/2	0.092	0.0123	1.142	1.142×10^{-3}
2	0.163	0.0218	2.024	2.024×10^{-3}
21/2	0.255	0.0341	3.167	3.167×10^{-3}
3	0.367	0.0491	4.558	4.558×10^{-3}
31/2	0.500	0.0668	6.209	6.209×10^{-3}
4	0.653	0.0873	8.110	8.110×10^{-3}
41/2	0.826	0.1104	10.260	10.260×10^{-3}
5	1.020	0.1364	12.670	12.670×10^{-3}
51/2	1.234	0.1650	15.330	15.330×10^{-3}
6	1.469	0.1963	18.240	18.240×10^{-3}
7	2.000	0.2673	24.840	24.840×10^{-3}
8	2.611	0.3491	32.430	32.430×10^{-3}
9	3.305	0.4418	41.040	41.040×10^{-3}
10	4.080	0.5454	50.670	50.670×10^{-3}
11	4.937	0.6600	61.310	61.310×10^{-3}
12	5.875	0.7854	72.960	72.960×10^{-3}
14	8.000	1.0690	99.350	99.350×10^{-3}
16	10.440	1.3960	129.650	129.650×10^{-3}
18	13.220	1.7670	164.180	164.180×10^{-3}
20	16.320	2.1820	202.680	202.680×10^{-3}
22	19.750	2.6400	245.280	245.280×10^{-3}
24	23.500	3.1420	291.850	291.850×10^{-3}
26	27.580	3.6870	342.520	342.520×10^{-3}
28	32.000	4.2760	397.410	397.410×10^{-3}
30	36.720	4.9090	456.020	456.020×10^{-3}
32	41.780	5.5850	518.870	518.870×10^{-3}
34	47.160	6.3050	585.680	585.680×10^{-3}
36	52.880	7.0690	656.720	656.720×10^{-3}

1 Gallon = 3.785 liters
1 Meter = 3.281 feet
1 Gallon water weighs 8.33 lbs. = 3.779 kilograms
1 Liter water weighs 1 kilogram = 2.205 pounds
1 Gallon per foot of depth = 12.419 liters per foot of depth
1 Gallon per meter of depth = 12.419×10^{-3} cubic meters per meter of depth

INITIAL DEVELOPMENT WATER

WATER LEVEL (TOIC) 10.8' TOIC
WELL DEPTH (TD) 59.65' TOIC
COLOR clear initially, then light brown
ODOR none
CLARITY clear to turbid on bottom

FINAL DEVELOPMENT WATER

WATER LEVEL (TOIC) Dry
WELL DEPTH (TD) 59.65' TOIC
COLOR Lt brn, cloudy
ODOR none
CLARITY turbid

DESCRIPTION OF DEVELOPMENT TECHNIQUE Bailing

WELL DEVELOPMENT - PARAMETER MEASUREMENTS CRMW-6D

TIME	TOTAL VOL. WITHDRAWN GALS.	TOTAL VOL. WITHDRAWN BORE VOL.	pH	COND. (µmhos/cm)	TEMP. (°C/°F)	TURB. (NTU)	COMMENTS
1/25/99 (well Development)							
1530	0		7.01	972	46.9	60.9	clear on top, sl. brn on bottom
1544	4		7.41	993	47.3	>1000	Lt. brn, turbid
1619	8		7.71	1050	46.2	>1000	" " "
1633	12		7.68	1061	46.1	>1000	" " "
1650	16		7.69	1042	45.8	>1000	" " "
1703	19		7.58	1001	45.8	>1000	" " ", DRY
1/26/99 (well Development)							
0923	19		7.15	989	42.2	48.4	clear WL = 16.32
0941	24		7.55	984	44.4	>1000	Lt. brn, cloudy
1004	29		7.57	958	41.8	>1000	" " "
1028	34		7.57	948	43.5	589	" " ", DRY
1/27/99 (well Purge)							
0935	34		7.07	1062	42.7	9.8	clear WL = 14.85'
0950	39		7.24	1118	44.6	183	Slightly cloudy
1005	44		7.32	1100	44.3	106	" "
1015	48		7.45	1104	43.8	—	" ", DRY
1/27/99 Sampled at 1445 G. Florentino							
1445	—	—	7.12	887	48.8	42.1	Clear

CRMW-6S dried up when CRMW-6D was purged dry, therefore, CRMW-6S and CRMW-6D are interconnected via fractures.

DEVELOPED BY: G. Florentino DATE 1/25/99 – 1/27/99

C

Inventory of Investigation-Derived Waste

INVESTIGATION-DERIVED WASTE INVENTORY SHEET

Site: Couterskill Road No. of Drums: 18

Inventory Date: 1-29-99

	Waste Source	Drum/Container ID Number	Date Generated	Contents (Solid, Liquids, etc.)	Approximate Volume	Drum Location/Comments
✓	CRMW-1	CR-1	1-13-99	Drillwater/rock cuttings	1/2 full	East side of Barn 3 under overhang
✓	CRMW-1	CR-2	1-22-99	Dev/Purge water	50 gal	↓
✓	CRMW-1	CR-3	1-27-99	Purge water	9 gal	
✓	CRMW-2	CR-4	1-22-99 ~~to 1-27-99~~	~~Drill~~ Rock Cuttings	1/4 full	
✓	CRMW-2	CR-5	1-22-99 to 1-27-99	Dev./Purge water	17 gal	
✓	CRMW-3	CR-6		Rock cuttings	full	
✓	CRMW-3	CR-7	1-25-99 to 1-27-99	Dev./Purge water	37.5 gal	
✓	CRMW-4	CR-8	1-22-99	Drill water + Rock Cuttings	full	
✓	CRMW-4	CR-9	1-26-99 1-27-99	Dev./Purge water	46 gal	↓
✓	CRMW-5/6	CR-10	1-21-99	Rock cuttings	3/4 full	Test Pit 9 Area
✓	CRMW-5	CR-11	1-26-99 1-27-99	Dev./Purge water	9.5 gal	East side of Barn 3 under overhang
✓	CRMW-6	CR-12	1-25-99 to 1-27-99	Dev./Purge water	48 gal	
✓	CRMW-6	CR-13	1-12-99 to 1-21-99	Soil/Rock cuttings	full	
✓	Decon Pad	CR-14		water	full	
✓	Decon Pad	CR-15		water/sludge	3/4 full	
✓	Decon Pad	CR-16		Plastic	full	
✓	PPE	CR-17	1-27-99		full	
✓	None	CR-18	—	Empty	—	

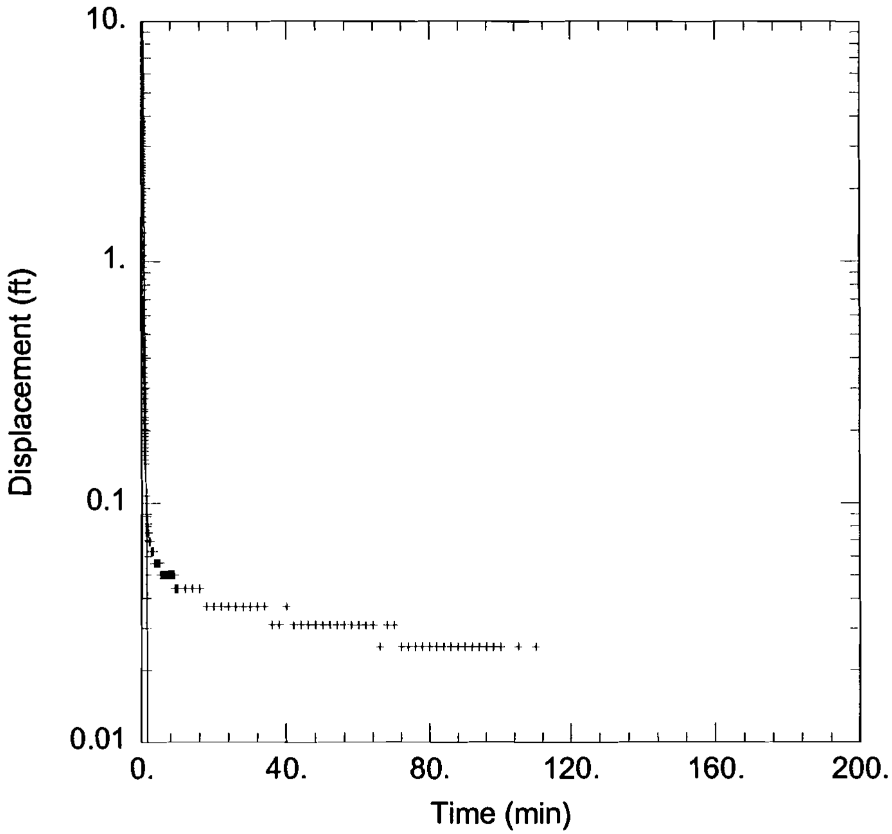
D

Analytical Data Forms

Appendix D is bound separately as Volume II.

E

Aquifer Test Results



CRMW-1, FALLING HEAD SLUG TEST

Data Set: C:\CATSKI~2\CAUTER~1\SLUGTE~1\CRMW1.AQT
Date: 04/02/99 Time: 15:45:34

PROJECT INFORMATION

Company: Ecology and Environment, Inc.
Client: NYSDEC
Project: QQ010022
Test Location: Cauterskill Road, Catskill NY
Test Well: CRMW-1
Test Date: 1/28/99

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.009525 ft/min
y0 = 86.32 ft

AQUIFER DATA

Saturated Thickness: 12. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Initial Displacement: 4.311 ft
Casing Radius: 0.083 ft
Screen Length: 15. ft
Water Column Height: 12. ft
Wellbore Radius: 0.167 ft
Gravel Pack Porosity: 0.4

Data Set: C:\CATSKI~2\CAUTER~1\SLUGTE~1\CRMW1.AQT
Title: CRMW-1, Falling Head Slug Test
Date: 04/02/99
Time: 15:45:43

PROJECT INFORMATION

Company: Ecology and Environment, Inc.
Client: NYSDEC
Project: QQ010022
Location: Cauterskill Road, Catskill NY
Test Date: 1/28/99
Test Well: CRMW-1

AQUIFER DATA

Saturated Thickness: 12. ft
Anisotropy Ratio (Kz/Kr): 0.1

OBSERVATION WELL DATA

Number of observation wells: 1

Observation Well No. 1: CRMW-1

X Location: 0. ft
Y Location: 0. ft

No. of observations: 172

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.0083	4.311	0.4	0.948	2.4	0.069	20.	0.037
0.0166	4.753	0.4166	0.847	2.6	0.063	22.	0.037
0.025	3.913	0.4333	0.764	2.8	0.063	24.	0.037

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.0333	3.837	0.45	0.695	3.	0.063	26.	0.037
0.0416	3.786	0.4666	0.638	3.2	0.063	28.	0.037
0.05	3.71	0.4833	0.587	3.4	0.056	30.	0.037
0.0583	3.641	0.5	0.543	3.6	0.056	32.	0.037
0.0666	3.597	0.5166	0.505	3.8	0.056	34.	0.037
0.075	3.634	0.5333	0.474	4.	0.056	36.	0.031
0.0833	3.578	0.55	0.442	4.2	0.056	38.	0.031
0.0916	3.483	0.5666	0.41	4.4	0.056	40.	0.037
0.1	3.401	0.5833	0.391	4.6	0.056	42.	0.031
0.1083	3.344	0.6	0.366	4.8	0.056	44.	0.031
0.1166	3.242	0.6166	0.347	5.	0.056	46.	0.031
0.125	3.16	0.6333	0.335	5.2	0.05	48.	0.031
0.1333	3.084	0.65	0.316	5.4	0.05	50.	0.031
0.1416	3.002	0.6666	0.297	5.6	0.05	52.	0.031
0.15	2.933	0.6833	0.284	5.8	0.05	54.	0.031
0.1583	2.863	0.7	0.271	6.	0.05	56.	0.031
0.1666	2.781	0.7166	0.259	6.2	0.05	58.	0.031
0.175	2.718	0.7333	0.246	6.4	0.05	60.	0.031
0.1833	2.642	0.75	0.24	6.6	0.05	62.	0.031
0.1916	2.566	0.7666	0.227	6.8	0.05	64.	0.031
0.2	2.503	0.7833	0.221	7.	0.05	66.	0.025
0.2083	2.446	0.8	0.214	7.2	0.05	68.	0.031
0.2166	2.383	0.8166	0.202	7.4	0.05	70.	0.031
0.225	2.32	0.8333	0.195	7.6	0.05	72.	0.025
0.2333	2.256	0.85	0.189	7.8	0.05	74.	0.025
0.2416	2.187	0.8666	0.183	8.	0.05	76.	0.025
0.25	2.117	0.8833	0.176	8.2	0.05	78.	0.025
0.2583	2.06	0.9	0.17	8.4	0.05	80.	0.025
0.2666	2.003	0.9166	0.164	8.6	0.05	82.	0.025
0.275	1.94	0.9333	0.158	8.8	0.05	84.	0.025
0.2833	1.877	0.95	0.158	9.	0.05	86.	0.025
0.2916	1.807	0.9666	0.151	9.2	0.044	88.	0.025
0.3	1.744	0.9833	0.145	9.4	0.044	90.	0.025
0.3083	1.668	1.	0.145	9.6	0.044	92.	0.025

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.3166	1.605	1.2	0.107	9.8	0.044	94.	0.025
0.325	1.529	1.4	0.088	10.	0.044	96.	0.025
0.3333	1.453	1.6	0.082	12.	0.044	98.	0.025
0.35	1.314	1.8	0.075	14.	0.044	100.	0.025
0.3666	1.169	2.	0.069	16.	0.044	105.	0.025
0.3833	1.055	2.2	0.069	18.	0.037	110.	0.025

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.009525	ft/min
y0	86.32	ft

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	
K	0.009525	0.0001596	ft/min
y0	86.32	0.1668	ft

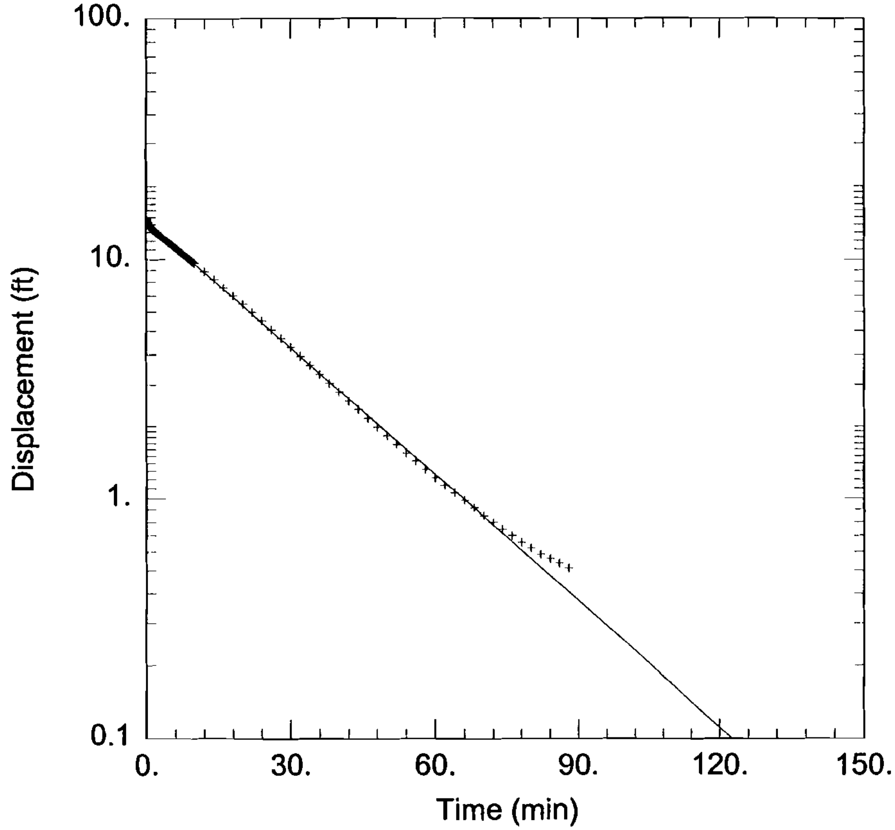
Parameter Correlations

	K	y0
K	1.00	0.67
y0	0.67	1.00

Residual Statistics

for weighted residuals

Sum of Squares ... 151.4 ft^2
Variance .... 0.8906 ft^2
Std. Deviation...... 0.9437 ft
Mean .... -0.4523 ft
No. of Residuals ... 172.
No. of Estimates ... 2



CRMW-2, FALLING HEAD SLUG TEST

Data Set: C:\CATSKI~2\CAUTER~1\SLUGTE~1\CRMW2.AQT
Date: 04/02/99 Time: 15:46:31

PROJECT INFORMATION

Company: Ecology and Environment, Inc.
Client: NYSDEC
Project: QQ010022
Test Location: Cauterskill Road, Catskill NY
Test Well: CRMW-2
Test Date: 1/29/99

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 4.266E-05 ft/min
y0 = 14.3 ft

AQUIFER DATA

Saturated Thickness: 18. ft

Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Initial Displacement: 14.82 ft
Casing Radius: 0.083 ft
Screen Length: 15. ft

Water Column Height: 18. ft
Wellbore Radius: 0.167 ft

Data Set: C:\CATSKI~2\CAUTER~1\SLUGTE~1\CRMW2.AQT
Title: CRMW-2, Falling Head Slug Test
Date: 04/02/99
Time: 15:46:38

PROJECT INFORMATION

Company: Ecology and Environment, Inc.
Client: NYSDEC
Project: QQ010022
Location: Cauterskill Road, Catskill NY
Test Date: 1/29/99
Test Well: CRMW-2

AQUIFER DATA

Saturated Thickness: 18. ft
Anisotropy Ratio (Kz/Kr): 0.1

OBSERVATION WELL DATA

Number of observation wells: 1

Observation Well No. 1: CRMW-2

X Location: 0. ft
Y Location: 0. ft

No. of observations: 165

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	14.08	0.3666	14.11	1.8	13.12	12.	8.889
0.0083	14.66	0.3833	14.08	2.	13.02	14.	8.219
0.0166	14.63	0.4	14.06	2.2	12.91	16.	7.606

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.025	14.25	0.4166	14.04	2.4	12.81	18.	7.018
0.0333	14.82	0.4333	14.02	2.6	12.71	20.	6.474
0.0416	14.3	0.45	14.	2.8	12.61	22.	5.974
0.05	14.78	0.4666	13.98	3.	12.52	24.	5.513
0.0583	14.32	0.4833	13.96	3.2	12.42	26.	5.07
0.0666	14.68	0.5	13.94	3.4	12.33	28.	4.665
0.075	14.4	0.5166	13.91	3.6	12.23	30.	4.286
0.0833	14.57	0.5333	13.9	3.8	12.15	32.	3.938
0.0916	14.44	0.55	13.89	4.	12.05	34.	3.616
0.1	14.5	0.5666	13.88	4.2	11.96	36.	3.319
0.1083	14.46	0.5833	13.87	4.4	11.87	38.	3.047
0.1166	14.45	0.6	13.85	4.6	11.78	40.	2.794
0.125	14.45	0.6166	13.85	4.8	11.69	42.	2.566
0.1333	14.41	0.6333	13.83	5.	11.6	44.	2.358
0.1416	14.44	0.65	13.82	5.2	11.52	46.	2.162
0.15	14.39	0.6666	13.8	5.4	11.43	48.	1.985
0.1583	14.41	0.6833	13.8	5.6	11.34	50.	1.827
0.1666	14.37	0.7	13.78	5.8	11.26	52.	1.681
0.175	14.39	0.7166	13.77	6.	11.17	54.	1.548
0.1833	14.35	0.7333	13.76	6.2	11.1	56.	1.435
0.1916	14.36	0.75	13.75	6.4	11.01	58.	1.321
0.2	14.33	0.7666	13.73	6.6	10.93	60.	1.22
0.2083	14.33	0.7833	13.73	6.8	10.84	62.	1.131
0.2166	14.32	0.8	13.71	7.	10.76	64.	1.055
0.225	14.3	0.8166	13.7	7.2	10.69	66.	0.979
0.2333	14.3	0.8333	13.69	7.4	10.6	68.	0.91
0.2416	14.28	0.85	13.68	7.6	10.52	70.	0.847
0.25	14.28	0.8666	13.66	7.8	10.45	72.	0.796
0.2583	14.26	0.8833	13.65	8.	10.36	74.	0.745
0.2666	14.25	0.9	13.64	8.2	10.29	76.	0.701
0.275	14.23	0.9166	13.63	8.4	10.21	78.	0.657
0.2833	14.23	0.9333	13.62	8.6	10.14	80.	0.625
0.2916	14.21	0.95	13.61	8.8	10.05	82.	0.587
0.3	14.2	0.9666	13.6	9.	9.977	84.	0.562

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.3083	14.19	0.9833	13.59	9.2	9.907	86.	0.537
0.3166	14.18	1.	13.58	9.4	9.831	88.	0.512
0.325	14.17	1.2	13.46	9.6	9.756		
0.3333	14.16	1.4	13.34	9.8	9.68		
0.35	14.13	1.6	13.23	10.	9.61		

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	3.411E-05	ft/min
y0	14.3	ft

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	
K	4.266E-05	1.969E-07	ft/min
y0	14.3	0.01342	ft

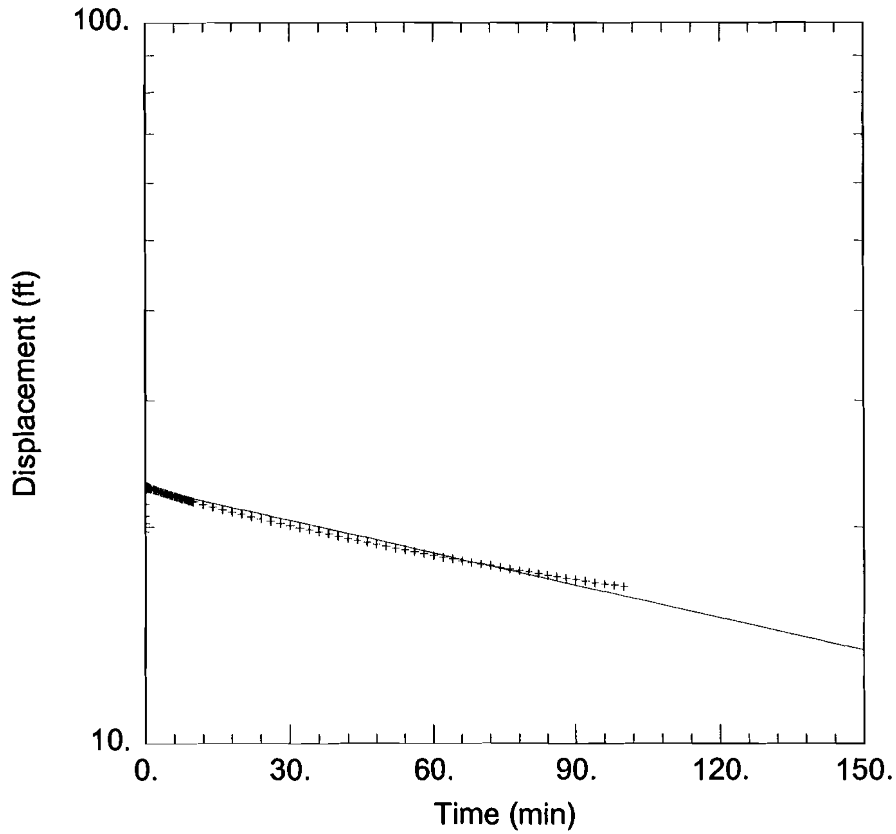
Parameter Correlations

	K	y0
K	1.00	0.45
y0	0.45	1.00

Residual Statistics

for weighted residuals

Sum of Squares ... 2.382 ft^2
Variance .... 0.01508 ft^2
Std. Deviation...... 0.1228 ft
Mean .... 0.00216 ft
No. of Residuals ... 160.
No. of Estimates ... 2



CRMW-3, FALLING HEAD SLUG TEST

Data Set: C:\CATSKI~2\CAUTER~1\SLUGTE~1\CRMW3.AQT
Date: 04/02/99 Time: 15:47:42

PROJECT INFORMATION

Company: Ecology and Environment, Inc.
Client: NYSDEC
Project: QQ010022
Test Location: Cauterskill Road, Catskill NY
Test Well: CRMW-3
Test Date: 1/28/99

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 2.545E-06 ft/min
y0 = 22.66 ft

AQUIFER DATA

Saturated Thickness: 41. ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Initial Displacement: 22.82 ft
Casing Radius: 0.083 ft
Screen Length: 25. ft
Water Column Height: 41. ft
Wellbore Radius: 0.167 ft

Data Set: C:\CATSKI~2\CAUTER~1\SLUGTE~1\CRMW3.AQT
Title: CRMW-3, Falling Head Slug Test
Date: 04/02/99
Time: 15:47:46

PROJECT INFORMATION

Company: Ecology and Environment, Inc.
Client: NYSDEC
Project: QQ010022
Location: Cauterskill Road, Catskill NY
Test Date: 1/28/99
Test Well: CRMW-3

AQUIFER DATA

Saturated Thickness: 41. ft
Anisotropy Ratio (Kz/Kr): 0.1

OBSERVATION WELL DATA

Number of observation wells: 1

Observation Well No. 1: CRMW-3

X Location: 0. ft
Y Location: 0. ft

No. of observations: 170

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.0083	19.7	0.4	22.73	2.4	22.47	20.	20.84
0.0166	20.24	0.4166	22.73	2.6	22.45	22.	20.68
0.025	20.72	0.4333	22.72	2.8	22.42	24.	20.53

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.0333	21.52	0.45	22.72	3.	22.41	26.	20.37
0.0416	22.34	0.4666	22.72	3.2	22.38	28.	20.23
0.05	22.75	0.4833	22.72	3.4	22.35	30.	20.09
0.0583	22.69	0.5	22.72	3.6	22.34	32.	19.95
0.0666	22.84	0.5166	22.72	3.8	22.31	34.	19.81
0.075	22.73	0.5333	22.71	4.	22.29	36.	19.68
0.0833	22.82	0.55	22.71	4.2	22.27	38.	19.55
0.0916	22.8	0.5666	22.7	4.4	22.25	40.	19.42
0.1	22.8	0.5833	22.7	4.6	22.23	42.	19.29
0.1083	22.8	0.6	22.7	4.8	22.2	44.	19.17
0.1166	22.79	0.6166	22.7	5.	22.18	46.	19.05
0.125	22.78	0.6333	22.7	5.2	22.16	48.	18.93
0.1333	22.78	0.65	22.7	5.4	22.14	50.	18.82
0.1416	22.78	0.6666	22.69	5.6	22.12	52.	18.7
0.15	22.78	0.6833	22.69	5.8	22.1	54.	18.6
0.1583	22.78	0.7	22.69	6.	22.08	56.	18.49
0.1666	22.78	0.7166	22.68	6.2	22.06	58.	18.38
0.175	22.78	0.7333	22.68	6.4	22.04	60.	18.27
0.1833	22.77	0.75	22.68	6.6	22.02	62.	18.17
0.1916	22.77	0.7666	22.68	6.8	21.99	64.	18.07
0.2	22.77	0.7833	22.68	7.	21.98	66.	17.97
0.2083	22.77	0.8	22.68	7.2	21.96	68.	17.88
0.2166	22.77	0.8166	22.67	7.4	21.94	70.	17.78
0.225	22.76	0.8333	22.67	7.6	21.92	72.	17.69
0.2333	22.76	0.85	22.67	7.8	21.9	74.	17.59
0.2416	22.76	0.8666	22.66	8.	21.88	76.	17.5
0.25	22.76	0.8833	22.66	8.2	21.86	78.	17.41
0.2583	22.75	0.9	22.66	8.4	21.84	80.	17.33
0.2666	22.75	0.9166	22.66	8.6	21.82	82.	17.24
0.275	22.75	0.9333	22.66	8.8	21.8	84.	17.15
0.2833	22.75	0.95	22.66	9.	21.79	86.	17.07
0.2916	22.75	0.9666	22.65	9.2	21.77	88.	16.98
0.3	22.75	0.9833	22.65	9.4	21.74	90.	16.91
0.3083	22.75	1.	22.65	9.6	21.73	92.	16.83

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.3166	22.75	1.2	22.63	9.8	21.71	94.	16.74
0.325	22.74	1.4	22.59	10.	21.69	96.	16.67
0.3333	22.74	1.6	22.57	12.	21.51	98.	16.6
0.35	22.74	1.8	22.54	14.	21.33	100.	16.52
0.3666	22.73	2.	22.53	16.	21.16		
0.3833	22.73	2.2	22.5	18.	20.99		

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	2.161E-06	ft/min
y0	22.52	ft

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	
K	2.545E-06	1.97E-08	ft/min
y0	22.66	0.01623	ft

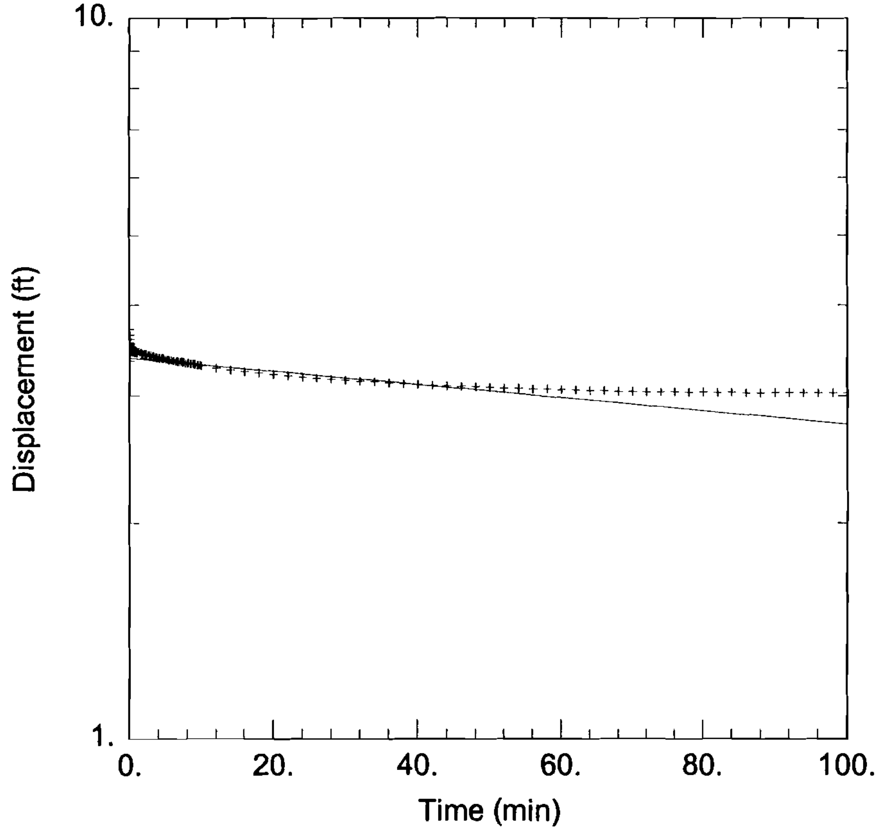
Parameter Correlations

	K	y0
K	1.00	0.48
y0	0.48	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . 4.67 ft^2
Variance . . . . 0.02937 ft^2
Std. Deviation . . . . . . 0.1714 ft
Mean . . . . 0.0005825 ft
No. of Residuals . . . 161.
No. of Estimates . . . 2



CRMW-4, FALLING HEAD SLUG TEST

Data Set: C:\CATSKI~2\CAUTER~1\SLUGTE~1\CRMW4.AQT
Date: 04/02/99 Time: 15:49:04

PROJECT INFORMATION

Company: Ecology and Environment, Inc.
Client: NYSDEC
Project: QQ010022
Test Location: Cauterskill Road, Catskill NY
Test Well: CRMW-4
Test Date: 1/28/99

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 1.941E-06 ft/min
y0 = 3.381 ft

AQUIFER DATA

Saturated Thickness: 47. ft

Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Initial Displacement: 3.638 ft
Casing Radius: 0.083 ft
Screen Length: 20. ft

Water Column Height: 47. ft
Wellbore Radius: 0.167 ft

Data Set: C:\CATSKI~2\CAUTER~1\SLUGTE~1\CRMW4.AQT
Title: CRMW-4, Falling Head Slug Test
Date: 04/02/99
Time: 15:49:08

PROJECT INFORMATION

Company: Ecology and Environment, Inc.
Client: NYSDEC
Project: QQ010022
Location: Cauterskill Road, Catskill NY
Test Date: 1/28/99
Test Well: CRMW-4

AQUIFER DATA

Saturated Thickness: 47. ft
Anisotropy Ratio (Kz/Kr): 0.1

OBSERVATION WELL DATA

Number of observation wells: 1

Observation Well No. 1: CRMW-4

X Location: 0. ft
Y Location: 0. ft

No. of observations: 170

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.0083	3.518	0.4	3.462	2.4	3.418	20.	3.21
0.0166	3.455	0.4166	3.462	2.6	3.411	22.	3.197
0.025	3.355	0.4333	3.455	2.8	3.405	24.	3.185

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.0333	3.701	0.45	3.455	3.	3.405	26.	3.172
0.0416	3.468	0.4666	3.455	3.2	3.399	28.	3.16
0.05	3.588	0.4833	3.455	3.4	3.392	30.	3.153
0.0583	3.468	0.5	3.455	3.6	3.392	32.	3.141
0.0666	3.638	0.5166	3.455	3.8	3.386	34.	3.134
0.075	3.487	0.5333	3.455	4.	3.386	36.	3.122
0.0833	3.544	0.55	3.455	4.2	3.38	38.	3.115
0.0916	3.499	0.5666	3.455	4.4	3.38	40.	3.109
0.1	3.537	0.5833	3.455	4.6	3.38	42.	3.103
0.1083	3.531	0.6	3.455	4.8	3.374	44.	3.097
0.1166	3.455	0.6166	3.449	5.	3.367	46.	3.09
0.125	3.506	0.6333	3.455	5.2	3.367	48.	3.084
0.1333	3.499	0.65	3.455	5.4	3.361	50.	3.078
0.1416	3.506	0.6666	3.449	5.6	3.361	52.	3.071
0.15	3.487	0.6833	3.449	5.8	3.361	54.	3.071
0.1583	3.499	0.7	3.449	6.	3.355	56.	3.065
0.1666	3.487	0.7166	3.449	6.2	3.355	58.	3.065
0.175	3.493	0.7333	3.449	6.4	3.348	60.	3.059
0.1833	3.481	0.75	3.449	6.6	3.348	62.	3.053
0.1916	3.487	0.7666	3.449	6.8	3.342	64.	3.046
0.2	3.481	0.7833	3.449	7.	3.342	66.	3.046
0.2083	3.487	0.8	3.449	7.2	3.342	68.	3.04
0.2166	3.474	0.8166	3.449	7.4	3.336	70.	3.04
0.225	3.481	0.8333	3.449	7.6	3.336	72.	3.04
0.2333	3.474	0.85	3.449	7.8	3.329	74.	3.034
0.2416	3.474	0.8666	3.449	8.	3.329	76.	3.034
0.25	3.474	0.8833	3.449	8.2	3.329	78.	3.027
0.2583	3.474	0.9	3.449	8.4	3.323	80.	3.034
0.2666	3.468	0.9166	3.449	8.6	3.323	82.	3.034
0.275	3.449	0.9333	3.449	8.8	3.323	84.	3.034
0.2833	3.468	0.95	3.443	9.	3.317	86.	3.027
0.2916	3.468	0.9666	3.443	9.2	3.317	88.	3.027
0.3	3.468	0.9833	3.443	9.4	3.311	90.	3.027
0.3083	3.468	1.	3.443	9.6	3.311	92.	3.027

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.3166	3.468	1.2	3.443	9.8	3.311	94.	3.027
0.325	3.462	1.4	3.437	10.	3.304	96.	3.027
0.3333	3.462	1.6	3.43	12.	3.279	98.	3.027
0.35	3.462	1.8	3.424	14.	3.26	100.	3.027
0.3666	3.462	2.	3.424	16.	3.241		
0.3833	3.462	2.2	3.418	18.	3.229		

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	1.941E-06	ft/min
y0	3.381	ft

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	
K	1.593E-06	4.963E-08	ft/min
y0	3.433	0.005453	ft

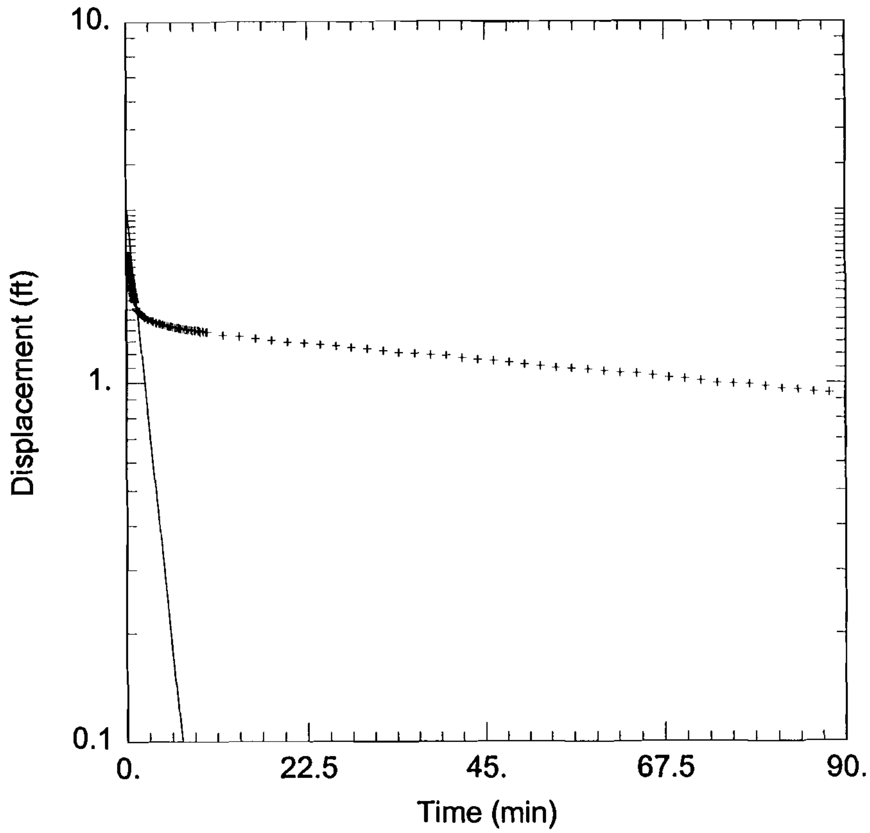
Parameter Correlations

	K	y0
K	1.00	0.50
y0	0.50	1.00

Residual Statistics

for weighted residuals

Sum of Squares ... 0.553 ft^2
Variance........... 0.003435 ft^2
Std. Deviation...... 0.05861 ft
Mean .... 4.614E-05 ft
No. of Residuals ... 163.
No. of Estimates ... 2



CRMW-5, RISING HEAD SLUG TEST

Data Set: C:\CATSKI~2\CAUTER~1\SLUGTE~1\CRMW5.AQT
Date: 04/02/99 Time: 15:49:46

PROJECT INFORMATION

Company: Ecology and Environment, Inc.
Client: NYSDEC
Project: QQ010022
Test Location: Cauterskill Road, Catskill NY
Test Well: CRMW-5
Test Date: 1/29/99

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.000523 ft/min
y0 = 3.064 ft

AQUIFER DATA

Saturated Thickness: 17. ft

Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Initial Displacement: 2.303 ft
Casing Radius: 0.083 ft
Screen Length: 15. ft

Water Column Height: 17. ft
Wellbore Radius: 0.167 ft

Data Set: C:\CATSKI~2\CAUTER~1\SLUGTE~1\CRMW5.AQT
Title: CRMW-5, Rising Head Slug Test
Date: 04/02/99
Time: 15:49:50

PROJECT INFORMATION

Company: Ecology and Environment, Inc.
Client: NYSDEC
Project: QQ010022
Location: Cauterskill Road, Catskill NY
Test Date: 1/29/99
Test Well: CRMW-5

AQUIFER DATA

Saturated Thickness: 17. ft
Anisotropy Ratio (Kz/Kr): 0.1

OBSERVATION WELL DATA

Number of observation wells: 1

Observation Well No. 1: CRMW-5

X Location: 0. ft
Y Location: 0. ft

No. of observations: 165

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.	2.303	0.3666	1.995	1.8	1.548	12.	1.359
0.0083	2.303	0.3833	1.982	2.	1.535	14.	1.347
0.0166	2.291	0.4	1.976	2.2	1.523	16.	1.328

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.025	2.284	0.4166	1.963	2.4	1.516	18.	1.315
0.0333	2.278	0.4333	1.951	2.6	1.504	20.	1.296
0.0416	2.265	0.45	1.944	2.8	1.498	22.	1.284
0.05	2.265	0.4666	1.932	3.	1.491	24.	1.277
0.0583	2.253	0.4833	1.919	3.2	1.485	26.	1.265
0.0666	2.24	0.5	1.913	3.4	1.479	28.	1.252
0.075	2.24	0.5166	1.9	3.6	1.472	30.	1.24
0.0833	2.221	0.5333	1.894	3.8	1.466	32.	1.227
0.0916	2.221	0.55	1.882	4.	1.466	34.	1.214
0.1	2.215	0.5666	1.869	4.2	1.46	36.	1.208
0.1083	2.209	0.5833	1.863	4.4	1.454	38.	1.195
0.1166	2.196	0.6	1.856	4.6	1.454	40.	1.189
0.125	2.19	0.6166	1.844	4.8	1.447	42.	1.17
0.1333	2.184	0.6333	1.837	5.	1.441	44.	1.158
0.1416	2.177	0.65	1.831	5.2	1.435	46.	1.151
0.15	2.165	0.6666	1.825	5.4	1.435	48.	1.139
0.1583	2.165	0.6833	1.812	5.6	1.435	50.	1.126
0.1666	2.158	0.7	1.806	5.8	1.428	52.	1.114
0.175	2.152	0.7166	1.8	6.	1.422	54.	1.101
0.1833	2.146	0.7333	1.787	6.2	1.422	56.	1.095
0.1916	2.133	0.75	1.781	6.4	1.422	58.	1.088
0.2	2.133	0.7666	1.775	6.6	1.416	60.	1.076
0.2083	2.121	0.7833	1.768	6.8	1.416	62.	1.063
0.2166	2.114	0.8	1.762	7.	1.416	64.	1.057
0.225	2.108	0.8166	1.756	7.2	1.409	66.	1.044
0.2333	2.096	0.8333	1.749	7.4	1.409	68.	1.032
0.2416	2.089	0.85	1.743	7.6	1.403	70.	1.025
0.25	2.083	0.8666	1.73	7.8	1.403	72.	1.013
0.2583	2.077	0.8833	1.724	8.	1.403	74.	1.
0.2666	2.07	0.9	1.718	8.2	1.397	76.	0.994
0.275	2.064	0.9166	1.712	8.4	1.397	78.	0.988
0.2833	2.058	0.9333	1.705	8.6	1.397	80.	0.975
0.2916	2.051	0.95	1.699	8.8	1.397	82.	0.963
0.3	2.045	0.9666	1.693	9.	1.391	84.	0.956

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.3083	2.039	0.9833	1.686	9.2	1.384	86.	0.944
0.3166	2.033	1.	1.68	9.4	1.391	88.	0.937
0.325	2.026	1.2	1.617	9.6	1.384		
0.3333	2.02	1.4	1.586	9.8	1.384		
0.35	2.007	1.6	1.567	10.	1.384		

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.000523	ft/min
y0	3.064	ft

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	
K	0.000523	1.341E-06	ft/min
y0	3.064	0.02258	ft

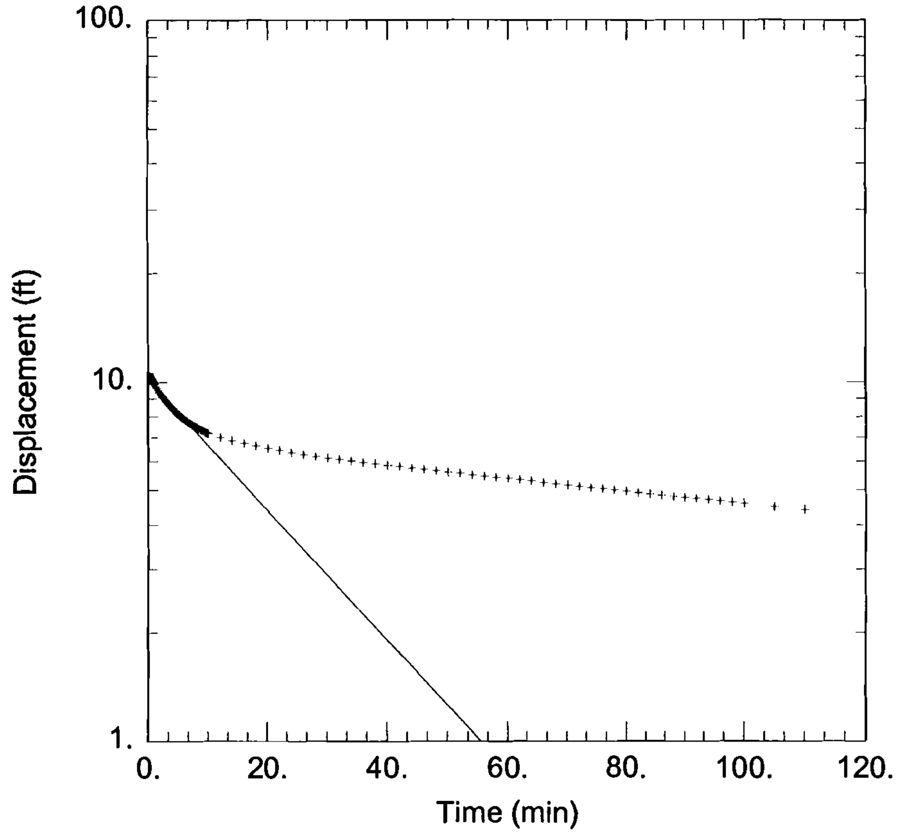
Parameter Correlations

	K	y0
K	1.00	0.41
y0	0.41	1.00

Residual Statistics

for weighted residuals

Sum of Squares . . . 9.344 ft^2
Variance . . . . 0.05732 ft^2
Std. Deviation. . . . . . 0.2394 ft
Mean . . . . 0.003062 ft
No. of Residuals . . . 165.
No. of Estimates . . . 2



CRMW6D, FALLING HEAD SLUG TEST

Data Set: C:\CATSKI~2\CAUTER~1\SLUGTE~1\CRMW6D.AQT
Date: 04/02/99 Time: 15:50:59

PROJECT INFORMATION

Company: Ecology and Environment, Inc.
Client: NYSDEC
Project: QQ010022
Test Location: Cauterskill Road, Catskill NY
Test Well: CRMW-6D
Test Date: 1/28/99

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 3.093E-05 ft/min
y0 = 10.07 ft

AQUIFER DATA

Saturated Thickness: 44. ft

Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA

Initial Displacement: 10.58 ft
Casing Radius: 0.083 ft
Screen Length: 25. ft

Water Column Height: 44. ft
Wellbore Radius: 0.167 ft

Data Set: C:\CATSKI~2\CAUTER~1\SLUGTE~1\CRMW6D.AQT
Title: CRMW6D, Falling Head Slug Test
Date: 04/02/99
Time: 15:51:05

PROJECT INFORMATION

Company: Ecology and Environment, Inc.
Client: NYSDEC
Project: QQ010022
Location: Cauterskill Road, Catskill NY
Test Date: 1/28/99
Test Well: CRMW-6D

AQUIFER DATA

Saturated Thickness: 44. ft
Anisotropy Ratio (Kz/Kr): 0.1

OBSERVATION WELL DATA

Number of observation wells: 1

Observation Well No. 1: CRMW-6D

X Location: 0. ft
Y Location: 0. ft

No. of observations: 169

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.0333	10.58	0.45	10.23	3.	8.794	26.	6.269
0.0416	10.42	0.4666	10.22	3.2	8.706	28.	6.2
0.05	10.56	0.4833	10.2	3.4	8.624	30.	6.137

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.0583	10.41	0.5	10.2	3.6	8.548	32.	6.074
0.0666	10.53	0.5166	10.19	3.8	8.479	34.	6.018
0.075	10.43	0.5333	10.17	4.	8.404	36.	5.961
0.0833	10.51	0.55	10.16	4.2	8.334	38.	5.911
0.0916	10.46	0.5666	10.15	4.4	8.271	40.	5.854
0.1	10.46	0.5833	10.14	4.6	8.208	42.	5.803
0.1083	10.44	0.6	10.12	4.8	8.152	44.	5.753
0.1166	10.44	0.6166	10.11	5.	8.089	46.	5.696
0.125	10.44	0.6333	10.1	5.2	8.038	48.	5.652
0.1333	10.42	0.65	10.09	5.4	7.982	50.	5.602
0.1416	10.43	0.6666	10.08	5.6	7.938	52.	5.552
0.15	10.41	0.6833	10.07	5.8	7.887	54.	5.508
0.1583	10.43	0.7	10.06	6.	7.837	56.	5.457
0.1666	10.42	0.7166	10.05	6.2	7.793	58.	5.413
0.175	10.41	0.7333	10.03	6.4	7.755	60.	5.369
0.1833	10.4	0.75	10.02	6.6	7.711	62.	5.325
0.1916	10.39	0.7666	10.01	6.8	7.673	64.	5.281
0.2	10.39	0.7833	10.	7.	7.636	66.	5.237
0.2083	10.38	0.8	9.99	7.2	7.598	68.	5.193
0.2166	10.39	0.8166	9.978	7.4	7.566	70.	5.155
0.225	10.37	0.8333	9.965	7.6	7.535	72.	5.111
0.2333	10.37	0.85	9.959	7.8	7.497	74.	5.073
0.2416	10.37	0.8666	9.94	8.	7.466	76.	5.029
0.25	10.36	0.8833	9.934	8.2	7.44	78.	4.991
0.2583	10.36	0.9	9.921	8.4	7.409	80.	4.954
0.2666	10.36	0.9166	9.915	8.6	7.384	82.	4.91
0.275	10.34	0.9333	9.902	8.8	7.352	84.	4.872
0.2833	10.33	0.95	9.89	9.	7.327	86.	4.834
0.2916	10.34	0.9666	9.877	9.2	7.302	88.	4.796
0.3	10.33	0.9833	9.871	9.4	7.277	90.	4.758
0.3083	10.32	1.	9.858	9.6	7.251	92.	4.721
0.3166	10.32	1.2	9.732	9.8	7.233	94.	4.683
0.325	10.31	1.4	9.606	10.	7.207	96.	4.645
0.3333	10.31	1.6	9.493	12.	7.019	98.	4.607

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.35	10.3	1.8	9.38	14.	6.861	100.	4.576
0.3666	10.29	2.	9.266	16.	6.735	105.	4.488
0.3833	10.27	2.2	9.165	18.	6.622	110.	4.4
0.4	10.27	2.4	9.065	20.	6.521		
0.4166	10.26	2.6	8.97	22.	6.433		
0.4333	10.24	2.8	8.876	24.	6.345		

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	3.093E-05	ft/min
y0	10.07	ft

AUTOMATIC ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	Std. Error	
K	3.077E-05	2.799E-07	ft/min
y0	10.22	0.08125	ft

Parameter Correlations

	K	y0
K	1.00	0.41
y0	0.41	1.00

Residual Statistics

for weighted residuals

Sum of Squares ... 122.4 ft^2
Variance .... 0.7327 ft^2
Std. Deviation...... 0.856 ft
Mean .... 0.01934 ft
No. of Residuals ... 169.
No. of Estimates ... 2

F

Summary Report Toxicity

SUMMARY REPORT

TOXICITY EVALUATION OF SEDIMENT WITH *Hyalella azteca* FOR ECOLOGY AND ENVIRONMENT PROJECT No.: 699.QQ01

Submitted to:
Ecology and Environment, Inc.
4493 Walden Avenue
Lancaster, New York 14086

SLI Report # 13597.6103

Study Director: Arthur E. Putt

Springborn Laboratories, Inc.
790 Main Street
Wareham, Massachusetts 02571-1075

July 29, 1999

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EXECUTIVE SUMMARY

The following is a summary of testing performed with the freshwater amphipod (*Hyalella azteca*) to evaluate sediment for Ecology and Environment project number 699.QQ01. Six test samples were collected on June 30, 1999 and shipped on July 1, 1999 by Ecology and Environment personnel. The test samples were identified as: CRSD-13, -14, -15, -16, -17 and -17D. These samples were received at Springborn on July 2, 1999. In addition, Springborn prepared an artificial sediment that was used as the laboratory control sediments. The artificial sediment was prepared by mixing 10% sphagnum peat, 20% kaolin clay and 70% industrial sand (with >50% of the particles between 50 and 200 microns).

The test method used during the conduct of this study followed the "Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates", Test Method 100.1 (U.S. EPA 1994) and ASTM Guideline E 1706-95b "Standard Test Methods for Measuring the Toxicity of Sediment-Associated Contaminants with Fresh Water Invertebrates" (ASTM, 1997). The test method followed during the conduct of this test is attached in Appendix I.

A summary of the Day 0 and Day 10 water quality characteristics of overlying water during the 10-day subchronic test with *Hyalella azteca* are presented in Table 1. Water quality remained acceptable throughout the 10 day exposure period. Dissolved oxygen concentrations were greater than or equal to 4.0 mg/L throughout the study in all exposure vessels and safely above the 40% saturation concentrations of 3.4 to 3.5 mg/L for temperatures between 22 and 24° C. Ammonia concentrations, measured during the exposure, were < 0.45 mg/L in all samples and where safely below levels were toxicity is observed. Water temperature, measured daily in exposure vessels ranged from 22 to 23°C.

A summary of the *Hyalella azteca* survival and growth during the 10-day subchronic test is presented in Table 2. The mean percent Laboratory Control survival was 98%. The mean percent survival in samples CRSD-13, -14, -15, -16, -17 and -17D ranged from 84 to 96% and were comparable to the control organisms. The mean average dry amphipod weight in the Laboratory Control sample was 0.33 mg per amphipod. The mean average amphipod weight in samples

CRSD-13, -1 , -15, -16, -17 and -17D ranged from 0.29 to 0. 0 mg per amphipod and were comparable to the control organisms.

Conclusions

Results of the samples tested established that the Laboratory Control organism survival and growth were well within the range of acceptance criteria. The survival and growth effects seen in the amphipods are thus reliable. The results of the survival and growth effects observed in the samples samples CRSD-13, -1 , -15, -16, -17 and -17D suggest the absence of adverse effects associated with these samples.

SUMMARY OF TEST CONDITIONS
10-Day Sediment Toxicity Tests with *Hyalella azteca*

DATE SAMPLES RECEIVED:	July 1, 1999
TEST DATES:	July 9 to 19, 1999
TEST TYPE:	Whole-sediment toxicity test with renewal of overlying water
TEMPERATURE:	22 to 23°C
LIGHT INTENSITY:	70 to 90 footcandles
PHOTOPERIOD:	16 hours light, 8 hours dark
TEST CHAMBER SIZE:	300 mL
SEDIMENT VOLUME:	100 mL
OVERLYING WATER VOLUME:	175 mL
RENEWAL OF TEST SOLUTIONS:	2 volume additions/day
AGE OF TEST ORGANISMS:	11 days old at start of test
NUMBER OF ORGANISMS PER TEST CHAMBER:	10
NUMBER OF REPLICATE TEST CHAMBERS PER TREATMENT:	8
NUMBER ORGANISMS/SAMPLE:	80
FEEDING:	1.5 mL of YCT daily per chamber
AERATION:	None
TEST CONCENTRATION:	100% (no dilutions)
TEST DURATION:	10 days
ENDPOINTS:	Survival and growth (amphipod dry weight)
TEST ACCEPTABILITY:	Minimum mean control survival of 80%

Table 1. **Water quality summary for the *Hyalella azteca* 10 day exposure.**

Sample Identification	Dissolved Oxygen (mg/L) Day 0	Dissolved Oxygen (mg/L) Day 10	pH Day 0	pH Day 10	Ammonia as N (mg/L) Day 0	Ammonia as N (mg/L) Day 10
Lab Control	7.2-7.3	5.0-5.9	7.1	6.9	<0.10	<0.10
CRSD-13	5.0-6.1	4.0-4.5	7.3	7.0-7.3	0.44	0.25
CRSD-14	6.7-7.0	6.1-6.8	7.3-7.4	7.0-7.1	<0.10	<0.10
CRSD-15	5.3-5.7	4.0-4.8	7.1-7.2	7.2-7.5	<0.10	0.45
CRSD-16	6.2-6.5	4.5-5.4	7.4	7.9-8.4	<0.10	0.36
CRSD-17	6.5-6.6	5.3-6.0	7.5-7.6	7.6-7.8	<0.10	<0.10
CRSD-17D	6.4-6.6	5.7-6.2	7.6	7.6-7.9	<0.10	<0.10

Sample Identification	Alkalinity (mg/L as $CaCO_3$) Day 0	Alkalinity (mg/L as $CaCO_3$) Day 10	Hardness (mg/L as $CaCO_3$) Day 0	Hardness (mg/L as $CaCO_3$) Day 10	Conductivity (µmhos/cm) Day 0	Conductivity (µmhos/cm) Day 10
Lab Control	40	38	48	56	170	165
CRSD-13	52	48	64	68	190	180
CRSD-14	32	32	48	56	160	165
CRSD-15	54	48	60	68	200	190
CRSD-16	62	54	56	76	190	200
CRSD-17	50	46	56	64	190	190
CRSD-17D	40	44	52	60	180	180

Table 2. Summary of the survival and growth of *Hyalella azteca* after a 10 day exposure.

Sample Identification	Mean Percent Survival (Standard Deviation)	Mean Dry Weight in mg/organism (Standard Deviation)
Lab Control	98(5)	0.33(0.03)
CRSD-13	96(5)	0.40(0.05)
CRSD-14	94(7)	0.29(0.03)
CRSD-15	84(18)	0.34(0.03)
CRSD-16	96(7)	0.37(0.03)
CRSD-17	93(12)	0.32(0.06)
CRSD-17D	89(11)	0.31(0.03)

REFERENCES

ASTM. 1997. Guideline E 1706-95b *Standard Test Methods for Measuring the Toxicity of Sediment-Associated Contaminants with Fresh Water Invertebrates* Volume 11.05. ASTM 100 Barr Harbor Drive, West Conshohocken, PA.

U.S. EPA. 199 . Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates. U.S. Environmental Protection Agency. Office of Research and Development. EPA/600/R-9 /02 .

APPENDIX I

10-Day Toxicity Test with Freshwater Amphipod (*Hyalella azteca*) to Meet U.S. EPA Guidelines.

1.0 INTRODUCTION

The objective of this study is to determine the toxicity of a contaminated sediment sample(s) to amphipod (*Hyalella azteca*) during a 10-day exposure. Amphipods are exposed to the sediment sample to assess survival and growth on test day 10 (test termination). The methods (Springborn Laboratories test method #: SED-Ha-121b) described in this study plan meet the standard procedures described in the "Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates", test method 100.1 (U.S. EPA 199) and ASTM Guideline E 1706-95b "Standard Test Methods for Measuring the Toxicity of Sediment-Associated Contaminants with Fresh Water Invertebrates" (ASTM, 1997).

2.0 MATERIALS AND METHODS

2.1 Test

2.1.1 Species

The freshwater invertebrate, *Hyalella azteca,* is the species used in this test. Test organisms will be 7 to 1 days old and within a range of 3 days (e.g., 7 to 10 days old) at initiation of the test. Amphipods used in the exposure will be the young amphipods produced by adult amphipods removed from culture tanks 7 to 1 days prior to test initiation. The adult amphipods are placed in 9.5 liter aquaria with approximately 8L of water. Young produced by these isolated adults will then be removed and pipetted into holding containers until test initiation. Amphipods will not be used if >10% mortality is observed during the 8 hours prior to test initiation.

2.1.2 Source

Hyalella azteca cultures will be maintained at Springborn Laboratories, Inc. Amphipods will be cultured in 20 liter glass aquaria (containing approximately 10-L of culture water) under flow-through conditions. Water used to culture the amphipods is similar to the overlying water used during the 10-day test. Culture water will be maintained at 23 ± 1°C.

2.1.3 Feeding

While being maintained in the culture prior to the test, adult and juvenile amphipods will be fed every other day. They will be fed a combination of Yeast, Cereal leaves and flaked fish food suspension (YCT) and a unicellular green algae *Psueokirchneriella subcapitata*. During testing, 1.5 mL of YCT Suspension will be added daily to each test vessel. If food collects on the sediment surface during testing, feeding will be suspended for one or more days.

2.1.4 Handling

Wide-bore pipets will be used to transfer the amphipods, taking care to minimize possible stress due to handling. Amphipods that are damaged or dropped during transfer will not be used.

2.2 Physical System

2.2.1 Sediment

Sediment samples should be shipped overnight to Springborn Laboratories after collection. Upon receipt at Springborn, sample containers will be inspected for leakage or damage and the sample identity recorded. If storage is required, the samples will be refrigerated at approximately °C. In addition, a sediment sample will be collected from an uncontaminated location near the site of interest to be used as a reference sediment. A laboratory control sediment, prepared or collected by Springborn Laboratories, will be included in the test to evaluate performance of the test organisms and exposure system. The test will be initiated within 1 days of sediment collection.

2.2.2 Test Vessels

The test vessels used in the static-renewal toxicity test will be 300 mL glass beakers which are chemically clean. Each test vessels has a 2-cm hole cut on the top portion of the vessel and is covered with 0-mesh Nitex® screen for drainage. Each vessel will contain 100 mL (approximately 2 cm layer) of sediment and 175 mL of overlying water. Test vessels will be cleaned by an appropriate method to remove residue of test substance previously used (i.e., acid to remove metals and bases; detergents and organic solvents to remove organic compounds) and rinsed several times using diluent water.

2.2.3 Overlying Water

Water from a 100 meter bedrock well is pumped to a concrete reservoir where it is supplemented on demand with untreated, unchlorinated, Town of Wareham well water. The water is characterized as being "soft" with a normal pH range of 6.9 - 7.7, a total hardness of 30 - 60 mg/L and a specific conductance of 110 - 160 µmhos/cm. The pH, total hardness, alkalinity, and specific conductance of this water will be monitored weekly at a central location in the laboratory to assure that these parameters are within the normal, acceptable ranges. Total hardness and alkalinity will be determined according to *Standard Methods for the Water and Wastewater*, (APHA, 1992).

The quality of the water is judged by periodic analyses of representative samples conducted to ensure the absence of potential toxicants, including pesticides, PCBs and selected toxic metals, at concentrations which may be harmful to the amphipods, as well as the ability of amphipod cultures to survive and reproduce in the water free of stress.

2.3 Test Procedures:

2.3.1 Test Concentration

Eight replicates will be maintained for each sediment sample consisting of 100% whole sediment sample (no dilutions). A reference control (if collected), conducted with eight replicates, will be used to evaluate the survival and growth potential of the test organism in a non-contaminated sediment. In addition, a laboratory control sediment, prepared or collected by Springborn Laboratories, will also be used to evaluate the survival and growth potential of the test organisms. The laboratory control sediment will also be conducted with eight replicates. Ten amphipods (7 to 1 days old) per replicate (80 organisms per sediment sample or control) will be used to initiate the test.

2.3.2 Test Initiation

The day before test initiation (day -1) test sediment, reference control and laboratory control sediments will be added to the replicate test vessels and the overlying water added. Prior to addition to the test vessels, each sediment sample will be wet pressed through a 2.0 mm stainless steel sieve to remove any potential predators. The water will be added gently to prevent resuspension of the sediment layer in the water column. This allows the sediment and water to equilibrate prior to addition of the test organisms

The juvenile amphipods (7 to 1 days old), produced by isolated adults, will be removed from the holding vessels (see section 2.1.1). Ten juvenile amphipods will be randomly selected and pipeted into a replicate test or control vessel. This procedure will be repeated until all vessels contain ten amphipods (eighty per test sample and control). Test vessels will be inspected within 1 hour after the juvenile amphipods are introduced to ensure organisms are not trapped in the surface tension or not burrowed into the sediment. During this one hour period, organisms observed to be trapped in the surface tension or not burrowed will be replaced with new juvenile amphipods.

Measurement of dry weight will be made on a subset of the population (i.e., twenty amphipods) used to initiate the exposure. The dry weight of the amphipods in the subset will be determined by pooling the amphipods and drying at 60°C for 2 hours. Pooled amphipods will be weighed on a calibrated analytical balance to the nearest 0.01 mg. This initial weight measurement may be used to determine the growth rate of amphipods during the exposure period.

2.3.3 Renewal of Overlying Water

During the 10-day study, the overlying water will be renewed by adding two volume additions (i.e., 350 mL) per day using an intermittent delivery system in combination with a calibrated water-distribution system (Zumwalt et al., 199). The intermittent delivery system will be calibrated to provide 1 liter of water per cycle to the water-distribution system, which subsequently provides 50 mL of water per cycle to each replicate test chamber. The water delivery system cycles 7 times per day, providing 2 volume additions every 2 hours. Delivery of two volume replacements per day is sufficient to provide consistent and acceptable water quality characteristics throughout the duration of the 10 day exposure.

2.3.4 Photoperiod

The test vessels will be located in an area illuminated to a light intensity of 500 to 1000 lux using a combination of fluorescent bulbs. A 16-hour light, 8-hour dark photoperiod will be maintained with an automatic timer. Sudden transitions from light to dark and vice versa will be avoided.

2.3.5 Measurement of Water Quality Variables

Total hardness, alkalinity, specific conductance, pH and ammonia will be determined at test initiation and test termination in the overlying water from a composite sample from all eight replicate vessels. The composite sample will be taken from 1 to 2 cm from the sediment surface using a pipet. Dissolved oxygen and temperature will be measured in all replicate vessels at test initiation and test termination. Dissolved oxygen and temperature will be monitored daily in one alternating replicate during the course of the study (test days 1-9). Temperature will be monitored continuously in the waterbath using a minimum-maximum thermometer. Readings of temperature extremes will be recorded daily.

2.3.6 Dissolved Oxygen

Total dissolved oxygen will not be allowed to drop below 40% (3.4 mg/L at 23°C) or exceed 100% of saturation for the duration of the study. Aeration (with oil-free air) will be initiated to raise and maintain the dissolved oxygen concentration at or above 40% of saturation.

2.3.7 Temperature

Temperature of the overlying water will be maintained at 23 ± 1°C by conducting the study in a temperature controlled waterbath maintained at the appropriate test temperature.

2.3.8 Biological Data

Survival of the amphipods will be determined in each test vessel at test termination (test day 10) by sieving the sediment to remove all surviving amphipods. In addition, daily observations of organism behavior (e.g., sublethal effects) and characteristics of sediment and overlying water will also be observed and recorded daily. Dead organisms are removed from the exposure vessels daily. The growth of surviving amphipods in each replicate will be recorded at test termination by pooling all surviving amphipods from each replicate vessel and drying at 60°C for 24 hours. Pooled amphipods will be weighed on a calibrated analytical balance to the nearest 0.01 mg. The initial dry weight measurement and the final (day 10) dry weight measurement of the amphipods may be used to determine the growth rate (in mg per day) of the amphipods in each test sample, reference and laboratory control sediment.

2.3.9 Test Acceptability

At termination of the study, mean survival of the amphipods in the laboratory control must be ≥ 80%.

3.0 STATISTICAL ANALYSES

The mean survival and growth of organisms exposed in each test sediment and reference control sample will be tested for normality and homogeneity of variance using Shapiro-Wilks Test and Ba F-Test. If the data set passes these two tests, then a parametric method (e.g., ANOVA 2-Sample T-Test or Dunnett's Test) will be used to evaluate the results of the mean survival and growth of each test sample for significant adverse effects. If the data set fails the test for normality and homogeneity of variance, then a non-parametric method (e.g., Steel's Many-One Rank Test) will be used to determine significant adverse effects. If necessary, mean survival values will be transformed (e.g., arcsine square).

4.0 REPORTING

The raw data and the final summary report will be reviewed by the Study Director. The test results will be presented in an outline format on a per sample basis.

5.0 REFERENCES

APHA, AWWA, WPCF. 1992. *Standard Methods for the Examination of Water and Wastewater.* 18th Edition, Washington, D.C.

ASTM. 1997. Guideline E 1706-95b *Standard Test Methods for Measuring the Toxicity of Sediment-Associated Contaminants with Fresh Water Invertebrates* Volume 11.05. ASTM 100 Barr Harbor Drive, West Conshohocken, PA.

U.S. EPA. 199 . Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates. U.S. Environmental Protection Agency. Office of Research and Development. EPA/600/R-9 /02 .

Zumwalt, D.C., F.J. Dwyer, I.E. Greer and C.G. Ingersoll. 199 . A water-renewal system that accurately delivers small volumes of water to exposure chambers. Environmental Toxicology and Chemistry. pgs. 1311-131 .

SIGNATURES AND APPROVAL

SUBMITTED BY:

Springborn Laboratories, Inc.
Environmental Sciences Division
790 Main Street
Wareham, Massachusetts 02571-1075

PREPARED BY:

7/29/99

Arthur E. Putt — Date
Study Director

7-29-99

Ronald C. Biever — Date
Manager,
Environmental Toxicology