ND-2900 D1773

ENGINEERING INVESTIGATIONS AT INACTIVE HAZARDOUS WASTE SITES

PHASE I INVESTIGATION

SKW ALLOYS, INC., SITE NUMBER 932001
TOWN OF NIAGARA, NIAGARA COUNTY

June 1989

STATE OF NEW YORK
ALEXANDER H. WHITMAN, JR.
No. 063202-1
LICENSED PROFESSIONAL ENGINEER

Prepared for:

New York State Department of Environmental Conservation

50 Wolf Road, Albany, New York 12233
Thomas C. Jorling, Commissioner

Division of Hazardous Waste Remediation
Michael J. O'Toole, Jr., P.E., Director

Prepared by:

ecology and environment engineering, p.c.
BUFFALO CORPORATE CENTER
368 PLEASANTVIEW DRIVE, LANCASTER, NEW YORK 14086, TEL. 716/684-8060

recycled paper

Errata

Airco Carbon is currently owned by Carbon Graphite Group.

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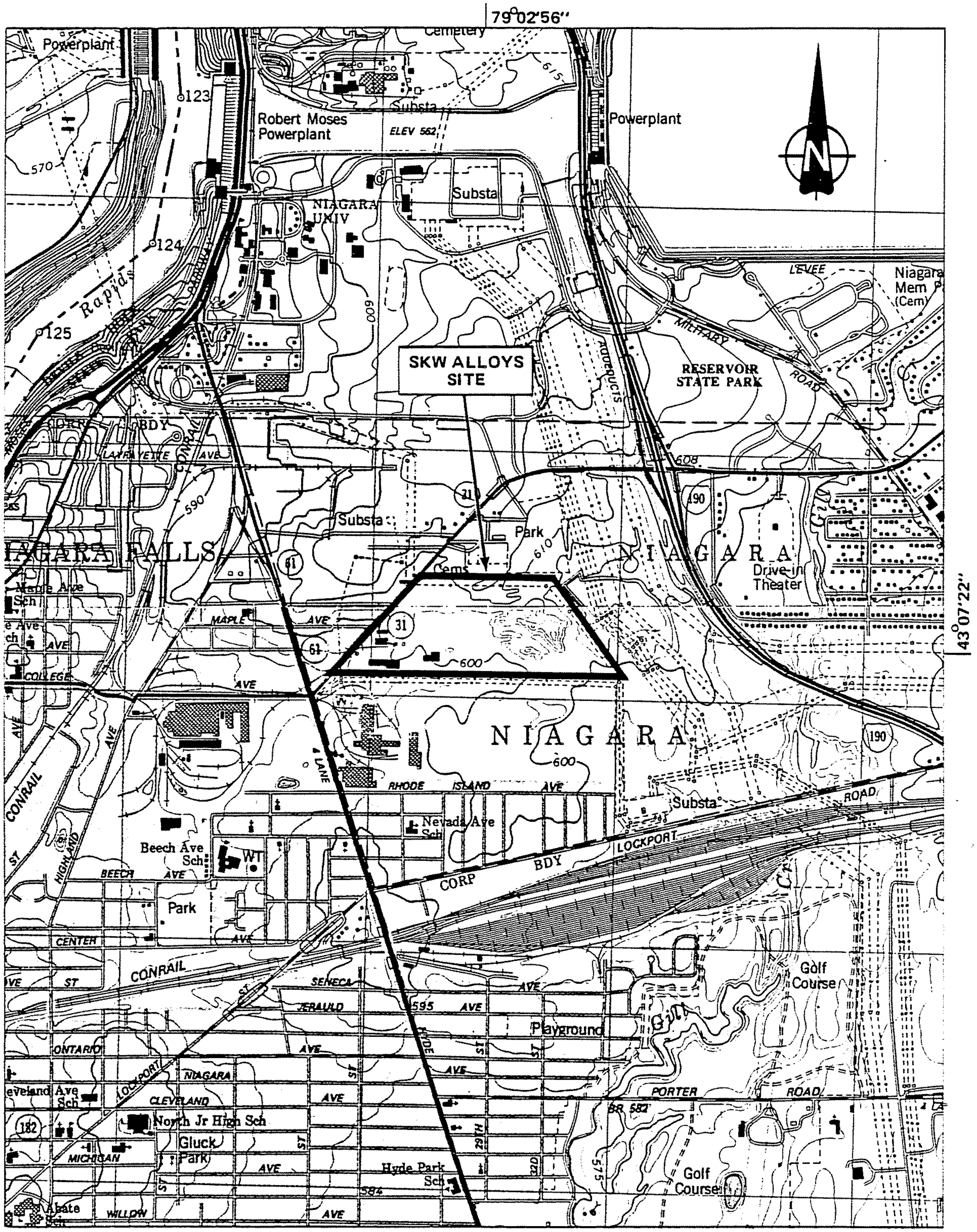
1.1 SITE BACKGROUND

The SKW Alloys, Inc. landfill (SKW Alloys) site is located on Witmer Road in the City of Niagara Falls, New York. The 62-acre site was formerly owned by the U.S. Vanadium Corporation from 1920 to 1964. In 1964, Pittsburgh Metallurgical Company (now Airco, Inc.) purchased the property. In 1979, SKW Alloys, Inc. bought the Airco Alloys division of Airco, Inc., obtaining the western 37 acres of the property. (Airco Carbon retained the eastern 25 acres of the original 62-acre site.) The 62-acre site has been used by SKW Alloys, Inc.; Airco Carbon; and former owners to dispose of ferrochrome silicon alloy dust, ferromanganese slag, ferrochrome silicon slag, ferrosilicon dust, calcium hydroxide, and miscellaneous refuse including but not limited to old machinery and raw materials. The portion of the site owned by Airco Carbon contains a landfill which is currently active and operating under a New York State Department of Environmental Conservation (NYSDEC) permit.

This eastern 25-acre portion of the site (owned by Airco Carbon) exhibits approximately 30 feet of relief from landfill waste. Lime slag is evident on this and the adjacent Niagara Mowhawk Power Corporation right-of-way. Surface water, in drainage ditches at the base of this landfill area, had a white milky appearance at the time of the Ecology and Environment, Inc. (E & E) site inspection. Substances reportedly landfilled by Airco include brick, coke, concrete, carbon fines, and graphite plant waste.



SOURCE: USGS 7.5 Minute Series (Topographic) Quadrangles: Lewiston, NY—ONT, 1980 and Niagara Falls, NY—ONT, 1980.

SCALE

0 ½ 1 MILE

0 .5 1 KILOMETER

Figure 1—1 LOCATION MAP

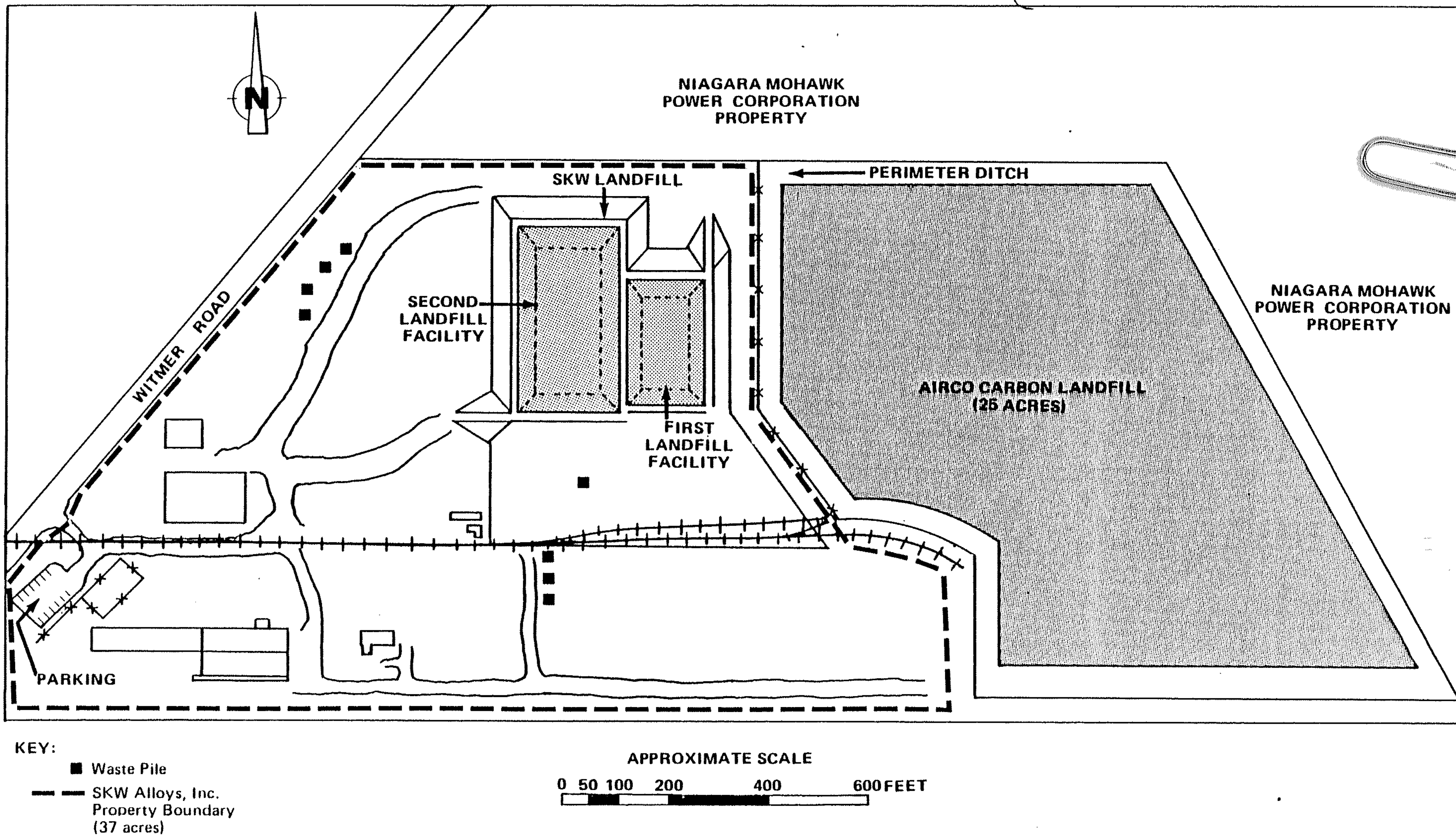


Figure 1—2 SITE MAP -SKW ALLOYS

The SKW Alloys property occupies approximately 37 acres consisting of a currently active landfill (operating under NYSDEC permit) area comprising approximately 5 acres, and the surrounding grounds and buildings. The site exhibits little relief except at the landfill area which rises 25 to 30 feet above the adjacent land surfaces. Additionally, various waste piles on site exhibit up to 20 feet of relief. Standing water was observed adjacent to the landfill area during a recent site inspection conducted by E & E.

1.2 PHASE I EFFORTS

The site was visited on August 26, 1987 and January 25, 1989 by E & E personnel to conduct a physical inspection of the site in support of this investigation. Prior to the inspection, all available state, federal, and municipal files were reviewed, and individuals having knowledge of the site were contacted. The site inspection consisted of a walk-over survey around the perimeter and into adjacent areas of the site. Of interest to the inspection were:

- Overall site conditions; and
- Determination of former waste disposal areas.

1.3 ASSESSMENT

In general, the landfill area appears to have been maintained in good condition with the exception of an area where slurry was spilled onto the berm area of one of the disposal cells. The adjacent surrounding grounds were maintained in poorer condition. Waste piles of metal, woodchips and scrap, and baghouse dust were noted at various locations throughout the site. Piles of mixed raw materials including wood chips and steel turnings, apparently removed from the plant facility, also were noted during the site inspection. On the Airco, Inc., property, uncovered construction debris and carbon waste was noted. In addition, the Niagara Mohawk Power Corp. property and the Airco property contained lime slag piles.

1.4 HRS SCORE

A preliminary application of the Hazard Ranking System (HRS) was made to quantify the risk associated with this site. As the Phase I investigation is limited in scope, not all the information needed to fully evaluate the site is available. An HRS score was completed on the basis of the available data. Absence of necessary data may result in an unrealistically low HRS score.

Under the HRS, three numerical scores are computed to express the site's relative risk or damage to the population and the environment. The three scores are:

- S_M reflects the potential for harm to humans or the environment from migration of a hazardous substance away from the facility by routes involving groundwater, surface water, or air. It is a composite of separate scores for each of the three routes (S_{GW} = groundwater route score, S_{SW} = surface water route score, and S_A = air route score).

- S_{FE} reflects the potential for harm from substances that can explode or cause fires.

- S_{DC} reflects the potential for harm from direct contact with hazardous substances at the facility (i.e., no migration need be involved).

The preliminary HRS score was:

S_M = 13.31 (S_{GW} = 22.45; S_{SW} = 5.09; S_A = 0)
S_{FE} = not scored
S_{DC} = 50.00

2. PURPOSE

This Phase I investigation was conducted under contract to the New York State Department of Environmental Conservation (NYSDEC) Superfund Program. The purpose of this investigation was to provide a preliminary evaluation of the potential environmental or public health hazards associated with past disposal activities at the SKW Alloys, Inc. landfill site. This initial investigation consisted of a detailed file review of available information and a site inspection. This evaluation includes both a narrative description and preliminary HRS score. The investigation at this site encompassed the entire 62-acre site and the Niagara Mohawk right-of-way where industrial wastes allegedly had been disposed of from 1920 to the present.

3. SCOPE OF WORK

The Phase I effort involved:

- o The review of available information from state, municipal, and private files;
- o Interviews with individuals with knowledge of the site; and
- o A physical inspection of the site.

State files reviewed were maintained by the New York State Department of Environmental Conservation (NYSDEC) Region 9 in Buffalo, New York. County files reviewed were maintained by Niagara County Department of Health. Private files which were reviewed are maintained by SKW Alloys, Inc., at the Highland Avenue, Town of Niagara facility. Items reviewed were:

- o Groundwater and EP Toxicity sample analysis; and
- o Engineering reports.

Mr. Michael Hopkins of the Niagara County Health Department was contacted in person on May 1, 1987, to discuss information maintained in the county files.

A site inspection was conducted by E & E on August 26, 1987 and January 25, 1989. During the inspection, Anthony Kruk, engineering

Table 3-1 (Cont.)

Niagara County Health Department
10th and East Falls Street, Niagara Falls, New York, 14302
Telephone Number: (716) 284-3128
Contact: Michael Hopkins
Dates Contacted: May 1, 1987
Information: Site ownership and history
Site operations and reasons for suspected contamination
Correspondence concerning site
Groundwater use

City of Niagara Falls
Utilities Department, Division of Water
Buffalo Avenue and 53rd Street, Niagara Falls, New York
Telephone Number: (716) 278-8248
Date Contacted: June 15, 1987
Information: Well water usage

Town of Niagara Water Department
7105 Lockport Road, Niagara, New York
Telephone Number: (716) 297-2150
Contact: Dean Brown
Date Contacted: June 15, 1987
Information: Well water usage

City of Niagara Falls, Parks Division
Hyde Park, Niagara Falls, New York
Telephone Number: (716) 278-8341
Date Contacted: June 15, 1987
Information: Surface water usage

SKW Alloys, Inc.
3801 Highland Avenue
Niagara Falls, New York
Telephone Number: (716) 285-1252
Contact: Anthony Kruk
Date Contacted: August 26, 1987
Information: Site history, background information, groundwater analysis results, engineering reports

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4. SITE ASSESSMENT

4.1 SITE HISTORY

The SKW Alloys, Inc. landfill site on Witmer Road in the City of Niagara Falls, New York was owned by the Vanadium Corporation of America from 1920 to 1964. During this period, Vanadium Corporation disposed of between 350,000 and 594,000 tons of brick, wood, ash, calcium hydroxide, and iron alloy slags on the 62-acre site. Most of this disposal allegedly occurred on the eastern 25 acres which is now owned by Airco Carbon and on a right-of-way owned by the Niagara Mohawk Power Corp. (Niagara County Health Department [NCHD] 1984).

The 62-acre site was bought by Pittsburgh Metallurgical Company in 1964. This company subsequently changed its name to Airco, Inc., and continued to dispose of similar classes of wastes on the property. Airco, Inc. installed baghouse collectors at their plant in 1971 and began to dispose of slurried dusts on the property, principally in the area currently owned by Airco Carbon. Storage and/or disposal of various materials such as coke, brick, concrete, carbon fines, and graphite plant waste occurred on the property currently owned by SKW Alloys (NCHD 1984).

In 1979, SKW bought the Airco Alloys division of Airco, Inc. and acquired the western 37 acres of the Witmer Road landfill property, while Airco Carbon retained the eastern 25 acres of the property. SKW obtained a NYSDEC permit for operation of a solid waste disposal site at their Witmer Road property in 1980. Under this permit SKW disposes of ferrochrome silicon alloy and ferrosilicon alloy baghouse dusts generated at their Niagara Falls facility located at 3801 Highland

Avenue. These dusts are slurried with water before landfilling. A leachate collection system has been installed for the landfill.

Once collected, leachate is used to slurry fresh batches of baghouse dust. Several monitoring wells are located around the SKW and adjacent properties. These wells are sampled quarterly and analyzed for total dissolved solids (TDS), chemical oxygen demand (COD), total organic carbon (TOC), barium, chromium (total and hexavalent), iron, manganese, silica, and zinc. Specific conductance and pH measurements are also taken on the samples. SKW's NYSDEC permit has expired and they are currently operating on an extension until a decision is made regarding renewal (Kruk 1987, NYSDEC 1986, NCHD 1984, Snyder 1980).

In 1984, the Radian Corp. analyzed samples of solid waste collected at the SKW Alloys facility. These samples consisted of ferrosilicon emission control dust, ferrochrome silicon emission control dust, and ferrosilicon slag. The analysis showed 14 mg/L for chromium in the ferrochrome silicon emission control dust. This value is above the 5 mg/L maximum contaminant concentration for the Resource Conservation and Recovery Act (RCRA) hazardous waste characteristic of EP Toxicity. A value of 2 mg/L was obtained for selenium, which is above the 1 mg/L maximum contaminant concentration for RCRA hazardous waste characteristic, EP Toxicity (Radian Corp. 1984).

4.2 SITE TOPOGRAPHY

The SKW site is located on the Tonawanda Plain approximately 1 mile northwest of the Niagara River in the City of Niagara Falls, New York. The river gorge represents the most topographic relief in the area, running in a south-north direction and rising approximately 250 feet near the vicinity of the site. This site is located 3 miles south of the Niagara Escarpment and the area is characterized by very low relief. Lake Ontario is located approximately 12 miles to the north (USGS 1980).

The site elevation is approximately 600 feet above mean sea level, and is not in a floodplain. The nearest wetland is approximately 2.5 miles to the north of the site (NYSDEC 1987). The site is located in the highly industrialized northern area of the City of

Niagara Falls. Residential areas occur 0.5 mile west of the site and New York Power Authority power lines bound the site to the south (USGS 1980).

Groundwater was used for drinking purposes by four families approximately 0.25 mile north of the site (Hopkins 1987). These homes were connected to a water line during January 1987 (Aungst 1988).

4.3 SITE HYDROLOGY

4.3.1 Regional Geology and Hydrology

The geology of the Niagara Falls area is well understood because of its simplicity and because of the excellent exposures of bedrock along the Niagara River gorge and the Niagara Escarpment.

The overburden in the Niagara Falls area is relatively thin. Three types of unconsolidated deposits are present. The lowermost is glacial till and regolith, an unsorted mixture of boulders, clay, and sand deposited by glaciers, which directly overlies the bedrock. This is covered by clays, silts, and fine sands of lacustrine origin. These are the surface soils throughout most of the region. In isolated spots, sand and gravel deposits are found above the lacustrine soils. These were deposited by glacial melt streams and by wave action of the larger ancestors of the Great Lakes.

The bedrock in the Niagara Falls area consists of nearly flat-lying sedimentary rocks, including dolomite, shale, limestone, and sandstone units. The several beds of bedrock slope southward approximately 30 feet per mile.

The entire region south of the Niagara escarpment, and extending almost to Erie County, is directly underlain by the Lockport Dolomite. The Clinton and Albion groups underlie the Lockport but crop out only along the escarpment and in the gorge of the Niagara River. These units are underlain by the Queenston shale. This unit is the uppermost bedrock unit under the plain north of the escarpment.

Groundwater in the Niagara Falls area occurs in both the unconsolidated deposits and in the bedrock. The bedrock, specifically the Lockport Dolomite, is, however, the principal source of groundwater in the Niagara Falls area. Three types of bedrock openings contain the groundwater: bedding joints, vertical joints, and solution cavities.

The bedding joints, which transmit most of the water in the Lockport, are fractures along prominent bedding planes which have been widened up to 1/8 inch by solution of the rocks. These joints extend several miles thus constituting effective water conduits.

The vertical joints are generally too short and sparse to account for significant groundwater storage and transmission, except in the top 10-25 feet of bedrock. Solution cavities, formed when gypsum is dissolved, are also not important components of the aquifer. Although they increase the storage capacity of the aquifer, they are isolated and do not contribute to groundwater transmission.

Two distinct sets of groundwater conditions exist in the Lockport Dolomite. The first is the upper 10 to 25 feet of the bedrock. This region is highly fractured resulting in moderate permeabilities. In some areas in the region, a confining layer of clay above this zone can produce artesian groundwater conditions. The second class of groundwater conditions is found deeper in the bedrock, where at least seven different permeable zones have been identified. These zones are surrounded by impermeable bedrock and are not likely hydraulically connected (Johnston 1964).

4.3.2 Site Geology and Hydrogeology

Soil conservation survey reports and results of several onsite or nearby boreholes were used to describe the site geology and hydrogeology. The soil at this site is Odessa silty clay loam of the Odessa-Lakemont-Ovid association. This is a poorly drained, fine textured soil that is predominantly reddish in color. The underlying bedrock is the Lockport Dolomite (Higgins *et al*. 1972).

Specific soil information is available from subsurface soil boring logs. These borings indicate that the overburden consists of:

- Dense loamy glacial till with an extreme range in texture, from clay and silt to gravel and occasional boulders. This material ranges from 0.6 to 7 feet thick and directly overlies the bedrock;

- Water sorted stratified sediments which are characterized by a mixture of dolomitic rock fragments and overlying clay. This layer is found between the overlying clay and glacial till;

- A silty-clay lake sediment with a thickness varying from 2 to 12.5 feet containing fine silt lenses and vertical dessication cracks; and

- Fill with a thickness ranging from 1.3 to 9 feet. This fill consists primarily of slag, cinders, and fly ash (Spears 1978).

Site hydrology information is available from monitoring wells and piezometers installed on site. The following information was obtained by these groundwater studies:

- Bedrock is encountered at various depths ranging from 11 feet to 24 feet;

- A natural perched water table exists above the silty clay layer during most of the year. This water table may be encountered as little as 3 feet below ground surface;

- The permanent groundwater table is located approximately 20 feet below ground surface. Groundwater flow is expected to be to the southwest (SLC Consultants 1987).

For purposes of HRS scoring, the Lockport Dolomite is considered the aquifer of concern. This aquifer is expected to be encountered from 10 to 25 feet below land surface. The permeability of the Lockport Dolomite depends on fracturing, weathering, and solutioning of the bedrock beneath the site (Johnston 1962).

4.3.3 Hydraulic Connections

As discussed above, the aquifer of concern at this site is the Lockport Dolomite bedrock aquifer. The Lockport can be divided into two zones on the basis of water-transmitting properties. The upper 10 to 25 feet of rock is a moderately permeable zone that contains relatively abundant bedding planes and vertical joints enlarged by dissolution of dolomite and abundant solution cavities left by dissolution of gypsum. These zones are more than likely hydraulically connected. The remainder of the formation contains low to moderately permeable bedding planes of which as many as seven may be major water-bearing zones that are surrounded by fine-grained crystalline dolomite. These zones are probably not hydraulically connected. The Lockport group outcrops along the Niagara Gorge approximately 1 mile northwest of the site. Groundwater in bedding planes discharges from the bedrock at this outcropping. The bedrock aquifer is thus hydraulically connected to the Niagara River.

The seasonal shallow perched aquifer is likely not connected to the bedrock aquifers due to confining soil layers of silty clay (Johnston 1962).

In order to determine the occurrence and direction of groundwater movement below the SKW Alloys site, measurements of the depth to the water were taken at both the shallow and deep wells on site. Based on average measured water elevations of five deep wells on site for the period February 19 through May 8, 1987, an isopotential contour map was constructed (Snyder 1980). This isopotential map indicates that the net flow of groundwater in the deeper till-bedrock aquifer is toward the south to southwest, with a pronounced low in the southwest corner of the property. This observation is also consistent with depth-to-bedrock data, and is suggested to reflect the intersection of geologic joints or fissures, or a nearby industrial pumping well. Shallow well data indicate that the perched groundwater within the silty clay overburden mimics the direction of movement in the lower layers (Snyder 1980).

4.4 SITE CONTAMINATION

Two classes of waste disposal have occurred on the SKW Alloys site. From 1920 to 1964, Vanadium Corporation disposed of between 350,000 and 594,000 tons of brick, wood, ash, calcium hydroxide, and iron alloy slags. A majority of this disposal may have occurred on the adjacent Airco Alloys property. Currently, SKW Alloys disposes of slurried baghouse dust in a NYSDEC-permitted landfill on the site. EP toxicity analyses of these dusts indicate high concentrations of selenium at 2 mg/L, total phenols at 0.36 ug/L, and chromium at 14.0 mg/L. The dusts, therefore, fail the test for EP Toxicity because chromium and selenium are above the RCRA listed maximum concentrations. Up to 102,000 tons of dust have been disposed of at this site to date (NYSDEC 1986).

Groundwater monitoring wells surrounding the site are sampled quarterly. Samples are analyzed for pH, conductivity, TDS, COD, and TOC. Additionally, the metals barium, chromium, iron, manganese, silicon, and zinc are measured annually (NCHD 1984). Monitoring wells located in the southwest section of the landfill are considered downgradient based on subsurface hydrogeologic investigations (Snyder 1980). The most recent sampling report (April 15, 1987) indicates that downgradient wells exceeded New York Class GA drinking water standards for iron, manganese, and hexavalent chromium. Upgradient wells also exceeded standards up for iron and manganese (SLC Consultants 1987). These data indicate a release of chromium to the groundwater from the SKW landfill or the adjacent Airco landfill.

5. PRELIMINARY APPLICATION OF THE HAZARD RANKING SYSTEM

5.1 NARRATIVE SUMMARY

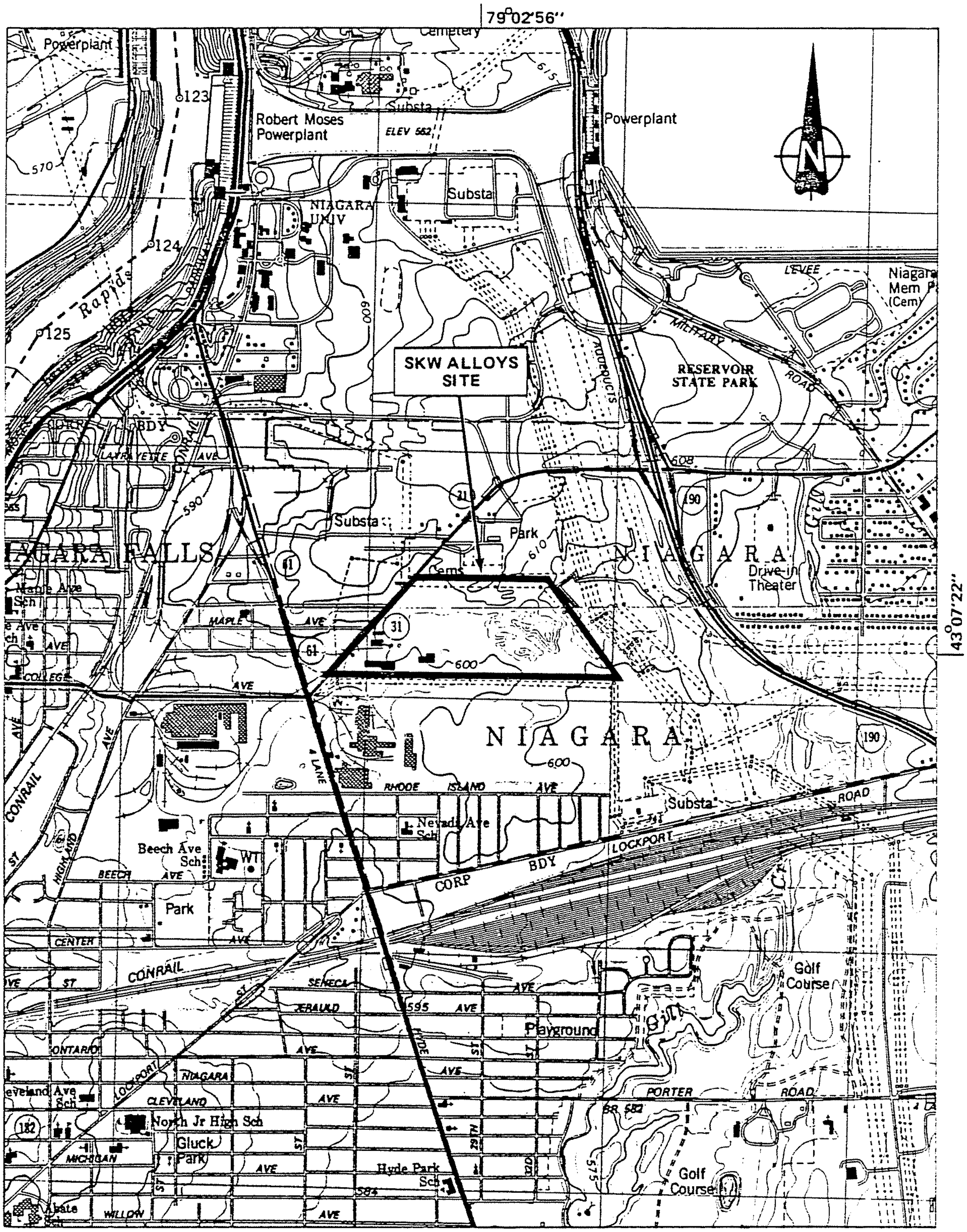
The SKW Alloys site, located on Witmer Road, covers approximately 62 acres in the Town of Niagara, Niagara County, New York and is located approximately 1.5 miles east of the Niagara River Gorge. Gill Creek is located approximately 1 mile to the west. The Lewiston Reservoir is located approximately 1 mile to the northeast just north of the Reservoir State Park. The area surrounding the site is essentially flat lying with the exception of the Niagara Gorge to the west and the Niagara Escarpment approximately 3 miles to the north.

Vanadium Corporation of America used this site, including the Airco Carbon property, to dispose of ferrochrome silicon slag, ferromanganese slag, calcium hydroxide, old machinery, demolition debris, and raw materials from 1920 to 1964. Airco Alloys also used this site for disposal of similar industrial wastes from 1964 to 1979. SKW Alloys, Inc. bought the Airco Alloys production facility and the western 37 acres of the facility in 1979 and currently landfills slurried ferrochrome silicon and ferrosilicon baghouse dusts under a NYSDEC permit.

The exact quantity of wastes is difficult to determine but it is believed to be in excess of 102,000 tons.

According to tests conducted by Radian Corporation and SLC Consultants between 1979 and 1987, the groundwater was found to be contaminated with elevated levels of chromium, manganese, barium, and iron, and the facility wastes failed EP Toxicity tests for selenium and chromium.

The site is located in the Town of Niagara in the northern, industrialized section of the City of Niagara Falls. A residential area is approximately 0.5 mile to the west. Approximately 58,299 people live within 3 miles of the site. Groundwater was used for drinking water purposes by four households within 0.25 mile of the site. These homes were connected to a water line during January 1987 (Aungst 1988).



SOURCE: USGS 7.5 Minute Series (Topographic) Quadrangles: Lewiston, NY–ONT, 1980 and Niagara Falls, NY–ONT, 1980.

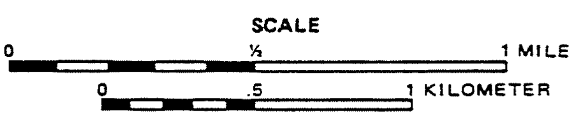


Figure 5–1 LOCATION MAP

FIGURE 1

HRS COVER SHEET

Facility Name: SKW Alloys, Inc.

Location: Witmer Road, Niagara Falls, New York

EPA Region: II

Person(s) in Charge of Facility: Anthony H. Kruk, Manager - Maintenance and Engineering, SKW Alloys, Inc.; Suzette Kosikowski, Environmental Supervisor, Carbon Graphite Group

Name of Reviewer: Dennis Sutton   Date: September 15, 1987

General Description of the Facility:

(For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action; etc.)

The SKW Alloys, Inc. site occupies 62 acres located on Witmer Road, Town of Niagara. The site contains ferrochrome silicon slag, ferrochrome silicon alloy dust, ferromanganese slag, ferro silicon dust, calcium hydroxide and miscellaneous refuse. The 25-acre portion of the site owned by Airco Carbon contains a landfill currently permitted by NYSDEC. The SKW Alloys property occupies 37 acres including a 5-acre NYSDEC permitted landfill, buildings, and surrounding grounds. The area is primarily industrial with private residences to the west.

It has been reported that in addition to industrial wastes, old machinery and raw material had been placed on site in a random manner before the construction of the current landfill.

The primary concern is migration of contaminants found in the groundwater on site. The groundwater flow appears to be toward the Niagara River, 1.5 miles to the west. There is also a possibility of soil contamination from the waste landfilled. Airborne dust could be a potential problem caused by the lime slag piles on site and the use of the area by dirt bikers and ATVs.

Scores: S_M = 13.31 (S_{gw} = 22.45 S_{sw} = 5.09 S_a = 0)

S_{FE} = Not scored

S_{DC} = 50.00

D1773

Ground Water Route Work Sheet					
Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max. Score	Ref. (Section)
[1] Observed Release	0 (45)	1	45	45	3.1
If observed release is given a score of 45, proceed to line [4]. If observed release is given a score of 0, proceed to line [2].					
[2] Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2		6	
Net Precipitation	0 1 2 3	1		3	
Permeability of the Unsaturated Zone	0 1 2 3	1		3	
Physical State	0 1 2 3	1		3	
	Total Route Characteristics Score			15	
[3] Containment	0 1 2 3	1		3	3.3
[4] Waste Characteristics					3.4
Toxicity/Persistence	0 3 6 9 12 15 (18)	1	18	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 (8)	1	8	8	
	Total Waste Characteristics Score		26	26	
[5] Targets					3.5
Ground Water Use	0 (1) 2 3	3	1	9	
Distance to Nearest Well/Population Served	0 4 6 8 (10) 12 16 18 20 24 30 32 35 40	1	10	40	
	Total Targets Score		19	49	
[6] If line [1] is 45, multiply [1] x [4] x [5] If line [1] is 0, multiply [2] x [3] x [4] x [5]			12,870	57,330	
[7] Divide line [6] by 57,330 and multiply by 100		S_{gw} =	22.45		

FIGURE 2
GROUND WATER ROUTE WORK SHEET

Surface Water Route Work Sheet					
Rating Factor	**Assigned Value (Circle One)**	**Multi-plier**	**Score**	**Max. Score**	**Ref. (Section)**
1 Observed Release	(0) 45	1	0	45	4.1
If observed release is given a value of 45, proceed to line 4. If observed release is given a value of 0, proceed to line 2.					
2 Route Characteristics					4.2
Facility Slope and Intervening Terrain	(0) 1 2 3	1	0	3	
1-yr. 24-hr. Rainfall	0 1 (2) 3	1	2	3	
Distance to Nearest Surface Water	0 (1) 2 3	2	2	6	
Physical State	0 1 2 (3)	1	3	3	
Total Route Characteristics Score			7	15	
3 Containment	0 1 2 (3)	1	3	3	4.3
4 Waste Characteristics					4.4
Toxicity/Persistence	0 3 6 9 12 15 (18)	1	18	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 (8)	1	8	8	
Total Waste Characteristics Score			26	26	
5 Targets					4.5
Surface Water Use	0 1 (2) 3	3	6	9	
Distance to a Sensitive Environment	(0) 1 2 3	2	0	6	
Population Served/Distance to Water Intake Downstream	(0) 4 6 8 10 / 12 16 18 20 / 24 30 32 35 40	1	0	40	
Total Targets Score			6	55	
6 If line 1 is 45, multiply 1 x 4 x 5. If line 1 is 0, multiply 2 x 3 x 4 x 5			3,276	64,350	
7 Divide line 6 by 64,350 and multiply by 100		S_{sw} =	5.09		

FIGURE 7
SURFACE WATER ROUTE WORK SHEET

Air Route Work Sheet					
Rating Factor	**Assigned Value (Circle One)**	**Multi-plier**	**Score**	**Max. Score**	**Ref. (Section)**
1 Observed Release	(0) 45	1	0	45	5.1
Date and Location:					
Sampling Protocol:					
If line 1 is 0, the S_a = 0. Enter on line 5. If line 1 is 45, then proceed to line 2.					
2 Waste Characteristics					5.2
Reactivity and Incompatibility	0 1 2 3	1		3	
Toxicity	0 1 2 3	3		9	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1		8	
	Total Waste Characteristics Score			20	
3 Targets					5.3
Population Within 4-Mile Radius	0 9 12 15 18 21 24 27 30	1		30	
Distance to Sensitive Environment	0 1 2 3	2		6	
Land Use	0 1 2 3	1		3	
	Total Targets Score			39	
4 Multiply 1 x 2 x 3				35,100	
5 Divide line 4 by 35,100 and multiply by 100	S_a = 0				

FIGURE 9
AIR ROUTE WORK SHEET

	S	S^2
Groundwater Route Score (S_{gw})	22.45	504.00
Surface Water Route Score (S_{sw})	5.09	25.91
Air Route Score (S_a)	0	0
$S^2_{gw} + S^2_{sw} + S^2_a$		529.91
$\sqrt{S^2_{gw} + S^2_{sw} + S^2_a}$		23.02
$\sqrt{S^2_{gw} + S^2_{sw} + S^2_a} / 1.73 = S_M =$		13.31

FIGURE 10
WORKSHEET FOR COMPUTING S_M

Fire and Explosion Work Sheet	Not Scored				
Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
1 Containment	1 3	1		3	7.1
2 Waste Characteristics					7.2
Direct Evidence	0 3	1		3	
Ignitability	0 1 2 3	1		3	
Reactivity	0 1 2 3	1		3	
Incompatibility	0 1 2 3	1		3	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1		8	
	Total Waste Characteristics Score			20	
3 Targets					7.3
Distance to Nearest Population	0 1 2 3 4 5	1		5	
Distance to Nearest Building	0 1 2 3	1		3	
Distance to Sensitive Environment	0 1 2 3	1		3	
Land Use	0 1 2 3	1		3	
Population Within 2-Mile Radius	0 1 2 3 4 5	1		5	
Buildings Within 2-Mile Radius	0 1 2 3 4 5	1		5	
	Total Targets Score			24	
4 Multiply 1 x 2 x 3				1,440	
5 Divide line 4 by 1,440 and multiply by 100	S_{FE} = Not scored				

FIGURE 11
FIRE AND EXPLOSION WORK SHEET

Direct Contact Work Sheet					
Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)
[1] Observed Incident	(0) 45	1	0	45	8.1
If line [1] is 45, proceed to line [4] If line [1] is 0, proceed to line [2]					
[2] Accessibility	0 1 2 (3)	1	3	3	8.2
[3] Containment	0 (15)	1	15	15	8.3
[4] Waste Characteristics Toxicity	0 1 2 (3)	5	15	15	8.4
[5] Targets					8.5
Population Within a 1-Mile Radius	0 1 2 3 (4) 5	4	16	20	
Distance to a Critical Habitat	(0) 1 2 3.	4	0	12	
Total Targets Score			16	32	
[6] If line [1] is 45, multiply [1] x [4] x [5] If line [1] is 0, multiply [2] x [3] x [4] x [5]			10,800	21,600	
[7] Divide line [6] by 21,600 and multiply by 100	S_{DC} = 50.00				

FIGURE 12
DIRECT CONTACT WORK SHEET

5.4 HRS Documentation Records

DOCUMENTATION RECORDS
FOR
HAZARD RANKING SYSTEM

Instructions: As briefly as possible summarize the information you used to assign the score for each factor (e.g., "Waste quantity = 4,230 drums plus 800 cubic yards of sludges"). The source of information should be provided for each entry and should be a bibliographic-type reference. Include the location of the document.

Facility Name: SKW Alloys Corp.

Location: Witmer Road

Date Scored: September 9, 1987

Person Scoring: Dennis Sutton

Primary Source(s) of Information (e.g., EPA region, state, FIT, etc.):

NYSDEC Region 9 files, Buffalo, New York
Niagara County Health Department Files, Niagara Falls, NY
SKW Alloys Corp. files, Niagara Falls, NY

Factors Not Scored Due to Insufficient Information:

Comments or Qualifications:

Fire and Explosion score not computed as site has not been declared a fire hazard by a fire marshal.

GROUNDWATER ROUTE

1. OBSERVED RELEASE

Contaminants detected (3 maximum):

Hexavalent Chromium
Iron
Manganese

Rationale for attributing the contaminants to the facility:

Downgradient wells have higher contaminant levels than upgradient wells
Ref. No. 11

* * *

2. ROUTE CHARACTERISTICS

Depth to Aquifer of Concern

Name/description of aquifer(s) of concern:

Lockport dolomite
Ref. No. 6

Depth(s) from the ground surface to the highest seasonal level of the saturated zone [water table(s)] of the aquifer of concern:

Approximately 25 feet
Ref. No. 12

Depth from the ground surface to the lowest point of waste disposal/storage:

Approximately 25 feet; landfill is placed on ground surface
Ref. No. 2

Net Precipitation

Mean annual or seasonal precipitation (list months for seasonal):

31 inches/year
Ref. No. 1

Mean annual lake or seasonal evaporation (list months for seasonal):

27 inches/year
Ref. No. 1

Net precipitation (subtract the above figures):

4 inches/year

Permeability of Unsaturated Zone

Soil type in unsaturated zone:

Odessa-Lakemont-Ovid Association
Ref. No. 5

Permeability associated with soil type:

10^{-5} to 10^{-7} cm/sec
Ref. Nos. 1 and 5

Physical State

Physical state of substances at time of disposal (or at present time for generated gases):

Dust and leachate slurry
Ref. No. 3

* * *

3. CONTAINMENT

Containment

Method(s) of waste or leachate containment evaluated:

Leachate collection system
Ref. No. 3

Method with highest score:

Landfill surface encourages ponding; no run-on control
Ref. Nos. 1 and 2

4. WASTE CHARACTERISTICS

Toxicity and Persistence

Compound(s) evaluated:

Phenols
Hexavalent Chromium
Selenium
Ref. Nos. 11, 15

Compound with highest score:

Hexavalent Chromium
Ref. No. 16

Hazardous Waste Quantity

Total quantity of hazardous substances at the facility, excluding those with a containment score of 0 (give a reasonable estimate even if quantity is above maximum):

102,000 tons
Ref. No. 14

Basis of estimating and/or computing waste quantity:

Ref. No. 14

* * *

5. TARGETS

Groundwater Use

Use(s) of aquifer(s) of concern within a 3-mile radius of the facility:

Commercial
Ref. Nos. 7 and 18

Distance to Nearest Well

Location of nearest well drawing from aquifer of concern or occupied building not served by a public water supply:

None
Ref. Nos. 7 and 18

Distance to above well or building:

NA

Population Served by Groundwater Wells Within a 3-Mile Radius

Identified water-supply well(s) drawing from aquifer(s) of concern within a 3-mile radius and populations served by each:

None
Ref. Nos. 7 and 18

Computation of land area irrigated by supply well(s) drawing from aquifer(s) of concern within a 3-mile radius, and conversion to population (1.5 people per acre):

NA
Ref. No. 7

Total population served by groundwater within a 3-mile radius:

Less than five people
Ref. No. 18

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S U R F A C E   W A T E R   R O U T E

1. OBSERVED RELEASE

Contaminants detected in surface water at the facility or downhill from it (5 maximum):

None detected

Rationale for attributing the contaminants to the facility:

* * *

2. ROUTE CHARACTERISTICS

Facility Slope and Intervening Terrain

Average slope of facility in percent:

0.5%
Ref. No. 13

Name/description of nearest downslope surface water:

Niagara River
Ref. No. 13

Average slope of terrain between facility and above-cited surface water body in percent:

1.3%
Ref. No. 13

Is the facility located either totally or partially in surface water?

No
Ref. No. 13

Is the facility completely surrounded by areas of higher elevation?

No
Ref. No. 13

1-Year 24-Hour Rainfall in Inches

2.5
Ref. No. 1

Distance to Nearest Downslope Surface Water

1.5 miles
Ref. No. 13

Physical State of Waste

Solid, sludge
Ref. Nos. 2, 3, 14

* * *

3. CONTAINMENT

Containment

Method(s) of waste or leachate containment evaluated:

Landfill, piles
Ref. Nos. 1 and 2

Method with highest score:

No liner
Piles not covered
Ref. No. 1

4. WASTE CHARACTERISTICS

Toxicity and Persistence

Compound(s) evaluated:

Hexavalent Chromium
Selenium
Phenols
Ref. Nos. 11, 14, 15

Compound with highest score:

Hexavalent Chromium
Ref. No. 16

Hazardous Waste Quantity

Total quantity of hazardous substances at the facility, excluding those with a containment score of 0 (give a reasonable estimate even if quantity is above maximum):

102,000 tons
Ref. No. 14

Basis of estimating and/or computing waste quantity:

Ref. No. 14

* * *

5. TARGETS

Surface Water Use

Use(s) of surface water within 3 miles downstream of the hazardous substance:

Recreation
Ref. No. 7

Is there tidal influence?

NA
Ref. No. 13

Distance to a Sensitive Environment

Distance to 5-acre (minimum) coastal wetland, if 2 miles or less:

NA
Ref. No. 13

Distance to 5-acre (minimum) fresh-water wetland, if 1 mile or less:

NA
Ref. No. 13

Distance to critical habitat of an endangered species or national wildlife refuge, if 1 mile or less:

NA
Ref. No. 10

Population Served by Surface Water

Location(s) of water-supply intake(s) within 3 miles (free-flowing bodies) or 1 mile (static water bodies) downstream of the hazardous substance and population served by each intake:

NA
Ref. No. 7

Computation of land area irrigated by above-cited intake(s) and conversion to population (1.5 people per acre):

NA
Ref. No. 7

Total population served:

0
Ref. No. 7

Name/description of nearest of above water bodies:

NA
Ref. No. 7

Distance to above-cited intakes, measured in stream miles:

NA
Ref. No. 7

AIR ROUTE

1. OBSERVED RELEASE

Contaminants detected:

None detected

Date and location of detection of contaminants:

NA; none detected.

Methods used to detect the contaminants:

HNu photoionizer; none detected.

Rationale for attributing the contaminants to the site:

NA; none detected.

* * *

2. WASTE CHARACTERISTICS

Reactivity and Incompatibility

Most reactive compound:

NA

Most incompatible pair of compounds:

NA

Toxicity

Most toxic compound:

Hexavalent chromium
Ref. No. 16

Hazardous Waste Quantity

Total quantity of hazardous waste:

102,000 tons
Ref. No. 14

Basis of estimating and/or computing waste quantity:

Ref. No. 14

* * *

3. TARGETS

Population Within 4-Mile Radius

Circle radius used, give population, and indicate how determined:

0 to 4 mi   (0 to 1 mi)   0 to 1/2 mi   0 to 1/4 mi

3,540
Ref. No. 4

Distance to a Sensitive Environment

Distance to 5-acre (minimum) coastal wetland, if 2 miles or less:

NA; coast is over 2 miles distant
Ref. No. 13

Distance to 5-acre (minimum) fresh-water wetland, if 1 mile or less:

NA
Ref. Nos. 9 and 13

Distance to critical habitat of an endangered species, if 1 mile or less:

NA
Ref. No. 10

Land Use

Distance to commercial/industrial area, if 1 mile or less:

0.10 mile
Ref. Nos. 2 and 13

Distance to national or state park, forest, or wildlife reserve, if 2 miles or less:

1 mile
Ref. No. 13

Distance to residential area, if 2 miles or less:

1,500 feet
Ref. No. 13

Distance to agricultural land in production within past 5 years, if 1 mile or less:

NA
Ref. Nos. 5 and 13

Distance to prime agricultural land in production within past 5 years, if 2 miles or less:

NA
Ref. Nos. 5 and 13

Is a historic or landmark site (National Register of Historic Places and National Natural Landmarks) within the view of the site?

No
Ref. Nos. 8 and 13

FIRE AND EXPLOSION

Fire and explosion route has not been scored since the site has not been declared a fire hazard by a fire marshall.
Ref. No. 7

1. CONTAINMENT

Hazardous substances present:

Hexavalent chromium, selenium, and phenols.
Ref. Nos. 11, 14, and 15

Type of containment, if applicable

Landfill, piles.
Ref. Nos. 1 and 2

* * *

2. WASTE CHARACTERISTICS

Direct Evidence

Type of instrument and measurements:

NA

Ignitability

Compound used:

NA

Reactivity

Most reactive compound:

NA

Incompatibility

Most incompatible pair of compounds:

NA

Hazardous Waste Quantity

Total quantity of hazardous substances at the facility:

102,000 tons
Ref. No. 14

Basis of estimating and/or computing waste quantity:

As stated on NYSDEC report
Ref. No. 14

* * *

3. TARGETS

Distance to Nearest Population

0.01 mile
Ref. No. 13

Distance to Nearest Building

0.01 mile
Ref. No. 13

Distance to a Sensitive Environment

Distance to wetlands:

>100 feet
Ref. No. 9

Distance to critical habitat:

>.5 mile
Ref. No. 10

Land Use

Distance to commercial/industrial area, if 1 mile or less:

500 feet
Ref. No. 13

Distance to national or state park, forest, or wildlife reserve, if 2 miles or less:

1 mile
Ref. No. 13

Distance to residential area, if 2 miles or less:

1,500 feet
Ref. No. 13

Distance to agricultural land in production within past 5 years, if 1 mile or less:

NA
Ref. Nos. 5 and 13

Distance to prime agricultural land in production within past 5 years, if 2 miles or less:

NA
Ref. Nos. 5 and 13

Is a historic or landmark site (National Register of Historic Places and National Natural Landmarks) within the view of the site?

No
Ref. Nos. 8 and 13

Population Within 2-Mile Radius

34,035
Ref. No. 4

Buildings Within 2-Mile Radius

12,824
Ref. No. 4

DIRECT CONTACT

1. OBSERVED INCIDENT

Date, location, and pertinent details of incident:

None observed

* * *

2. ACCESSIBILITY

Describe type of barrier(s):

The 62-acre site is fenced and guarded; waste is not covered. Waste piles also occur on adjacent Niagara Mohawk Power Corp. right-of-way.
Ref. No. 17

* * *

3. CONTAINMENT

Type of containment, if applicable:

Piles, landfill
Ref. Nos. 2, 3

* * *

4. WASTE CHARACTERISTICS

<u>Toxicity</u>

Compounds evaluated:

Hexavalent Chrome
Selenium
Phenols
Ref. Nos. 15, 11

Compound with highest score:

Hexavalent Chrome
Ref. No. 16

* * *

5. TARGETS

<u>Population within one-mile radius</u>

3,540
Ref. No. 4

<u>Distance to critical habitat (of endangered species)</u>

NA
Ref. No. 10

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REFERENCES

If the entire reference is not available for public review in the EPA regional files on this site, indicate where the reference may be found:

Reference Number	Description of the Reference
1	Barrett, K.W., S.S. Chang, S.A. Hans, A.M. Platt, 1982, Uncontrolled Hazardous Waste Site Ranking System Users Manual, Mitre Corporation. Document Location: Ecology and Environment, Buffalo, NY.
2	Ecology and Environment, Inc., August 26, 1987, Site Inspection logbook and photolog. Document Location: Ecology and Environment, Buffalo, NY.
3	Kruk, Anthony, Engineering and Maintenance Manager, SKW Alloys, Inc., August 1987, personal communication. Document Location: Ecology and Environment, Buffalo, NY.
4	Graphical Exposure Modeling System (GEMS) Volume 3, June 1987, Graphics and Geodata Handling, prepared for the USEPA Office of Pesticides and Toxic Substances Exposure Evaluation Division, Federal Plaza, New York, New York. Document Location: Ecology and Environment, Buffalo, NY.
5	Higgins, B.A., P.S. Puglia, R.P. Leonard, T.D. Yoakun, W.A. Wirtz, 1972, Soil Survey of Niagara County, New York, USDA Soil Conservation Service. Document Location: Ecology and Environment, Buffalo, NY.
6	Johnson, Richard H., 1964, Groundwater in the Niagara Falls Area, New York, State of New York Conservation Department, Water Resources Commission, Bulletin GW-53. Document Location: Ecology and Environment, Buffalo, NY.
7	Hopkins, Michael, June 1987, personal communication, Niagara County Health Department, Niagara Falls, New York. Document Location: Ecology and Environment, Buffalo, NY.
8	Murtagh, William, 1976, The National Register of Historic Places, U.S. Department of the Interior, National Park Service, Washington, D.C. Document Location: Ecology and Environment, Buffalo, NY.
9	New York State Department of Environmental Conservation (NYSDEC), wetlands map. Document Location: Region 9 files, Buffalo, New York.
10	Snider, James, wildlife biologist, personal communication, June 1987, NYSDEC Region 9, Buffalo, New York. Document Location: Ecology and Environment, Buffalo, NY.
11	SLC Consultants/Contractors, Inc., June 1987, Groundwater sample analysis results for SKW Alloys, Inc. Document Location: Ecology and Environment, Buffalo, New York.
12	United States Geological Survey, The Effect of Niagara Power Project on Groundwater Flow in the Upper Part of the Lockport Dolomite, Niagara Falls Area, Survey Report 86-4130. Document Location: Ecology and Environment, Buffalo, New York.
13	United States Geological Survey, 1980, Niagara Falls and Lewiston, New York quadrangles, 7.5-Minute Series (Topographic), Washington, DC. Document location: Ecology and Environment, Buffalo, NY.

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Reference Number	Description of the Reference
14	New York State Department of Environmental Conservation, Division of Solid and Hazardous Waste, Inactive Hazardous Waste Disposal Report. Document Location: Ecology and Environment, Buffalo, NY.
15	Radian Corporation, November 6, 1984, Analytical Results of the solid waste samples from SKW Alloys, Inc. Ferroalloy facility, Niagara Falls, NY. Document Location: Ecology and Environment, Buffalo, NY.
16	Sax, N. Irving, 1984, Dangerous Properties of Industrial Materials, 6th ed. Document Location: Ecology and Environment, Buffalo, NY.
17	Hopkins, Michael, December 1983, profile report, Niagara County Health Department, Niagara Falls, New York. Document location: Ecology and Environment, Inc., Buffalo, New York.
18	Aungst, Nancy, May 1988, personal communication, Project Manager, Hyde Park Oversight, Ecology and Environment, Inc. Document location: Ecology and Environment, Inc., Buffalo, New York.

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REFERENCE NO. 1

Uncontrolled Hazardous Waste Site Ranking System

A Users Manual

Kris W. Barrett
S. Steven Chang
Stuart A. Haus
Andrew M. Platt

August 1982

MTR-82W111

SPONSOR:
U.S. Environmental Protection Agency
CONTRACT NO.:
68-01-6278

The MITRE Corporation
Metrek Division
1820 Dolley Madison Boulevard
McLean, Virginia 22102

5-26

REFERENCE NO. 2

Snyder Engineering
CHEMICAL-ENVIRONMENTAL

86 Countryside Lane
Grand Island, NY 14072

716-773-5661
Richard R. Snyder, P.E.

SKW Alloys Site Inspection
August 26, 1987
Weather: Cloudy ~70 slight breeze

Personnell: Jon Sundquist
Dennis Sutton

Arrive: 9:47
Appointment @ 10:00
Review DEC & NCDOH files in our possession.

1015
Met with Tony ~~Groot~~ KRUTpas of SKW and Dick Snyder P.E of Snyder-Engineering at the ~~Witmer Road~~ Highland Ave Administration Offices to discuss background on landfill operations.

SKW was owned by Airco until SKW split from Airco in 1979

Monitoring wells on site - 1/4 sampling will request sampling results have been monitored for approx 7 years, results sent to DEC

from 1920 to 1964 owned
by Vanadium Corp of America
who disposed brick, wood, ash
and slag, ferro slags

1964-1979 - Airco Alloy's owned
site, Airco formerly called
Pittsburgh Metallurgical Company
who produced ferro alloys

SKW bought Airco Alloy's in
1979 and continued to produce
Alloy's and associated wastes

1050 metal scrap - scrap Dealer
lumber, paper, Rags - Modern Disposal
underground? holding tank
Solvents or lubricants - speedi-Oil
Cleaning agents - Safety Kleen

Landfill waste - submerged arc
furnace - produce silica
fume - waste does not
come in contact with
any solvents or lubricants

only dust produced.
50% ferro silicon } Balance is Iron
75% ferro silicon
pure silicon

leachate collected - reused for
slurry supply to move
more dust

Water treatment - BETS system
blowdown - city of Niagara Falls
sewer system

1125 proceed to land fill area on Witmer Road

1130 arrive at cell #2 - almost filled with dust

frame #1 showing cell #2 and leachate collection standpipe looking east from access road

1135 frame #2 looking west from access road by cell 2 showing discrete piles of metal, wood chips, wood scrap and dust

dust is mixed with ~~cement~~ water [illegible] slurry to prevent it from becoming airborne

1140 frame #3 showing cell #1 looking south from access road

s Anthony H. Kruk
Manager - Maintenance and Engineering
SKW Alloys Inc.

1145
frame #4 looking NE at edge of road near cell #1 showing runoff runnels in dust
fence is boundary between Aerco + SKW

1148
frame #5 looking east from road embankment showing old Vanadium foundation, loading ramp,
shows piles of mixed spill of raw materials - clean up from plant

1150
frame #6 showing low area looking south, note standing water, from access road near cell #2

1158
from #7 looking south from access road near cell #2 showing buildings on site

1200 no readings on site from HNU through entire investigation.

1205 prepare to leave site

Frame #8
1210 photo looking north from access road adjacent to cell #2 showing 2 monitoring wells on site

1215 leave site

Further information:
site Originally owned by Vanadium Corporation of America from 1920 to 1964

Airco Alloys was Originally called Pittsburg Metallurgical Company and changed their name in 1962

Airco Alloys used the site from 1964 to 1980 at which point SKW alloys aquired the Alloys division from Airco and proceeded to use the landfill

Ground water wells on site are monitored quarterly.

Metal scrap from plant operations are sold to a metal scrap dealer.

Solid waste (lumber, paper, etc.) is handled by Modern Disposal

a leachate collection system is in place and leachate is used in the dust slurry

Cooling water is in use on the furnace and a BETTS system of water treatment is used

Raw materials are:
- Quartz
- Coal
- Petroleum Coke
- Wood chips
- Steel turnings, scrap

Meeting c̄ DEC
concerning this site
9/16/87 1030

Met c̄ James Goehrig to discuss SKW Alloys site

He was able to provide EP-Tox analysis on SKW's waste - baghouse dust
He also stated that SKW landfill is operating under its old landfill permit until the new permit application is approved.

Mr Goehrig stated that the permit would probably not be renewed unless SKW addresses the ground water contamination - either cleans it up or ~~remediates~~ proposes a plan for remediation.
Mr Goehrig also stated that

the landfill is lined with a clay liner which is approximately 5 feet thick.

After talking for approximately 1 hour I left to return to TSA

Dennis Gatton

REFERENCE NO. 3

SKW ALLOYS, INC.
P. O. BOX 368, NIAGARA FALLS, NEW YORK 14302 • TELEPHONE 716 285-1252

September 24, 1987

Mr. Dennis Sutton
Ecology and Environment, Inc.
195 Sugg Road,
P.O. Box D
Buffalo, New York 14225

Dear Mr. Sutton:

Enclosed is a copy of your letter (unsigned) dated September 16, 1987 referring to information gathered during your inspection on August 26, 1987 of our landfill site. We have taken the liberty of numbering your listed information.

The following is submitted to clarify and/or correct this information:
Item #2 - The ground water wells on site are sampled every three months and results are sent to NYSDEC Region 9, Buffalo, New York.
Item #3 - The leachate system on the landfill drains leachate into a main sump. This leachate is then mixed with the baghouse dust to form a slurry for disposal.
Item #4 - SKW manufactured ferroalloys in forms such as ferrosilicon and ferrochrome silicon.
Item #5 - The generation of these products ferrosilicon (50% & 75%) and ferrochrome silicon by use of a submerged arc furnace produces dust of various compositions.
Item #8 - Woodchips may have been stored on site at one time, neither the site nor the landfill area have been used for disposal of metal scrap, wood scrap or baghouse dust.
Item #9 - There is no metal scrap from plant processes. Metal scrap (iron and steel) from repairs is sold to a metal scrap dealer.
Item #10 - Used oils (not solvents) and lubricants are placed in a holding tank and transported from SKW by Speedi Oil for proper disposal or recycling.
Item #11 - Cleaning agents used in cleaning parts of various equipment are handled by a firm called Safety Kleen.
Item #12 - Mixed spill material and piles of clean up from the plant have been temporarily stored on plant site (not the landfill site) for periodic removal and disposal to an independent controlled landfill.
Item #14 - Airco Alloys used the site from 1964 to 1979. The Airco Alloys plant site was previously owned and operated by Pittsburg Metallurgical Company.
Item #15 - SKW Alloys has used this site for landfill disposal from 1979 to the present to dispose of the slurried dust waste.

(cont'd....)

Mr. Dennis Sutton
Ecology & Environment, Inc. (Cont'd) 9/24/87

These corrections should bring your letter up to date. If you would resubmit your letter at that time I will sign and date it per your request. If there are any questions or any additions or corrections that you require please call me.

Sincerely,

A.H. Kruk
Manager of Maintenance &
Engineering

Enclosure

AHK/gc

cc: J. Biles
T. Riscili

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REFERENCE NO. 4

GSC-TR8705

DRAFT

GRAPHICAL EXPOSURE MODELING SYSTEM

(GEMS)

USER'S GUIDE

VOLUME 1. CORE MANUAL

Prepared for:

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF PESTICIDES AND TOXIC SUBSTANCES
EXPOSURE EVALUATION DIVISION
Task No. 3-2
Contract No. 68023970
Project Officer: Russell Kinerson
Task Manager: Loren Hall

Prepared by:

GENERAL SCIENCES CORPORATION
6100 Chevy Chase Drive, Suite 200
Laurel, Maryland 20707

Submitted: February, 1987

1. INTRODUCTION

The Graphical Exposure Modeling System (GEMS) is an interactive computer system developed by General Sciences Corporation under the auspices of the Modeling Section in the Exposure Evaluation Division (EED), Office of Toxic Substances (OTS) of the Environmental Protection Agency (EPA). It provides a simple interface to environmental modeling, physiochemical property estimation, statistical analysis, and graphic display capabilities, with data manipulation which supports all of these functions. An overview of the basic GEMS components is shown in Figure 1-1. The system is installed on the OTS VAX 11/780 computer in Research Triangle Park, North Carolina, and is accessible through dial-up lines.

GEMS is being developed to support integrated exposure analyses at OTS. Its purpose is to provide environmental researchers and analysts with a set of sophisticated tools to perform exposure assessments of toxic substances without requiring them to become familiar with most aspects of computer science or programming.

GEMS is designed under a unique concept which integrates the computerized tools of graphics, mapping, statistics, file management, and special functions such as modeling and physiochemical property estimation, under a user-oriented and simple-to-learn interface. GEMS prompts the user or provides a menu for each action to be performed. The following features provide users with great flexibility during the GEMS execution:

- HELP commands - When you are using the GEMS system, you may not always have a user's manual readily available and/or you may need to see the format and type of a command or an answer before you enter it. Various HELP commands are available in GEMS which provide such information.

- Recovering from errors - If you enter a command or a response incorrectly, the system issues an error message and reprompts you for the correct information.

- Built-in defaults for model execution - GEMS is designed to guide inexperienced users through the execution of selected models. Default responses are usually available when you cannot specify a choice or supply an input to a prompt during model execution.

- Data management of modeling results - Data generated from execution of the SESOIL, ISC, SWIP, or AT123D models may be stored automatically in GEMS. These data may be accessed or analyzed via GEMS' file management, graphics, and statistics operations.

The purpose of this document is to describe GEMS from the user's point of view. It is intended as a comprehensive guide to the use of GEMS for personnel who have no specialized knowledge of computer programming. However, a working knowledge of environmental modeling is necessary for complete and accurate use of the system.

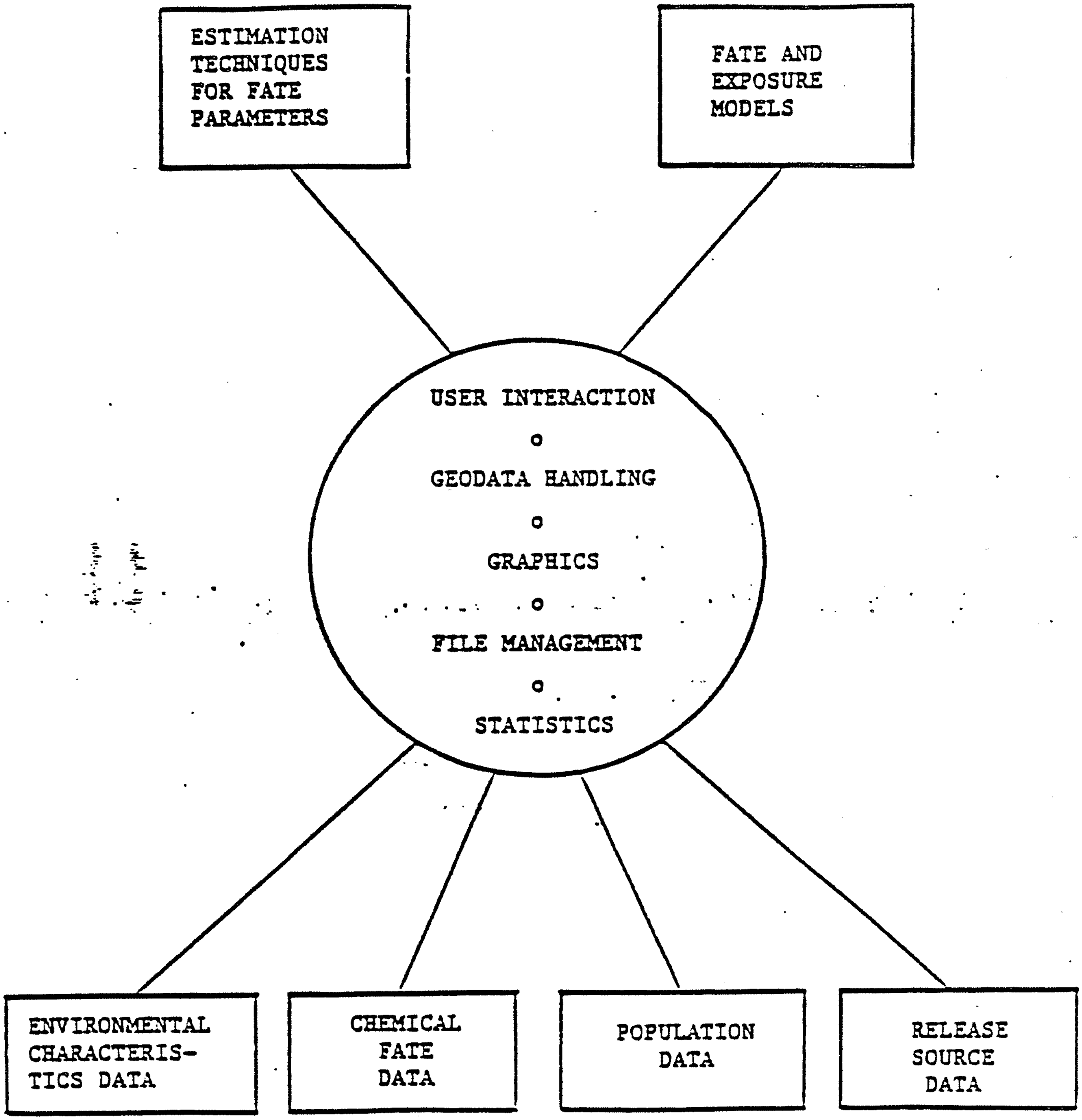


FIGURE 1-1. Components of the Graphical Exposure Modeling System (GEMS)

Since the last draft of the GEMS User's Guide, completed in June, 1984, the GEMS system has gone through a number of modifications and enhancements. It is no longer feasible to hold all sections in one single volume. This revised user's guide is designed in a modular fashion of six separate volumes described briefly below. In addition, GEMS has been adapted to function on an IBM PC/XT or AT. This prototype called PCGEMS has many of the same capabilities of the mainframe GEMS. These include environmental modeling procedures such as ENPART and AT123D as well as property estimation procedures such as CLOGP and AUTOCHEM. The prototype PCGEMS works in large part through interface with the OTS VAX 11/780 on which GEMS resides, a user's guide for PCGEMS will be available in the near future.

Volume 1: Core-Manual

This volume is a reference manual and introduction for first-time users. In addition to Section 1 - Introduction, a functional description of GEMS is presented in Section 2, a detailed guide to the use of the system is presented in Section 3, and summaries of the VAX operating environment and system and frequently used utilities are presented in Section 4. Two sample runs are given in the attachment to provide users with information in order to interact with the GEMS system, to generate a dataset, and subsequently, produce a map from the dataset.

Volume 2: Modeling

This volume consists of all GSC prepared user's manuals to GEMS models, grouped according to media. User's manuals are available for the following models: SESOIL, AT123D, SWIP, ENPART, TOX-SCREEN, INPUFF, and ISC/GAMS. A user's manual for EXAMS II model will be available later this year. Refer to Section 2.2 for further information.

Volume 3: Graphics and Geodata Handling

This volume contains two GEMS operations, Graphics and Geodata Handling. The Graphics operation contains a variety of graphics procedures which may be used to display results from modeling runs or from datasets. The Geodata Handling operation contains procedures that perform geographic data manipulation and generate maps of U.S. states or counties. Refer to Section 2.3 for further information.

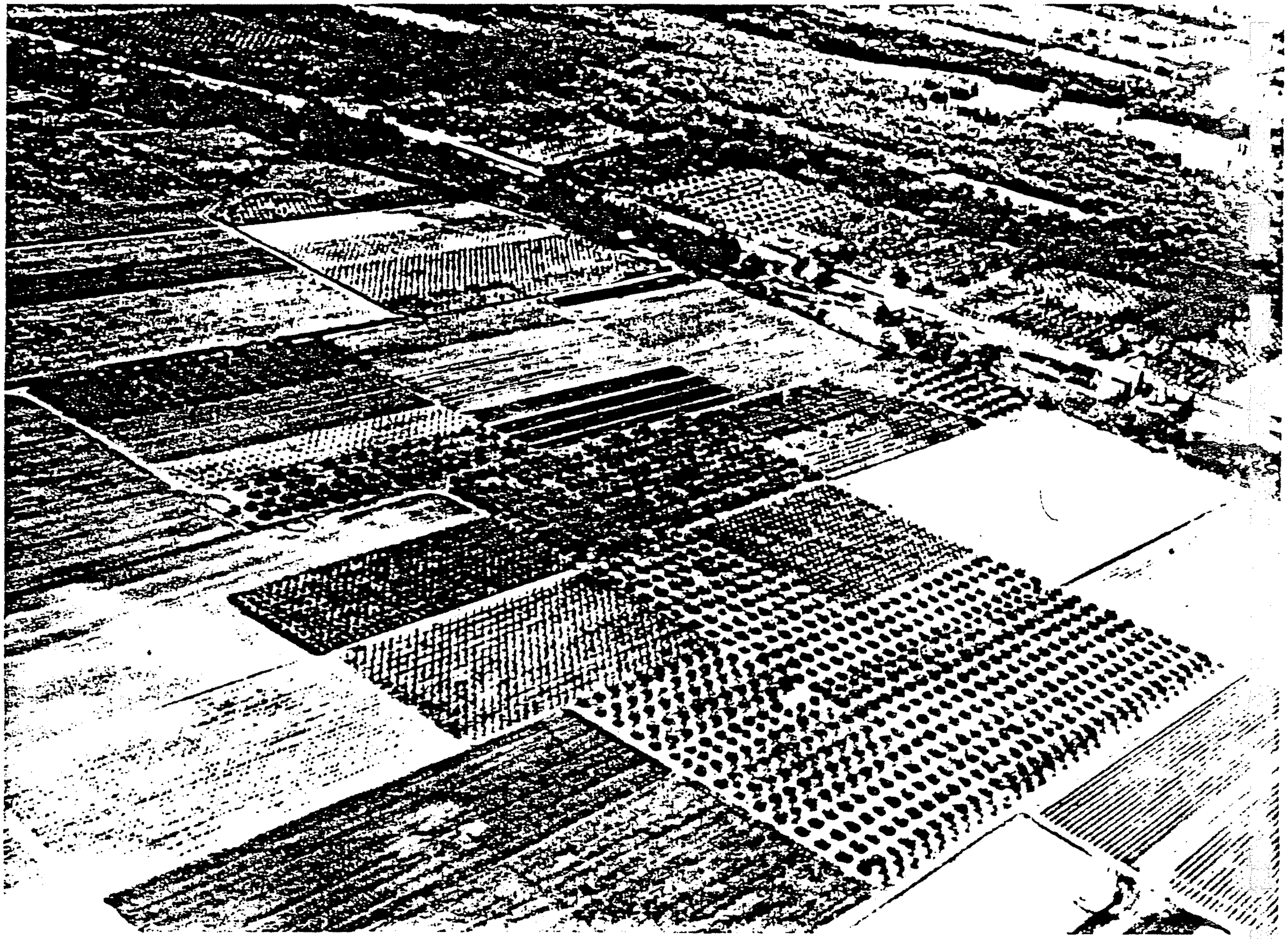
Volume 4: Data Manipulation

This volume contains descriptions of GEMS system-installed datasets and two GEMS operations - File Management, and Utilities. Refer to Section 2.4 for further information.

REFERENCE NO. 5

SOIL SURVEY OF

Niagara County, New York



United States Department of Agriculture
Soil Conservation Service
In cooperation with
Cornell University Agricultural Experiment Station

Issued October 1972

in the northwestern part of the county near the village of Youngstown. Three smaller areas also occur.

This association makes up about 15 percent of the county. About 32 percent of this is Rhinebeck soils, 10 percent is Ovid soils, and 9 percent is Madalin soils. The remaining 49 percent consists of minor soils.

The Rhinebeck soils are deep and are somewhat poorly drained. These soils typically have a silt loam surface layer, a silty clay or silty clay loam subsoil, and underlying material of varved silt and clay. They occupy the broad areas within the association and are slightly dissected by erosion in a few places, especially in areas that border Lake Ontario.

The Ovid soils occupy the slightly elevated areas where there has been some reworking of the fine-textured lake deposits and the glacial till or glacial beach deposits. The Ovid soils are deep and somewhat poorly drained. They typically have a silt loam surface layer and a silty clay loam subsoil and are underlain by loamy glacial till. Some coarse fragments are generally in and below the surface layer.

The Madalin soils occupy the more nearly level, more depressional areas within the broad, level lake plain. They are deep and poorly drained to very poorly drained. Madalin soils typically have a dark silt loam surface layer that is high in organic-matter content, a silty clay subsoil, and underlying material of varved silt and clay.

The minor soils are mainly of the Collamer, Hudson, and Niagara series. These soils are intermingled with the major soils in this association. The Collamer and Hudson soils occupy knolls or higher elevations and are intermingled with the Ovid soils. The Niagara soils are mainly nearly level.

This association has a medium value for farming. Much of it is idle or is cropland that is not used intensively. A fairly small acreage that is close to Lake Ontario is used intensively for fruit. The area near Youngstown is in community development, mostly for rural homes. The acreage in grapes is increasing, especially near the Model City area in the town of Lewiston.

Natural drainage is the principal concern in town and country planning and in farm development. The flatness of the area is the biggest factor to consider in planning artificial drainage. The soils in most of the association can be drained readily by installing adequate surface ditches. Tile lines help in draining some of the wet, coarser textured inclusions. The major need is group drainage projects that provide suitable outlets.

If drainage is adequate, this association has a good potential for apples, grapes, pears, and other fruit. Peaches and cherries normally are not suited. Some vegetables can be grown intensively, but maintaining soil tilth is difficult. Grain and hay crops are suited if drainage is adequate. The need for lime is generally small.

Natural drainage and slow permeability are the two most limiting factors for community development. Sanitary sewers and adequate surface drainage are needed. In many places the soils are unstable because they formed in deep lake deposits.

About 85 percent of the acreage is in open land. The forested areas consist mostly of scattered farm woodlots. Some of the idle land is reverting to ash, soft maple, and other native hardwoods. Openland wildlife is plentiful in many areas. Pheasants and rabbits are the most commonly hunted wildlife species, and there is a potential for wetland wildlife. Recreation in this association consists mostly of hunting, fishing, camping, and golfing. Scenic areas are confined mostly to the part of the association that borders the Niagara River and Lake Ontario.

11. Odessa-Lakemont-Ovid association

Deep, somewhat poorly drained to very poorly drained soils having a fine textured or moderately fine textured subsoil that is dominantly reddish in color

This is the largest soil association in Niagara County. It consists of level or nearly level soils on lake plains south of the limestone escarpment (fig. 5). There are two large areas that are dotted with small knolls and ridges of till. The largest area is west of the Barge Canal, and the other area is in the same topographical position as the larger area but is east of the Barge Canal.

This association makes up about 21 percent of the county. About 24 percent of this is Odessa soils, 14 percent is Lakemont soils, and 11 percent is Ovid soils. The remaining 51 percent consists of minor soils.

The Odessa soils are deep and somewhat poorly drained. They typically have a silty clay loam surface layer, a silty clay subsoil, and clay and silt underlying material. These soils are level and occupy the broad areas between the poorly drained, depressional areas and the slightly elevated till ridges.

The Lakemont soils are level to slightly depressional and are generally adjacent to the better drained Odessa soils. Lakemont soils typically have a silty clay loam surface layer, a silty clay subsoil, and underlying material of clay and silt. They have a darker surface layer than the Odessa soils and show more indications of wetness.

The Ovid soils are nearly level to gently undulating and are on till landscapes at slightly higher elevations above the lake plain. They are deep and somewhat poorly drained. Ovid soils typically have a silt loam surface layer, a silty clay loam subsoil, and underlying material of loamy glacial till.

The minor soils are mainly of the Churchville, Cayuga, Cazenovia, Fonda, and Hilton series. Also included are some areas of shallow muck. In many places the moderately well drained Hilton and Cazenovia soils occupy the higher parts of the knolls and

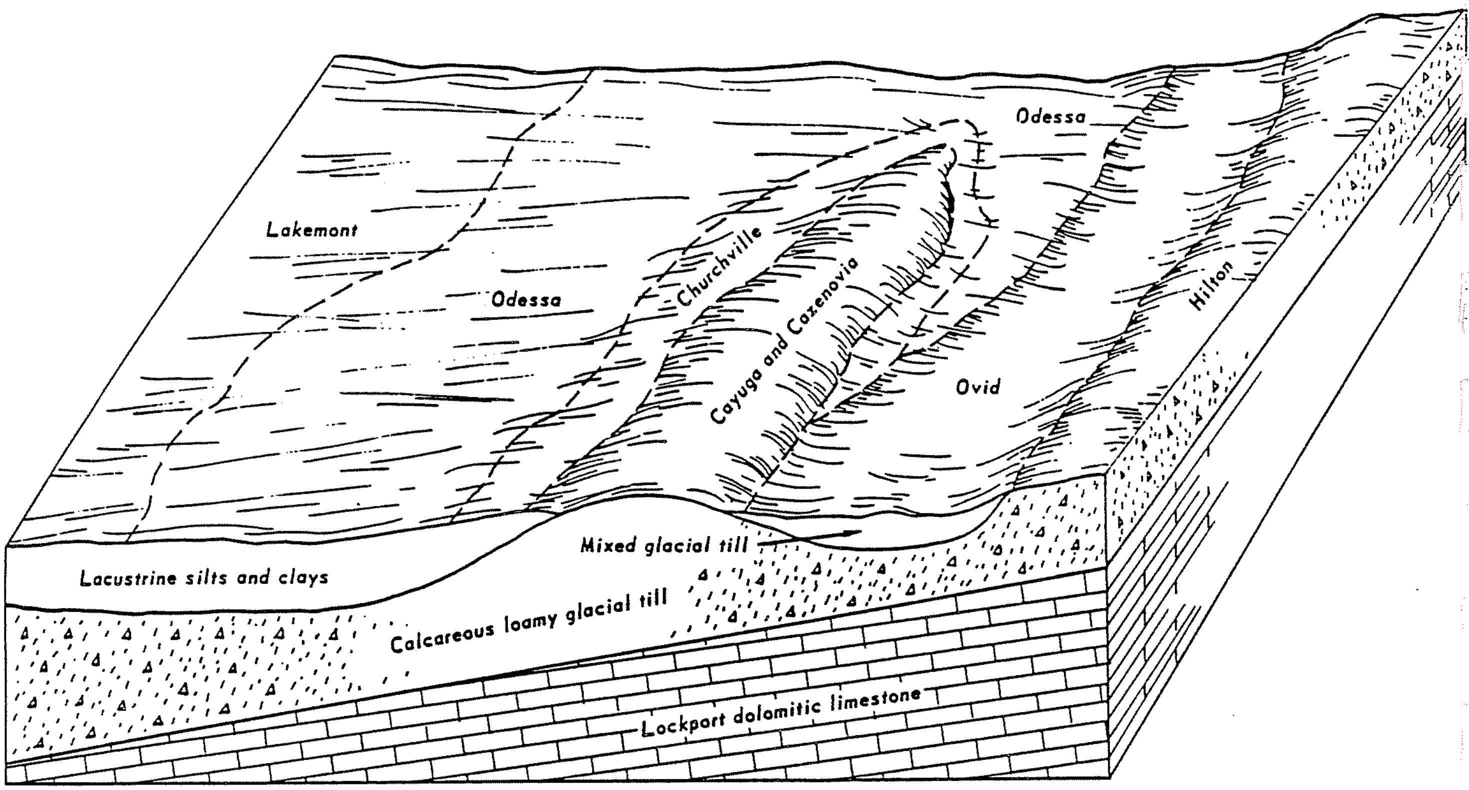


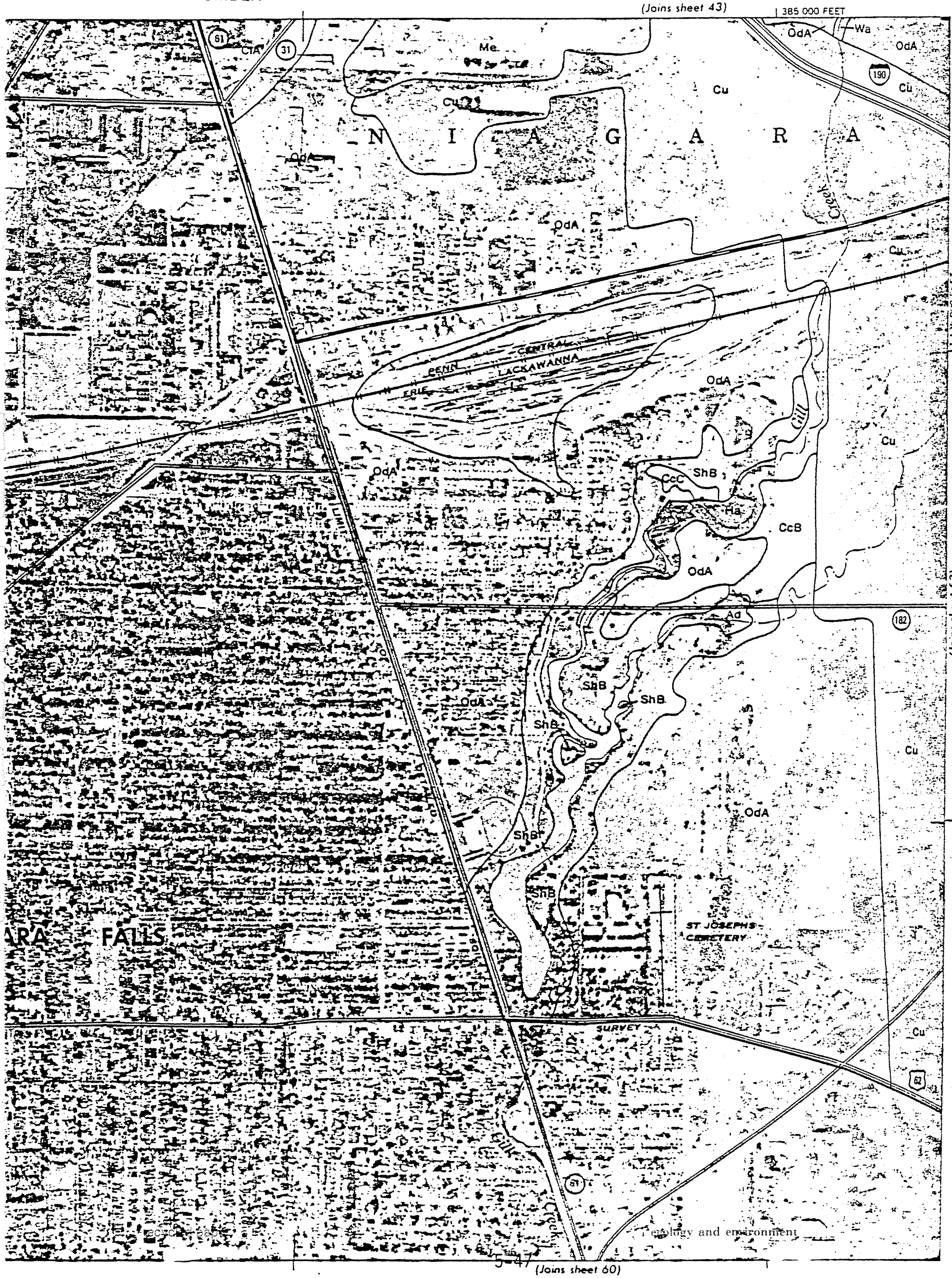
Figure 5.--Typical cross section of the Odessa-Lakemont-Ovid association.

till ridges that are scattered throughout the association. Around the fringes of these areas, where lacustrine clays overlap the till, are the somewhat poorly drained Churchville soils and the moderately well drained Cayuga soils. The very poorly drained Fonda soils and the shallow muck occupy some of the deeper depressions in the lake plain.

This association has a fairly low value for farming. Much of it is idle or cropland that is not intensively used. Communities are being rapidly developed in the western part of the association near Niagara Falls and in areas south of Lockport. The Conservation Needs Inventory for 1958 indicated that 58 percent of this association is cropland, 6 percent is pasture, 4 percent is forest, 14 percent is urban or built-up areas, and 18 percent is open land (6).

Natural drainage is the main concern in town and county planning and in agricultural development. The flatness of the area and the generally fine texture of the soils are the main factors to consider before installing artificial drainage. The biggest need is for group drainage projects that provide suitable outlets.

If adequately drained, the soils in this association have a good potential for grain and for dairy cattle and other livestock. The texture of the soils is generally too fine for most vegetable crops. If the soils are cultivated intensively, they are difficult to till because they crust, clod and compact. Most fruit crops are damaged by frost in this association. The need for lime is small.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REFERENCE NO. 6

GROUND WATER IN THE NIAGARA FALLS AREA, NEW YORK

With Emphasis on the Water-Bearing Characteristics of the Bedrock

BY

RICHARD H. JOHNSTON

GEOLOGIST

U.S. GEOLOGICAL SURVEY

STATE OF NEW YORK

CONSERVATION DEPARTMENT

WATER RESOURCES COMMISSION

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because studies made on the Lockport may contribute to a better understanding of the occurrence of ground water in bedrock generally. The Queenston Shale and Clinton and Albion Groups are poor aquifers in comparison to the Lockport Dolomite, and less is known of their water-bearing characteristics.

LOCKPORT DOLOMITE

Character and extent

The Lockport Dolomite is the uppermost bedrock formation in about one-third of the Niagara Falls area. Its outcrop area extends from the Niagara escarpment on the north to the southern boundary of the area covered by this report except in two small areas that may be underlain by the Salina Group. (See plate 3.) One of these areas is in the vicinity of the hamlet of Nashville and the other is in the extreme southeast corner. Because of a lack of rock outcrops in these areas the position of the contact between the Lockport and the Salina cannot be accurately determined. However, the Salina Group is not discussed as a separate water-bearing unit in this report because at most only a few feet of it occurs in the area. Continuous exposures of the Lockport are found along the gorge of the Niagara River and along the Niagara escarpment. The formation is about 150 feet thick in the southern part of the area but has been eroded to a thickness of only about 20 feet along the escarpment (pl. 2). The excellent exposures at Niagara Falls (fig. 5), where the Lockport forms the lip of the Falls, are shown in many geology textbooks as a classic example of flat-lying sedimentary rocks. Throughout most of the remainder of the area, which is relatively flat, the Lockport is concealed by a thin cover of glacial deposits.

As its name implies, the Lockport Dolomite consists mainly of dolomite; however, the formation also includes thin beds of limestone and shaly dolomite near the base. The Lockport consists of five lithologic types which, from top to bottom, are:

(a) brownish-gray, coarse- to medium-grained dolomite, locally saccharoidal with thin intervals of curved bedding (algal structures).

(b) gray to dark-gray, fine-grained dolomite, containing abundant carbonaceous partings.

(c) tannish-gray, fine-grained dolomite.

(d) light-gray, coarse-grained limestone containing abundant crinoid fragments (Gasport Limestone Member).

(e) light-gray shaly dolomite, laminated in part (DeCew Limestone Member of Williams, 1919).

Fisher (1960) divides the Lockport Dolomite into six units based on fossils as well as rock types. An excellent discussion of the stratigraphy of the

Lockport, including measured sections in the Niagara Falls area, is given in the recent thesis by Zenger 1/.

The detailed breakdowns by Fisher and Zenger, although helpful for geologic mapping and correlating the Lockport with rocks of similar age elsewhere, are not necessary in descriptions of the water-bearing properties of the formation. For this purpose the Lockport is subdivided as follows (figure 5 and table 1): (1) upper and middle parts of the Lockport, and (2) lower part of the Lockport, including the Gasport Limestone Member and DeCew Limestone Member of Williams (1919).

Most of the beds in the Lockport are described as either "thick" (1 foot to 3 feet) or "thin" (1 inch to 1 foot). However, massive beds up to eight feet thick and very thin beds (1/4 to 1 inch) occur within the formation. The bedding is generally straight, but curved bedding occurs in some places in the upper part of the formation. The curved bedding is caused by dome-shaped algal structures called "stromatolites" (Zenger, p. 140). These reefs (bioherms), which occur as lens-like masses up to 50 feet across and 10 to 20 feet thick, contain no bedding.

Gypsum (calcium sulfate) is common in the Lockport, occurring chiefly as small irregularly shaped masses (commonly 1/2 to 5 inches in diameter) and as selenite. Sulfide minerals, particularly sphalerite (zinc sulfide), galena (lead sulfide), and pyrite (iron sulfide) occur as particles disseminated throughout the formation.

Water-bearing openings

Types.--Ground-water occurs in the Lockport Dolomite in three types of openings: (1) bedding joints which constitute at least seven important water-bearing zones, (2) vertical joints, and (3) small cavities from which gypsum has been dissolved. Of these, the bedding joints are the most important and transmit nearly all the water moving through the formation. The three types of openings were observed in the dewatered excavations for the conduits of the Niagara Power Project. (See the description of the power project in the Introduction and the location of the conduits in figure 3.) The rock faces along the four-mile length of the conduits provided an unequaled opportunity to study water-bearing openings in the entire stratigraphic thickness of the Lockport and to observe the lateral extent of these openings for a few thousand feet. At the time the observations were made (July - August 1960), approximately one-third of the length of the conduits was available for inspection by the writer.

1/ Zenger, D. H., 1962, Stratigraphy of the Lockport Formation (Silurian) in New York State: Unpublished doctoral thesis, Cornell University.

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It was also noted in the conduit excavations that there were places, even along the most prominent water-bearing zones, where no seepage was occurring. Many such places doubtless represent natural supports for the overlying rock because no extensive horizontal opening below the earth's surface can exist for any great distance. Little is known either about the nature or the size of these support areas or the distance between them. The available data suggest, however, that they encompass an area of at least a few square feet and are separated by a few tens of feet. It may be expected that with depth the size of the supports increases and the distance between them decreases.

The occurrence of ground water principally in zones parallel to bedding is probably characteristic of flat-lying Paleozoic carbonate rocks in many other places. This type of occurrence was reported by Trainer and Salvas (1962, p. 42) in the Beekmantown Dolomite near Massena, N. Y. They observed that "... The openings which are horizontal or gently dipping, and most of which are probably joints or other fractures parallel to the bedding of the rocks, are wider and more numerous than the steeply dipping openings." Although the Beekmantown Dolomite is of an older geologic age than the Lockport, certain similarities exist between the two formations: (1) both units consist of indurated Paleozoic dolomite and limestone; (2) both units are gently dipping, neither having been subjected to extensive folding and faulting which would result in the development of more prominent vertical joints or fractures associated with faulting; (3) both units were subjected to scouring by ice during glaciation within the last 10,000 to 15,000 years and thus, the extensive solution features common to limestones and dolomite in unglaciated areas have not had time to develop. It seems probable that any flat-lying carbonate rock, possessing the characteristics just stated, will contain ground water principally within joints parallel to bedding.

Origin of water-bearing openings.--The origin and the sequence of development of both the vertical joints and bedding joints are of considerable importance in developing an understanding of the occurrence of water in bedrock. Although it was not possible to investigate the origin or the development during this study, speculations based on fundamental principles of geology, especially regarding the origin of the bedding joints, may be worthwhile.

It is widely recognized that joints are formed by forces which tend to pull the rock apart (tension joints) or slide one part of the rock past an adjacent part (shear joints); see, for example, the discussion by Billings (1954, p. 115). The vertical joints were probably formed by a combination of tension and shear forces during or following the folding of the Appalachian Mountains about 200 million years ago. The bedding joints represent tension fractures that formed as a result of expansion of the rock in a vertical direction during more recent geologic time. The Lockport as recently as 200 million years ago was doubtless buried under thousands of feet of other rocks in the Niagara Falls area just as it is at the present time in the southern part of New York State. During the erosion of the overlying rocks the Lockport expanded vertically. The expansion caused fracturing to occur along bedding planes which are natural planes of weakness in the rock and which are approximately parallel to the land surface. Vertical joints, being at right angles to the land surface were little affected by the removal of the overlying rock.

The bedding joints may have been further expanded by stresses produced in the rock during the recession of the glaciers 10 to 15 thousand years ago. The melting of several thousand feet of ice was doubtless accompanied by an expansion of the rock. This expansion either resulted in an enlargement of existing bedding-plane openings or the formation of new openings along other bedding planes.

In recent geologic times, chemical solution of the rock has widened both the vertical and bedding joints. In the already well-developed openings along bedding joints, slight widening by solution has occurred to depths of 100 feet or more. Enlargement of vertical joints, in contrast, is generally restricted to the upper 10 to 15 feet of rock. Cavities formed by solution of gypsum exist where water moving along joints in the Lockport came into contact with gypsum. Gypsum is much more soluble than dolomite; thus, openings formed by the solution of gypsum are wider than other openings along joints. Water moving down vertical joints has dissolved the gypsum to a depth of about 15 feet leaving irregularly-shaped cavities, and water moving along bedding joints has dissolved gypsum to depths of at least 70 feet.

Water-bearing characteristics

Ground water exists in the Lockport Dolomite under artesian, semi-artesian, and unconfined conditions. Unconfined conditions occur where the water table is the upper surface of the zone of saturation within an aquifer. The water table in an unconfined aquifer moves freely upward as water is added to storage, or downward as water is taken from storage. In contrast, an artesian aquifer contains water which is confined by an overlying impermeable bed and which is under sufficient pressure to rise above the top of the aquifer. The level to which water in an artesian aquifer will rise forms an imaginary surface which is called a piezometric surface. Water levels in artesian aquifers change in response to pressure changes on the aquifer rather than to changes in the amount of water stored in the aquifer.

Both artesian and water-table conditions exist in the Lockport. However, artesian conditions predominate. Figure 9 illustrates the occurrence of both artesian and water-table conditions in the Lockport. The wells shown in the diagram are cased through the clay and silt, but are open holes in the bedrock. A packer is installed in each well which tapped water at two or more distinct levels. The packers make possible the measurement of two distinct water levels in each well; a water level above the packer reflecting conditions in the upper part of the rock and a water level below the packer reflecting conditions in the lower part of the rock.

In the upper part of the rock, either artesian or water-table conditions may exist locally. The clay and silt overlying the Lockport are less permeable than the rock and thus act as a confining bed. Artesian conditions exist where the water in the Lockport has sufficient head to rise above the bottom of the overlying clay and silt. In contrast, unconfined (or water-table) conditions exist where the water level occurs within the fractured upper part of the rock, as at well 309-901-5 in figure 9. Locally a "washed till" or dirty gravel zone occurs just above the top of rock. In these localities good connection probably exists between the bedrock and the overlying till or gravel, and the upper part of the rock and washed till zone together form a continuous semi-confined aquifer.

In the lower part of the rock, artesian conditions occur exclusively. The seven water-bearing zones in the Lockport are surrounded by essentially impermeable rock and therefore act as separate and distinct artesian aquifers. The hydraulic nature of the water-bearing zones was observed during the drilling of observation wells in the vicinity of the Niagara Power Project. These wells, whose locations are shown in plate 1, were drilled to observe the effects of the reservoir on ground-water levels in the area. The piezometric level for each successively lower water-bearing zone is lower than for the zone just above it in most of the wells. The reasons for this will be discussed in the section entitled "Ground-Water Movement and Discharge." During construction, the water level in the wells progressively declined in a steplike sequence as the wells were drilled deeper--that is, when a well had been drilled through the uppermost water-bearing zone, the water level in the well remained approximately at a constant level until the next lower zone was penetrated, at which time the water level abruptly declined to the piezometric level of the next lower zone. The difference between the piezometric levels of any two water-bearing zones is large, and in some places is comparable to the distance between zones. If no packer is installed in a well tapping two water-bearing zones, the upper zone will continue to drain into the well indefinitely. This condition exists in a few of the power project observation wells. In these wells the sides of the well remain wet from the level of the upper zone down to the water level in the well. The nature of the water-bearing zones as described above substantiates the reports by drillers and others of "finding water and losing it" in a well, or of wells with "water running in the top and out the bottom." These phenomena occur in some wells tapping two or more water-bearing zones in the Lockport Dolomite.

A well drilled into the Lockport may penetrate several water-bearing zones, but only one of the zones may be hydraulically effective at the site of the well. This is the case for wells 309-901-1, 3, and 5 shown in figure 9. These wells are open below the packers to zones 1, 2, and 3. However, because the water levels observed below the packers in these three wells apparently represents the piezometric surface of zone 3, zones 1 and 2 are not believed to contain effective openings at the sites of the wells. A well also may be drilled through the section occupied by several zones and not be open to any of them. For example, well 309-901-7 shown in figure 9, is apparently open only to the weathered zone at the top of rock.

Yield and specific capacity of wells

The yield of a well in the Lockport Dolomite depends mainly upon which water-bearing zone or zones are penetrated and the degree to which the bedding joints comprising the zones are open to the well. Near the top of rock, the number of open vertical joints and gypsum cavities penetrated may also be important. The average yield of 56 wells tapping the upper and middle parts of the Lockport (which includes water-bearing zones 4 through 7) is 31 gpm (gallons per minute). In contrast, 15 wells penetrating only the lower 40 feet of the Lockport (which includes water-bearing zones 1, 2, and 3) have an average yield of 7 gpm. The yields of individual wells range from less than 1 gpm to 110 gpm. (These figures do not include a few exceptionally high yield wells which obtain water by induced infiltration from the Niagara River and which are discussed in a following paragraph.) Wells tapping the same water-bearing zone may have different yields. For example, wells 309-901-3 and 309-901-5, which are 500 feet apart and tap water-bearing zones 1 through 4 (fig. 9) yielded 7 gpm and 39 gpm, respectively, before the packers were installed. The bedding joints comprising the water-bearing zones are thus more open at well -5 than at well -3.

Increases in yield during drilling in the Lockport Dolomite occur abruptly rather than gradually. As drilling proceeds through the rock, relatively little increase in the yield of a well will be observed until a water-bearing zone is tapped. At that time a marked increase in yield usually occurs. For example, during the drilling of well 308-901-7, the bailing rate abruptly increased from 12 to 50 gpm when water-bearing zone 5 was tapped. During the drilling of well 308-900-21, three distinct increases in yield were observed. The yield, which was 3 gpm at 17 feet (water-bearing zone 7), increased to 9 gpm at 22 feet (an open vertical? joint or solution cavity?) and abruptly increased to 30 gpm at 34 feet (water-bearing zone 6).

Wells in an area about a half mile wide adjacent to the Niagara River above the falls have substantially higher yields than wells elsewhere in the area. The higher yields in this area are caused by two conditions: (1) the Lockport Dolomite is thickest in the area, and (2) more importantly, conditions are favorable for the infiltration of water from the Niagara River. The greater thickness of the Lockport provides the maximum number of water-bearing zones to supply water to the wells. The Niagara River provides an unlimited source of recharge to the water-bearing zones.

Evidence that a substantial part of the water pumped is supplied by induced infiltration from the Niagara River is indicated by the high yields, which exceed 2,000 gpm at some wells, and the chemical character of the water. The chemical composition of the water in well 304-901-6 (which has been pumped at 2,100 gpm) is more similar to Niagara River water than "typical" ground water in the Lockport. (See the following discussion of the chemical character of water and figure 11.) Similar infiltration of Niagara River water into the bedrock at Tonawanda, N. Y., a few miles south of Niagara Falls, was described by Reck and Simmons (1952, p. 19-20).

Infiltration from the river can occur where pumping has lowered ground-water levels below river level to such an extent that a hydraulic gradient is created between the river and the wells. The amount of the infiltration depends on the gradient and the nature of the hydraulic connection between the river and Lockport. The hydraulic connection is controlled by the character of the river bottom. Throughout most of its length in the Niagara Falls area the bottom of the river is covered by a layer of unconsolidated deposits including both till and clay and silt. This layer was found to be from 10 to 20 feet thick in the vicinity of the Niagara Falls water-system intake. (See logs 304-900-i and -j in figure 19.) In the section of the river occupied by rapids, extending a half mile or more above the falls, the bottom has been scoured clean by the river. Where the layer of unconsolidated deposits is present its low permeability greatly retards infiltration. Where the layer is thin or absent infiltration can readily occur.

One of the most striking features in plate 2 is that all wells yielding more than 1,000 gpm are located in a narrow band that intercepts the river about two miles east of the falls. This band trends in a northeasterly direction roughly parallel to one of the two major directions of vertical jointing. Thus, the very high yields may be caused by a greater abundance of vertical joints within the band of high-yielding wells. Vertical joints provide avenues through which water could readily move from the river downward to the bedding joints comprising the water-bearing zones in the Lockport Dolomite.

Wells in the Lockport Dolomite are almost always adequate for domestic needs of a few gallons per minute. Supplies of 50 to 100 gpm, which are adequate for commercial uses and small public supplies, can be obtained in much of the area underlain by the upper part of the Lockport (pl. 2). Large supplies (over 1,000 gpm), as previously noted, are available only in a small area adjacent to the Niagara River.

Wells inadequate for domestic needs are occasionally reported. All wells that are perennially inadequate are located near the Niagara escarpment and therefore tap only the lowest and least permeable water-bearing zones (1, 2, and 3) in the Lockport. Throughout the area a few shallow wells that derive nearly all their water from a single water-bearing zone become inadequate during the summer and autumn of some dry years. Such is the case with well 308-853-1. This well is 27 feet deep and reportedly obtained over 50 gpm from a water-bearing zone 17 feet below land surface. During the drought in 1960, this zone was dewatered as the water table declined in the fall of the year, and the yield of the well quickly declined to less than 1 gpm. The inadequacy of some wells in the Lockport Dolomite can normally be overcome by deepening the well until it penetrates one or more lower water-bearing zones.

Information on the specific capacity of a well is more meaningful than a simple statement of yield. The specific capacity is the yield per unit drawdown, generally expressed as gallons per minute per foot of drawdown. For example, well 307-903-1 was pumped at 20 gpm with 54 feet of drawdown which indicates a specific capacity of 0.37 gpm per foot. The yield and the drawdown for a number of wells in the Lockport are shown in plates 2 and 3. These data must be used with care as they apply only so long as no part of the formation is dewatered.

As water-bearing zones in the Lockport are dewatered, the specific capacity declines. The decline in specific capacity caused by dewatering a water-bearing zone is shown by the data obtained during a pumping test on well 309-859-1. This well was pumped at 2.2 gpm with 5.0 feet of drawdown for 70 minutes--specific capacity of 0.44 gpm per foot. After 70 minutes, water-bearing zone 3 was partially dewatered and a drawdown of 8.2 feet was required to maintain the pumping rate of 2.2 gpm. This indicates a specific capacity of 0.27 gpm per foot. At the time the well was drilled, it was bailed at 3 gpm with a drawdown of about 60 feet. Thus, during the bailing the entire 42 feet of Lockport penetrated by the well was dewatered. The specific capacity of the well with the Lockport dewatered is 0.07 gpm per foot (3 gpm with 42 feet of drawdown) compared to 0.44 gpm per foot with no dewatering.

water from the Queenston are usually found in two areas--(1) in a band about two miles wide immediately north of the Niagara escarpment, and (2) in areas immediately adjacent to streams. Both these areas are believed to be places of ground-water discharge--that is, areas where ground water is moving upward from the Queenston to discharge naturally.

The origin of the salty water in the Queenston is unknown. In commenting on a similar occurrence of salty water in the bedrock in northern St. Lawrence County, N. Y., Trainer and Salvas (1962, p. 103) suggest three causes for the salty water in that area: (1) connate water, (2) the Champlain Sea, and (3) evaporite deposits. They conclude that the Champlain Sea, which covered the area about 10 or 20 thousand years ago, is the most likely source. This source is not applicable to the Niagara area, however, because the Champlain Sea did not extend into the area. Furthermore, it is unlikely that the salty water in the Niagara area is derived from evaporite beds because no such deposits are known to exist in the Queenston. Nor do any salt beds occur in the bedrock formations overlying the Queenston Shale (fig. 5) in the Niagara Falls area. The nearest salt beds occur about 40 miles to the southeast in the Salina Group which overlies the Lockport Dolomite. However, it is very improbable that salty water from the Salina beds has entered the Queenston Shale because (1) the salt beds themselves act as impermeable barriers to water moving downward from the Salina to the Queenston, and (2) it is more likely that salty water from the Salina would be discharged at points between the outcrop areas of the two formations.

Although direct evidence is lacking, the writer believes that the salty water in the Queenston Shale is most likely derived from connate water. The discharge of connate water begins as soon as a deeply buried bed is brought up into the zone of circulating ground water. The Queenston rocks were deposited as a sea-bottom clay about 350 million years ago, and have been deeply buried throughout most of the intervening time. During some thousands of years of Recent geologic time, connate water has been flushed from the upper several hundred feet of the Queenston. However, it is probable that flushing of the deeper part of the formation is continuing at present.

OCCURRENCE OF WATER IN UNCONSOLIDATED DEPOSITS

The unconsolidated deposits in the Niagara Falls area are not important sources of water. These deposits may be classified into two types based on their water-bearing properties: (1) coarse-grained materials of high permeability (sand and gravel), and (2) fine-grained materials of very low permeability (glacial till and lake deposits). The unconsolidated deposits in the Niagara Falls area are predominantly of the fine-grained type. However, the lack of sand and gravel deposits in the Niagara Falls area, other than a few deposits of very limited thickness and extent, has severely limited the development of large ground-water supplies in the area. Most large ground-water supplies in New York State are derived from sand and gravel deposits.

Table 2 shows selected chemical constituents from wells tapping unconsolidated deposits. Water from the different types of unconsolidated deposits is not easy to differentiate on the basis of quality because many wells tap more than one type of deposit. Thus, water samples from such wells are mixtures of water from two or more deposits. In general, water from the unconsolidated deposits is very hard, but not so highly mineralized as water from the bedrock. A complete analysis of water from well 312-859-1, which taps both till and lake deposits, is listed in table 9. This is a calcium bicarbonate water, very hard (568 ppm of total hardness) containing a moderately high chloride content (105 ppm). Water from the unconsolidated deposits generally has a wide range in chloride content. Those wells which yield water with a high chloride content are probably affected either by (1) local pollution, or by (2) upward discharge of saline water from the underlying bedrock.

SAND AND GRAVEL

Sand and gravel is found in small isolated hills and in a narrow "beach ridge" which crosses the area along an east-west line (pl. 3). The sand and gravel deposits are of limited areal extent, generally thin, and occur as topographic highs. The deposits commonly consist of two lithologic types: (1) fine-grained reddish-brown sand, and (2) coarse sand and pebbles with a matrix of fine to medium sand. The origin of both the beach ridge and small hills of sand and gravel is associated with glaciation in the Niagara Falls area. The small hills are kames, i.e. hills of sand and gravel formed originally against an ice front by deposition from sediment-laden melt-water streams. The long, narrow beach ridge is believed to represent a former shore line of glacial Lake Iroquois. This large lake, the predecessor of the present Lake Ontario, existed in the Niagara Falls area near the end of the Ice Age. The sand and gravel composing the beach ridge apparently was produced from pre-existing material by wave action at the shore which winnowed out most of the silt and clay originally contained in the glacial deposit.

Although the sand and gravel deposits in the Niagara Falls area are much more permeable than the other unconsolidated deposits or the bedrock, their occurrence as small topographic highs permits them to drain rapidly. As a result, ground water generally occurs only within a thin zone at the base of the sand and gravel. This is shown in the cross section of the beach ridge in figure 12. It can be seen that the water table is only a few feet above the base of the sand and gravel. Extensive pumping of any of the wells shown would quickly dewater the sand and gravel. In general, wells in the beach ridge and kames will yield only the small amounts of water required for domestic and small-farm needs.

Moderate supplies of ground water can be obtained from a sand and gravel deposit (probably a kame) just east of Lockport, N. Y. (pl. 3). This is the largest sand and gravel deposit in the area, measuring 1 1/2 by 3/4 miles in size. The thickness of the deposit is highly variable because of the hummocky nature of the land surface, but probably averages 60-70 feet. Some notion of the ability of this deposit to yield water is shown by the yield of 165 gpm pumped from a sand pit during excavation. One large-diameter supply well has been constructed in this deposit. This well (311-838-3) was reportedly pumped at a rate of 200 gpm for 24 hours in 1956.

separating Lake Erie from Lake Ontario. The winds are thus less moisture-laden than if they had passed over the lakes. Even those winds which may be moisture-laden (from evaporated lake water) may retain most of their moisture until they reach the more hilly areas east of Lake Ontario. The Niagara escarpment appears to have a local effect on the amount of precipitation also. As can be seen from the precipitation data given in table 5, Lewiston (elevation 320 feet), which is located below the escarpment, receives less precipitation than Lockport (elevation 520 feet), which is at the escarpment. Table 5 also shows that precipitation is fairly evenly distributed throughout the year. Within a given year, however, large variations from the average figures listed may occur. Note that the minimum monthly precipitation for each month during the 25-year period is between 1/2 and 1/20 the average precipitation for that month. However, the minimum annual precipitation (1941) is more than 1/2 the average annual precipitation. Average annual temperature is 48°F at Lewiston. The length of the growing season averages 160 days.

GROUND WATER

A part of the rain and snow falling on the Niagara Falls area seeps into the ground and continues downward to the water table to become ground water. The ground water is in constant, but generally very slow, movement from points of recharge to points of discharge. Ultimately all ground water in the area is discharged into Lake Ontario or the Niagara River either directly or via small tributary streams. The Niagara Falls area is, in effect, a peninsula-shaped catchment area in which the ground-water reservoir is being repeatedly replenished by precipitation, and constantly discharging to the surrounding surface-water bodies. This section of the report describes: (1) recharge to the unconsolidated deposits and the bedrock, (2) movement and discharge of ground water in the area, and (3) changes in storage in the ground-water reservoir as shown by water-level fluctuations.

RECHARGE

The source of nearly all the ground-water recharge in the Niagara Falls area is precipitation; however, a small amount of recharge also occurs in the area beneath and immediately adjacent to the Niagara Power Project reservoir by infiltration from the reservoir. Recharge of ground water means simply the addition of water (or quantity added) to the zone of saturation (Meinzer, 1923, p. 46). The rate and amount of recharge depends mainly upon the permeability of the soil, the amount of precipitation, and the soil-moisture condition at the time of precipitation. The rate of infiltration of water into the soil increases with increase of permeability. In the relatively small part of the Niagara Falls area underlain by sand and gravel, infiltration rates are greatest. However, throughout most of the area underlain by glacial till and lake clays and silts infiltration rates are low and surface runoff is high.

Table 5.--Monthly precipitation at Lewiston and Lockport, N. Y., 1936-60 (Data from reports of U.S. Weather Bureau)

Month	Lewiston (1 mile north of; elevation 320 feet)		Lockport (2 miles northeast of; elevation 520 feet)	
	Average (inches)	Minimum (inches)	Average (inches)	Minimum (inches)
January	1.98	0.59 (1946)	2.38	0.67 (1946)
February	2.35	.54 (1947)	2.52	.85 (1947)
March	2.49	.63 (1958)	2.56	.71 (1958)
April	2.66	.83 (1946)	2.80	.91 (1946)
May	3.08	.71 (1941)	3.26	.94 (1936)
June	2.18	.66 (1953)	2.41	.33 (1953)
July	2.44	1.15 (1955)	2.70	.90 (1954)
August	2.57	.21 (1948)	2.97	.36 (1948)
September	2.97	.46 (1941)	2.92	.14 (1941)
October	2.55	.47 (1947)	2.85	.60 (1938)
November	2.33	.75 (1939)	2.62	.64 (1939)
December	2.02	.39 (1958)	2.39	.71 (1943)
Annual	29.62	17.64 (1941)	32.38	19.75 (1941)

The mechanism of recharge to the Lockport Dolomite is of primary concern in this report because this bedrock unit is by far the most important aquifer in the Niagara Falls area. As discussed previously, most ground water occurs in the Lockport within seven relatively permeable zones parallel to bedding which are separated by essentially impermeable rock. Recharge to these water-bearing zones occurs by one of two mechanisms: (1) downward movement of water through vertical joints or (2) recharge directly to the water-bearing zones at the outcrop of the bedding joints composing the zones.

Several lines of evidence suggest that recharge to the Lockport Dolomite occurs predominantly at the outcrop of the water-bearing zones. The lack of persistent open vertical joints in the Lockport as observed in the conduit excavations, suggests that vertical joints are not important avenues for downward movement of water. However, this is not conclusive evidence in itself because on an areal basis, many vertical joints, although apparently tight, might be able to transmit appreciable quantities of water when considered as a whole even though each joint singly might transmit a very small quantity of water. More conclusive evidence of a negligible movement of water along vertical joints is the occurrence of "dry" open bedding joints below the "wet" bedding joints comprising the water-bearing zones in the Lockport (fig. 8). This phenomenon could not occur if permeable vertical joints connected the "dry" and "wet" bedding joints. It seems probable that the "dry" bedding joints exist because they receive little or no recharge in their outcrop area. This lack of recharge would be particularly applicable to those bedding joints cropping out along the Niagara escarpment where there is very little opportunity for recharge.

The most important indication that recharge to the water-bearing zones of the Lockport Dolomite occurs at the outcrop of the zones, is the alignment of water levels approximately parallel to the dip of the zones themselves. This alignment of water level is shown for water-bearing zone 3 in figure 9.

The wells shown in the cross section are adjacent to the reservoir of the Niagara Power Project; however, the water levels shown were measured prior to flooding of the reservoir. If recharge to the water-bearing zones did occur throughout the area by downward movement through vertical joints, the gradient along the zones would steepen in the downdip direction rather than continue roughly parallel to the dip of the zones--that is, if it is assumed that there is no increase in transmissibility downdip. This steepening of the hydraulic gradient would be required in order to transmit the ever-increasing amounts of water supplied to the zone by the vertical joints. No such steepening of the gradient was observed.

In summary, it appears that recharge occurs principally at the outcrop of the water-bearing zones in the Lockport Dolomite and that water then moves down the dip of the zone with a relatively constant loss of head. Recharge is probably not limited to the actual line of outcrop of a zone, however, but occurs throughout the area where the zone is reached by the enlarged vertical joints that occur in the upper few feet of the rock.

Little is known about the recharge to the other bedrock formations underlying the Niagara Falls area. It is probable that a very small amount of water moves downward from the Lockport Dolomite into the Rochester Shale and the underlying bedrock units. As was pointed out in the preceding discussion, however, vertical openings even in the Lockport Dolomite appear to transmit relatively little water except in the upper few feet of the rock. Therefore, movement of water from the Lockport into the underlying formations probably occurs only along widely spaced major vertical joints. Some of the water in the deeper bedrock units in the Niagara Falls area may also be derived from recharge to these beds in the area to the south. Such water would move through the Niagara area toward the Niagara gorge and Lake Ontario, both of which are regional discharge areas.

GROUND-WATER MOVEMENT AND DISCHARGE

Ground water moves from points of high head to points of low head (or potential), in other words from points where the water table or piezometric surfaces are highest to points where they are lowest. The direction of ground-water movement in the upper few feet of bedrock and in the unconsoli- dated deposits (where water-table conditions exist) is shown by the configu- ration of the water table. The direction of movement in the remainder of the bedrock is shown by the configuration of the piezometric surfaces associ- ated with each of the artesian water-bearing zones in the different bedrock formations.

As discussed previously, each of the seven water-bearing zones in the Lockport is a distinct artesian aquifer with an associated piezometric surface. To show in detail the ground-water movement in the Niagara Falls area, it would be necessary to construct a water-table map, and piezometric maps for each of the water-bearing zones. Such maps are not included in this report because water levels could be measured in relatively few wells and because of the difficulty of differentiating between water levels which represent the water table and water levels which represent the piezometric surfaces associated with each of the several water-bearing zones. In a few wells constructed with packers, such as shown in figure 9, it was possible to measure separate water levels associated with the water table and with distinct water-bearing zones. In wells not equipped with packers, which includes all domestic and industrial wells in the area, a measured water level is an average of the heads of the different water-bearing openings penetrated by the well. Such an average water level represents neither the water table nor the piezometric surface of a single water-bearing zone.

Nearly all water-level data that could be used in determining direction of ground-water movement were obtained from wells in the vicinity of the pumped-storage reservoir. These data show that in general the configuration of the water table follows the surface of the land, being highest under hills and in interstream tracts and lowest in stream valleys. The configuration of the piezometric surfaces associated with each water-bearing zone in the Lock- port has little relationship to the land surface. The piezometric surfaces are approximately parallel to the slope of the water-bearing zones. The disparity in the configuration of the water table and the piezometric sur- faces is shown in figure 9, which was previously referred to in the discussion of artesian and water-table conditions in the Lockport. As shown in the figure, the water table slopes from all directions toward Fish Creek, whereas the piezometric surface for water-bearing zone 3 slopes to the south away from the creek. Thus, ground-water movement in the upper fractured part of rock and in the overlying unconsolidated deposits is toward the creek, but movement along water-bearing zone 3 and, presumable in the other water- bearing zones, is to the south toward the upper Niagara River.

Figure 14 shows the inferred direction of ground-water movement in the upper water-bearing zones of the Lockport Dolomite. This figure is based on adequate data only in the vicinity of the reservoir. Because only a few scattered water-level observations are available for the area south of the reservoir, the flow lines in that area are based largely on the fundamental principles governing ground-water movement.

It may be observed in figure 14 that ground water in the Lockport Dolomite moves north toward the Niagara escarpment in a narrow area parallel to the escarpment. This northerly direction of ground-water movement is shown by (1) the location of springs near the base of the Lockport along the escarpment (pl. 1), and (2) the decline of water levels in wells in the direction of the escarpment. A divide in the water table and in the upper fractured part of the rock apparently exists at a distance of 1,000 to 2,000 feet south of the escarpment. The existence of this divide is shown by the reversal of hydraulic gradient in the area. The gradient is toward the escarpment in the area less than 1,000 feet south of the escarpment. However, a hydraulic gradient to the southeast (approximately parallel to the dip of the beds in the Lockport) was observed in wells located over 2,500 feet south of the escarpment.

Prior to the start of the investigation it was assumed that water in the Lockport Dolomite in the western part of the Niagara Falls area moved west to the gorge to discharge. It was observed very early in the study, however, that there was practically no evidence of seepage on the sides of the gorge. The lack of seepage could be explained by (1) assuming that the water moving toward the gorge was intercepted by enlarged vertical joints parallel to the gorge, or (2) assuming that there was little or no movement of water toward the gorge.

Because the city of Niagara Falls and the area along the gorge north of the city is supplied by the Niagara Falls municipal water system, very few wells suitable for water-level observations were found in the area. The only wells readily accessible for water-level measurements were in the vicinity of the power station and canal. The data from these wells indicate that water moves toward the gorge. The width of the area supplying water to the gorge, however, could not be determined. Indirect information relative to this problem was derived from the water-level measurements in the vicinity of the reservoir. It was found that if the slope of the piezometric surface for a specific water-bearing zone (for example, zone 3 in figure 9) was extended to the south, the pressure reached the level of the upper Niagara River a short distance south of the reservoir. This does not prove but certainly strongly suggests that under natural (pre-power project) conditions the water in the Lockport Dolomite turned west to discharge into the Niagara River gorge, roughly midway between the escarpment and the upper Niagara River (fig. 14). The absence of seepage on the sides of the gorge, therefore, is believed to be attributable to enlarged vertical joints parallel to the gorge.

Ground-water movement as it probably existed in 1962 may be summarized as follows: (1) water moves northward in a narrow area parallel to the Niagara escarpment, (2) water moves southward (downdip) in the area around the reservoir (which acts as a recharge mound and tends to deflect the water moving from the north), (3) water moves into the canal, conduits, and area of industrial pumping to discharge, and (4) water moves toward the gorge in the southwestern part of the area.

On the lake plain, north of the Niagara escarpment, ground water moves in a generally northward direction toward Lake Ontario. The water table is located within the lake deposits about 3 to 10 feet below the surface. The water table very nearly parallels the land surface and slopes regionally toward Lake Ontario with a gradient of 5 to 20 feet per mile. It also slopes toward the streams crossing the lake plain in a narrow area adjoining each stream. The direction of ground-water movement in the Lockport Dolomite in the eastern part of the Niagara Falls area is not known.

WATER-LEVEL FLUCTUATIONS

Fluctuations of ground-water levels reflect changes in the amount of water stored in an aquifer. A decline in water level shows a decrease in storage in the aquifer, and means simply that discharge from the aquifer is exceeding recharge. A rise in water level indicates the reverse situation--recharge is greater than discharge. In wells tapping unconfined aquifers, water-level fluctuations show changes in the position of the water table. In wells tapping artesian aquifers, water-level fluctuations show changes in artesian pressure.

Natural fluctuations

Water-level fluctuations of natural origin can be broadly classified as either short- or long-term fluctuations. The short-term fluctuations are produced mainly by changes in atmospheric pressure, ocean tides, and earth tides. Fluctuations due to atmospheric pressure and earth tides occur in the Niagara Falls area but are of relatively little importance in the description of the ground water. Such short-term fluctuations are observed only in wells tapping artesian aquifers. Long-term fluctuations are largely a product of climate, particularly precipitation and temperature. The long-term fluctuations in water levels show changes in the natural rate of recharge to an aquifer compared to its rate of discharge to springs and stream beds.

The most noticeable fluctuation of ground-water levels in the Niagara Falls area are seasonal fluctuations. In general, water levels in the area reach their peak during the spring of the year (March and April) because of the large amount of recharge provided by snow melt and precipitation. Water levels generally decline throughout the summer because most of the precipitation is lost by evaporation and the transpiration of plants. Such water loss is characteristic of the summer growing season. During other seasons substantial amounts of water pass through the soil zone and continue downward to the water table. Water levels generally reach their yearly lows near the end of the growing season during September or October. Thereafter water levels begin to rise and this rise is more or less continuous through March or April. Because the amount of precipitation is normally evenly spaced throughout the year in the Niagara Falls area (table 4), seasonal fluctuations are more a product of air temperature than of precipitation. The air temperature controls whether precipitation falls as snow or rain, whether the ground is frozen at the time of precipitation, and the length of the growing season; all of these are factors that affect water levels.

REFERENCE NO. 7

NIAGARA COUNTY
HEALTH DEPARTMENT
HUMAN RESOURCES BUILDING
MAIN POST OFFICE BOX 428
10th AND EAST FALLS STREET
NIAGARA FALLS, NEW YORK 14302

October 8, 1987

Mr. Dennis Sutton
Ecology & Environment, Inc.
195 Sugg Road
P.O. Box D
Buffalo, New York 14225

Dear Dennis:

Attached are the signed interview forms you request. Please note that I added several comments as footnotes for clarification.

Contact me with any questions at 284-3126.

Sincerely,

Michael Hopkins
Assistant Public
Health Engineer

MH:lj

Attach.

Footnotes:

1) The Erie Barge Canal is intermittent in the Lockport area. This section is dewatered during the winter months.

2) The drinking water supply is over 10 miles away.

3) We believe that 4 families use groundwater for drinking at Witmer and Pennsylvania Avenue. These homes may be connected to public water in the future. A line is now available for hook up.

4) It is noted that the wells referred to in #3 are seperated from the Frontier Bronze site by the PASNY Conduits which should be a total sink and barrier to groundwater flow.

5) The irrigation well referred to is used only casually and occasionally to water fruit trees.

6) We are unaware of a fire official certifying any site in Niagara County to be a fire or explosion hazard. We do not feel that any of the sites listed constitues a fire threat.

7) I assume that the location drawings provided are only approxiamte site locations. Most overestimate the site area.

ecology and environment, inc.

195 SUGG ROAD, P.O. BOX D, BUFFALO, NEW YORK 14225, TEL. 716-632-4491, TELEX 91-9183

International Specialists in the Environment

October 2, 1987

Mr. Michael Hopkins
Niagara County Department
of Health
10th and East Falls Street
Niagara Falls, New York 14302

Dear Mr. Hopkins:

On several occasions during the course of the Phase 1 investigations, E & E has contacted the Niagara County Department of Health to obtain information in regard to various characteristics of the sites under investigation. The DEC requires that all information contained in Phase 1 reports be fully documented. We ask you to review the information your department has provided, as presented in this letter, and sign this document to acknowledge that you have provided this information and that it (with any corrections or qualifications) is correct to the best of your knowledge.

Ross Steel

1) No hazardous waste is expected to be on site.
2) Groundwater is not used for irrigation within a 3-mile radius of the site.
3) Surface water within 3 miles of this site is used for commercial, industrial, and recreational purposes.
4) The drinking water intakes are upstream of site.

Dussault Foundry

1) There is no use of groundwater within 3 miles of site.
2) The surface water within 3 miles downstream of site is used for recreation (Erie Canal). *1

Town of Lockport Landfill

1) There is no use of groundwater within 3 miles of site.
2) The Erie Canal (surface water) is used for recreation near this site. *1
3) The drinking water intakes are located in the Niagara River located upstream of this site. *2

SKW Landfill

1) The drinking water surface intakes are located upstream of this site.
2) Groundwater is used within a 3 mile radius of this site for drinking water. *3
3) The surface water downstream (Niagara River) is used for recreation (Maid of Mist, fishing).

Diamond Shamrock

1) There is no groundwater used within a 3 mile radius of this site.

Roblin Street

1) There is no use of groundwater within a 3 mile radius of this site, drinking or irrigation.

Electro Minerals U. S. (formerly Carborundum Bldg. 82)

1) The water supply intakes are located upstream of this site.

Frontier Bronze

1) There is no suspected hazardous waste disposal present at this site.
2) Groundwater for drinking purposes is used by a neighborhood approximately 2.5 miles to the NW, at the intersection of Pennsylvania and Witmer Road. Two families, roughly 8 people, use groundwater for drinking purposes. *4

Walmore Road

1) The well on site is used for irrigation. *5
2) Approximately 1 acre of area is irrigated by this groundwater well.
3) There is no use of surface water 3 miles downstream of this site.

New York Power Authority Road Site

1) Hazardous waste is not suspected to be disposed of on site.
2) There is no land irrigated with groundwater within 3 miles of site.

I would also like you to confirm the fact that no fire official has declared any of the following sites a fire or explosion hazard: *6

- SKW Alloys Landfill - Witmer Road, Town of Niagara.
- Dussault Foundry - Washburn Street, Lockport.
- Frontier Bronze - New Road, City of Niagara Falls.
- Staufer Chemical, North Love Canal - Town of Lewiston.

- o Electro Minerals, U.S., Inc., (formerly Carobrundum Bldg. #82), Buffalo Avenue, City of Niagara Falls.
- o Ross Steel Co. - Pine Avenue, Niagara Falls (now the site of the New York Power Authority water intake conduit right-of-way).
- o Roblin Steel Company - Oliver Street, North Tonawanda.
- o LaSalle Expressway - specifically near Love Canal.
- o Diamond Shamrock, now Occidental Petroleum Corp., Ohio Street, Lockport, New York.
- o Town of Lockport Landfill - East Canal Street, Lockport, New York.
- o Power Authority Road Site - New Road, Lewiston, New York (across from Hyde Park Landfill).
- o 64 Street South (owned by Russo Chevrolet) - 64th and Niagara Falls Blvd., Niagara Falls.
- o Walmore Road, 6373 Walmore Road, Town of Wheatfield, New York.

I certify that I provided the above information to Ecology and Environment, Inc., and It is correct to the best of my knowledge.
Subject to foot notes & comments provided

Michael E. Hopkins (signature) — 10/7/87
Signature — Date

Please find maps enclosed to assist you in locating these sites. If you have any questions regarding the above, please contact me at 633-9881.

Thank you very much for your time and assistance in our ongoing investigations.

Sincerely,

Dennis Sutton

oio

REFERENCE NO. 8

The National Register of Historic Places

1976

Irene Lewishon to carry forward their work in drama and dance with local children. *Multiple public/private:* NHL.

NIAGARA COUNTY

Lewiston. **FRONTIER HOUSE,** 460 Center St., 1824–1826. Stone, 3 1/2 stories, rectangular; gabled roof with stepped gables, paired chimneys, and balustrade; off-center and center entrances, full-width front porch with hipped roof, regular fenestration, oval windows in gables; N kitchen wings. Federal elements. Built as a tavern for Joshua Fairbanks and Benjamin and Samuel Barton, local prominent businessmen. *Private.*

Lewiston. **LEWISTON MOUND,** Lewiston State Park, Hopewellian affinities (c. 160). Oval burial mound. Partially investigated. *County.*

Lewiston vicinity. **LEWISTON PORTAGE LANDING SITE,** Prehistoric–19th C.. Gently sloping ravine leading from river remains of path used by travelers to avoid Niagara Falls. Archeological explorations yielded artifacts from Indian to British occupation, indicating this was a heavily used access point to a vital overland route. *State.*

Lockport. **LOWERTOWN HISTORIC DISTRICT,** Roughly bounded by Erie Canal and New York Central RR., 19th–20th C.. Primarily residential district, with some religious and commercial buildings and warehouses; facing the canal are 2 1/2-story brick and stone residences with Greek Revival and Italianate elements built in the 1830's; off the canal are 1-2-story frame structures with additions and modern siding built mid-19th C. and some stone structures: notable are the Gothic Revival former Christ Episcopal Church (1854) and the Italianate Vine Street School (1864). Systematic development of the village began after canal opened; district was Lockport's social, commercial, and industrial center, 1830's–1860's. *Multiple public/private:* HABS.

Lockport. **MOORE, BENJAMIN C., MILL (LOCKPORT CITY HALL; HOLLY WATER WORKS)** , Pine St. on the Erie Canal, 1864. Coursed rubble, 2 1/2 stories over basement on sloping site, trapezoidal shape, hipped roof sections with cross gables, interior chimney; front center entrance with transom and pediment on pilasters, triple round arched windows in gables, rock-faced stone lintels and sills, ashlar quoins; interior altered; rear 2-story addition 1893. Built as a flour mill, converted c. 1885 to a water pumping plant; adapted as city hall 1893; one of few survivors of 25 industrial buildings once clustered along this section of Erie Canal. *Municipal.*

Niagara Falls. **DEVEAUX SCHOOL COMPLEX,** 2900 Lewiston Rd., 1855–1888. Educational complex; contains 3 connected structures–Van Rensselaer Hall (1855–1857), Patterson Hall (1866), and Munro Hall (1888); and outbuildings–barn, shed, and gymnasium. Gothic Revival elements. Founded by Judge Samuel DeVeaux as an Episcopal school for poor and orphaned boys; later became a prominent preparatory school; closed, 1971. *Private.*

Niagara Falls. **NIAGARA FALLS PUBLIC LIBRARY,** 1022 Main St., 1902–1904, E. E. Joralemon, architect. Stone, yellow brick; 1 story, rectangular with semielliptical rear bow, flat roof with parapet, slightly projecting center entrance bay with pedimented double doorway, pedimented windows, string courses; fine interior detail intact. Neo-Classical Revival elements. One of many public libraries endowed by Andrew Carnegie. *Public.*

Niagara Falls. **NIAGARA RESERVATION,** 1885. Includes the falls, Goat Island and other islets, paths, and an observation tower. In establishing a reservation of over 400 acres, New York became the first state to use eminent domain powers to acquire land for aesthetic purposes. *State:* NHL.

Niagara Falls. **SHREDDED WHEAT OFFICE BUILDING,** 430 Buffalo Ave., 1900. Steel frame, brick; 5 stories, rectangular, flat roof, center entrance, 5 paired window bays, segmental arched basement windows, wide parapet; interior featured 4th-floor auditorium and 5th-floor cafeteria; doubled glazed windows. Commercial style. Administrative office building of original Shredded Wheat factory complex, developed by Henry D. Perky. *Private.*

Niagara Falls. **U.S. CUSTOMHOUSE,** 2245 Whirlpool St., 1863. Stone, 2 1/2 stories, square, hipped roof, arched window and door openings on W facade; built into railroad embankment, S side opens onto railroad tracks; renovated, 1928. Continues to serve as customs office for trains from Canada. *Private:* HABS.

Niagara Falls. **WHITNEY MANSION,** 335 Buffalo Ave., 1849–1851. Limestone, 2 1/2 stories, L-shaped, intersecting gabled roof sections; original section has off-center entrance with full-width Ionic portico; 19th C. side addition has front bay window and gabled dormer with 3 round arched windows. Greek Revival. Built according to 1830's design by Solon Whitney, son of Gen. Parkhurst Whitney, village founder and prominent hotel and tavern owner. *Private.*

Youngstown vicinity. **OLD FORT NIAGARA,** N of Youngstown on NY 18, 1678. Complex of stone buildings bounded by stone walls, earthworks, and a moat; restored. Original fort built in 1678; altered 1725–1726 and 1750–1759. Held alternately by French, British, and Americans in struggle for control of continent; strategically located in commanding the Great Lakes from Lake Erie to Ontario and in covering approaches to western NY. *State:* NHL.

ONEIDA COUNTY

Boonville. **ERWIN LIBRARY AND PRATT HOUSE,** 104 and 106 Schuyler St., 1890, C. L. Vivian (Erwin Library); 1875, J. B. Lathrop (Pratt House). Erwin Library: limestone, 1 story, gabled and hipped roofs; square tower with pyramidal roof contains recessed arched entrance. Romanesque. Pratt House: brick, 3 stories, mansard roof with dormers and central tower crowned with iron cresting and spire, ornate bracketed cornices and metal lintels; original interior wall coverings, fixtures, and woodwork. Second Empire. *Private.*

Boonville. **FIVE LOCK COMBINE AND LOCKS 37 AND 38, BLACK RIVER CANAL (BOONVILLE GORGE PARK)** , NY 46, 19th–20th C.. Section of the abandoned Black River Canal (built mid-19th C.) running through rugged terrain of Boonville Gorge; contains locks 37 and 38 and a 5-lock combine (locks 39–43); canal was 42′ deep; locks, 90′ by 15′, which accommodate 70-ton boats, were built 1895–early 1900's. Canal built to connect Black River Valley to Erie Canal provided water supply for Erie Canal, allowed expansion of valley's lumbering industry, and fostered growth of towns. *State/county:* HAER.

Clinton. **HAMILTON COLLEGE CHAPEL,** Hamilton College campus, 1827, Philip Hooker, architect. Coursed rubble, 3 stories, rectangular, low pitched roof, interior chimney, modillion cornice, front and rear parapet; front slightly projecting 4-story clock tower with 3-stage frame belfry—2 stories, each with columns and entablature, surmounted by octagonal cupola; front center double-door entrance with round arched window above, flanked by tall round arched windows, blind decorative frame panels; limestone ashlar quoins, lintels, and sills; side elevations with 3 tiers of windows; apse added 1897; interior altered. Federal. Multipurpose classroom and chapel building designed by Philip Hooker; unusual 3-story interior plan attributed to John H. Lothrop, a trustee. *Private.*

Clinton. **ROOT, ELIHU, HOUSE,** 101 College Hill Rd., 1817. Frame, clapboarding; 2 stories, irregular shape, gabled roof, interior chimneys, pedimented arched portico, off-center entrance with semielliptical fanlight and side lights, 2-story pilasters dividing bays in flush-sided main facade, pedimented rear porch; side additions; restored, 1900's. Federal. Home of Elihu Root, U.S. Secretary of War largely credited with conceptual foundation for 20th C. development of American Army, Secretary of State, U.S. senator, and winner of 1912 Nobel Peace Prize. *Private; not accessible to the public:* NHL.

Rome. **ARSENAL HOUSE,** 514 W. Dominick St., c. 1813–1814. Brick, 2 1/2 stories, rectangular, gabled roof, pairs of bridged interior end chimneys above single gable steps, central pedimented gable with elliptical window, 2 vertical elliptical windows in gabled ends between chimneys, stone sills and lintels; later front porch with large modillion blocks, chamfered

REFERENCE NO. 9

Freshwater Wetlands Classification Sheet

December 5, 1984

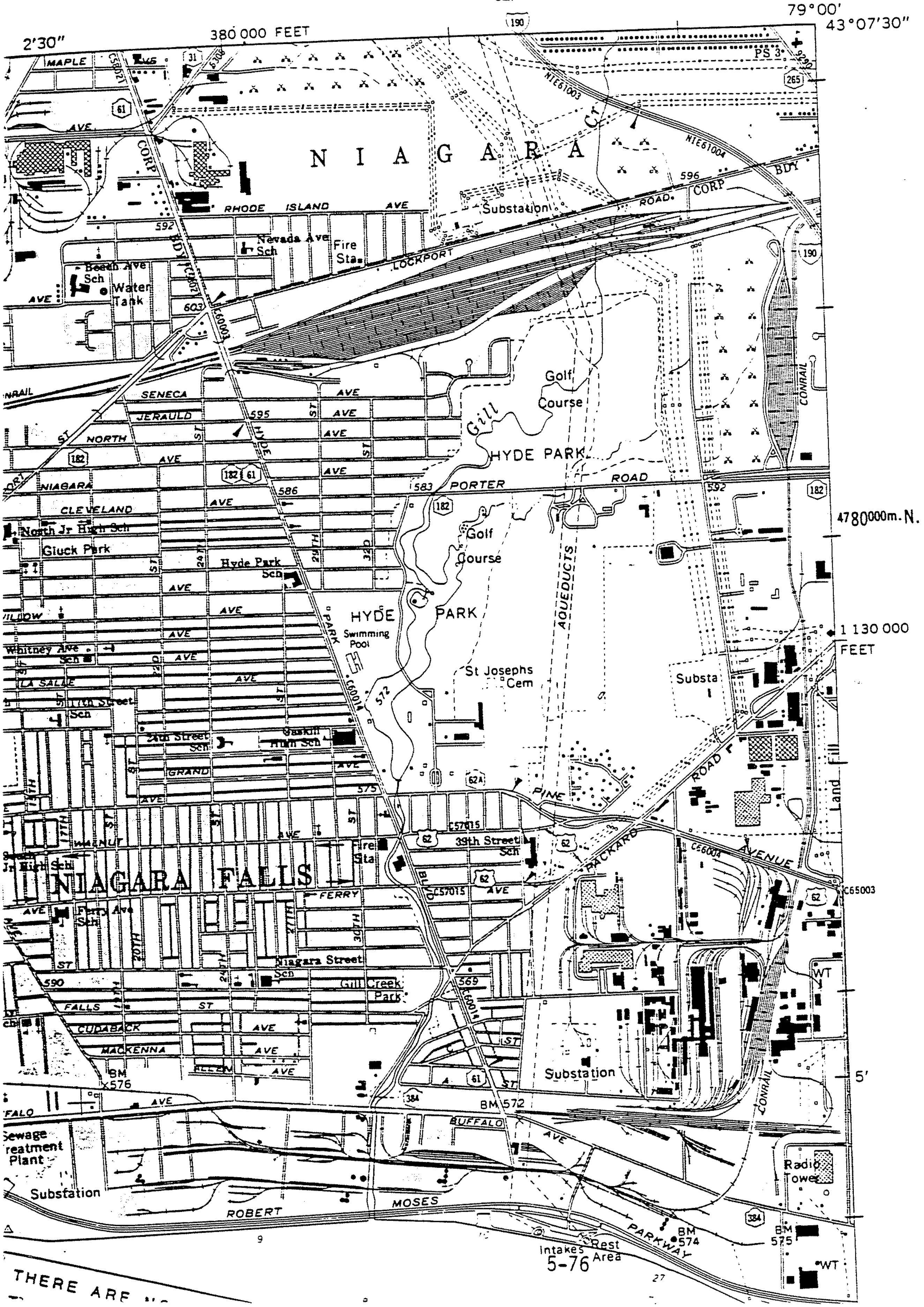
Niagara County
Map 13 of 18
Niagara Falls Quadrangle

Wetlands Identification Code	Municipality	Classification

There are no wetlands in Niagara County on the Niagara Falls Quadrangle.

Source: New York State Department of Environmental Conservation (NYSDEC), 1984, Wetland Maps, Region 9, Buffalo, New York.

NIAGARA FALLS QUADRANGLE
ONTARIO – NEW YORK
7.5 MINUTE SERIES PLANIMETRIC
SE/4 NIAGARA FALLS 15' QUADRANGLE



5-76

THERE ARE N...

REFERENCE NO. 10

CONTACT REPORT

AGENCY	:	New York State Department of Environmental Conservation, Region 9
ADDRESS	:	600 Delaware Ave., Buffalo, NY 14202
PHONE	:	(716)847-4550
PERSON CONTACTED	:	James Snider, Senior Wildlife Biologist
TO	:	Jon Sundquist
DATE	:	June 2, 1987
SUBJECT	:	Critical Wildlife habitats near potential hazardous waste sites in Niagara County

In preparation of Phase 1 reports on potential hazardous waste sites in New York for the NYSDEC, information about nearby critical wildlife habitats is necessary. The following information is provided by Mr. James Snider of the Bureau of Wildlife, NYSDEC Region 9.

Except for the seasonal appearance of migratory birds, including, possibly the bald eagle, there are no critical habitats of endangered species within 2 miles of the suspected waste sites listed below:

- SKW Alloys
  Witmer Road at Maryland Ave.
  Niagara Falls, NY
- Dussault Foundries
  2 Washburn Street
  Lockport, NY
- North Love Canal
  Near Cleghorn Drive
  Lewiston, NY
- Carborundum Building 82
  Buffalo Ave.
  Niagara Falls, NY
- Ross Steel Company
  4237 Pine Ave.
  Niagara Falls, NY
- Frontier Bronze
  4870 Packard Rd.
  Niagara Falls, NY
- Roblin Steel
  101 East Ave.
  N. Tonawanda, NY

- LaSalle Expressway
  Niagara Falls, NY

- Diamond Shamrock
  Ohio Ave.
  Lockport, NY

- Town of Lockport Landfill
  Canal Road
  Lockport, NY

- Power Authority Road
  Lewiston, NY

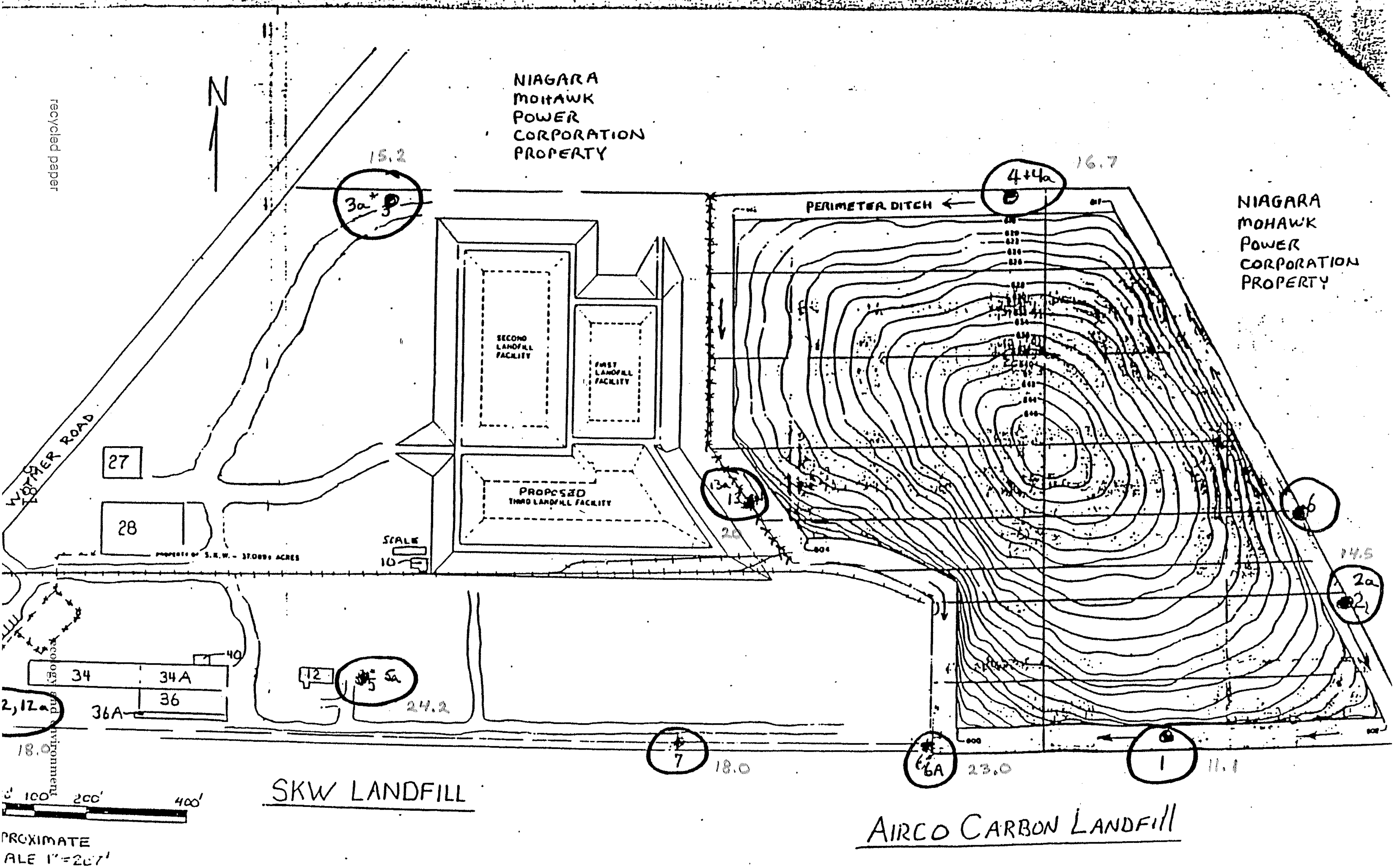
- 64th Street South
  Chevy Place
  Niagara Falls, NY

- Walmore Road
  Walmore Rd., 0.5 miles south of Lockport Road
  Wheatfield, NY

James R. [signature] — Signature

July 27, 1987 — Date

REFERENCE NO. 11



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ecology and environment

SLC Consultants/Constructors, Inc.

June 15, 1987

SKW Alloys, Inc.
3801 Highland Avenue
Niagara Falls, NY 14305

ATTENTION: Art Elmquest

Dear Mr. Elmquest:

Please find attached the results from the analysis performed on the samples taken on April 15, 1987 and the deep and shallow well elevations.

The "long list" of parameters was run per the agreement with the NYSDEC. The shallow wells were also sampled where there was enough sample and analyzed.

Please call with any questions.

Sincerely,

Donald J. Kuhn
President
SLC CONSULTANTS/CONSTRUCTORS, INC.

DJK/rk
Attach.: Witmer Road Sampling Report
cc Joseph E. Cumbo, Chief Chemist

6362 Robinson Road, Lockport, New York 14094 (716) 433-0776

WATER ELEVATIONS*

	1	1A	2	2A	3	3A	4	4A	5	5A	12	12A	13	13A
10/10/84	592.61	DRY	599.32	601.72	598.02	604.64	601.04	603.17	578.08	595.38	583.05	DRY	589.73	598.56
1/7/85	597.39	595.98	599.94	602.27	598.38	606.62	603.57	604.46	579.87	595.73	586.94	592.34	591.84	599.35
4/3/85	599.96	599.85	601.45	602.41	598.02	607.37	606.59	605.71	581.42	595.98	588.02	593.58	594.01	599.31
7/25/85	593.14	DRY	598.32	601.14	598.93	605.36	601.34	603.24	579.76	595.76	582.56	DRY	590.45	DRY
10/31/85	591.59	DRY	599.09	601.90	596.13	603.30	601.48	603.84	579.24	596.73	583.97	DRY	590.16	599.18
1/23/86	599.75	599.37	601.32	602.52	596.00	605.51	606.70	605.58	581.24	597.04	587.15	593.34	593.69	599.38
4/1/86	599.54	599.78	600.88	602.13	594.77	605.11	606.19	604.99	581.80	596.60	586.74	592.69	593.72	599.05
8/2/86	594.23	595.63	598.99	601.70	594.95	604.62	602.92	603.35	579.83	596.46	584.48	590.93	591.23	598.05
10/1/86	593.99	595.44	599.81	602.53	593.91	605.68	602.73	604.35	583.08	597.20	586.72	590.81	592.49	599.44
1/27/87	599.09	600.07	600.64	601.81	594.58	604.87	605.31	604.10	589.63	596.49	588.80	592.25	596.15	599.28
4/14/87	**	**	601.34	602.15	593.87	605.47	607.12	605.79	590.61	596.92	589.73	593.21	597.53	599.33

*Prior to Evacuation
**Well broken - no sample

SLC CONSULTANTS/CONSTRUCTORS, INC.

WITMER ROAD SAMPLING PROJECT

SAMPLE LOCATION NO. 1

Sample Date	pH Units	Cond. umhos	TDS mg/l	COD mg/l	TOC mg/l	Ba (mg/l)	Cr (T) (mg/l)	Cr (VI) (mg/l)	Fe (mg/l)	Mn (mg/l)	Si (mg/l)	Zn (mg/l)
3/7/79	7.30	1200		10	<2	0.10	<0.01		1.23	0.95	9.8	0.8[illegible]
4/11/79	7.30	1350		10	2	0.01	<0.01		1.00	1.10	9.0	0.9[illegible]
5/14/79	7.65	1000		18	5	0.15	0.01		1.10	0.80	4.9	0.7[illegible]
6/11/79	7.45	1100		6.4	17	0.10	<0.01		1.60	0.88	6.2	0.7[illegible]
12/14/79	6.85	1250		6	20	0.15	<0.02		1.1	0.24	—	0.4[illegible]
1/16/80	7.80	1200	774	<2	54	0.1	<0.02		0.26	0.26	10	0.3[illegible]
4/11/80	6.75	1400	1280	8	39	<0.1	<0.02	<0.01	0.02	0.19	6.1	0.7[illegible]
7/8/80	7.25	1300	1020	12	110	0.1	0.02		0.22	0.18	4.3	0.1[illegible]
10/30/80	—	—	—	—	—	—	—	—	—	—	—	—
1/7/81	6.9	1150	847	<20	4		0.096	<0.005	<0.050	0.055	7.0	<0.0[illegible]
4/7/81	7.58	1010	878	18.9	10	<0.2	<0.005	<0.005	<0.05	0.02	10.2	0.2[illegible]
6/22/81	6.97	1140	1074	21.6	2	0.40	0.016	0.010	<0.05	0.051	3.4	0.1[illegible]
10/29/81	7.05	960	1064	17.2	14	<0.2	<0.005	<0.005	<0.05	0.115	0.70	0.0[illegible]
1/6/82	7.00	1870	782	8.1	<1	<0.2	<0.005	<0.005	<0.050	0.079	9.5	0.0[illegible]
4/14/82	6.95	830	784	<2.00	11.5	0.214	<0.005	<0.005	<0.050	0.081	8.30	0.2[illegible]
7/27/82	7.10	670	660	14.9	24.4	<0.200	0.148	<0.005	<0.050	0.048	7.60	<0.0[illegible]
10/20/82	7.50	699	536	15.4	30.7	<0.200	<0.005	<0.005	0.095	0.210	8.32	<0.0[illegible]
3/1/83	6.92	870	788	<2.0	71.6	<0.2	0.005	0.005	<0.05	0.035	8.3	0.3[illegible]
7/21/83	7.31	840	694	42.2	57.9							
10/26/83	7.12	790	854	5.76	117.0							
2/24/84	7.30	800	654	2.9	10.4	1.9	<0.005	<0.005	<0.05	0.059	5.8	0.1[illegible]
4/11/84	7.01	780	700	12.7	8.9	0.01						
7/13/84	7.22	740	442	16	15							
10/11/84	7.42	940	760	13	13							

Continued on next page.

WITMER ROAD SAMPLING PROJECT

SAMPLE LOCATION NO. 1 (cont'd.)

Sample Date	pH Units	Cond. umhos	TDS mg/l	COD mg/l	TOC mg/l	mg/l Ba	Cr(T)	Cr(VI)	Fe	Mn	Si	Zn
1/8/85	7.28	800	770	<5	130	0.080	0.034	0.009	1.58	0.083	0.93	0.439
4/3/85	7.30	700	690	7.2	12							
7/25/85	7.25	1000	950	24	22							
10/31/85	7.02	1000	730	3.7	<10							
1/23/86	7.59	1000	750	4.7	89							
4/2/86	7.60	1100	670	11	12	0.062	<0.01	<0.01	0.308	0.044	7.90	0.390
8/4/86	7.45	900	730	<5	5							
10/2/86	7.25	1000	660	7.8	17							
1/28/87	7.15	990	630	<5	18							
4/15/87		WELL BROKEN - NO SAMPLE										

WITMER ROAD SAMPLING PROJECT

SAMPLE LOCATION NO. 1A

Sample Date	pH Units	Cond. umhos	TDS mg/l	COD mg/l	TOC mg/l	mg/l Ba	Cr(T)	Cr(VI)	Fe	Mn	Si	Zn
4/3/85	7.44	760	740	18	11							
7/25/85		INSUFFICIENT SAMPLE OR DRY										
10/31/85			D R Y									
1/23/86	7.67	1100	790	9.9	38							
4/2/86	7.70	1500	1200	89	17	0.042	<0.01	<0.01	1.80	0.725	5.54	0.207
8/4/86			D R Y									
10/2/86			D R Y									
1/28/87	7.90	2000	1600	110	11							
4/15/87		W E L L B R O K E N - N O S A M P L E										

WITMER ROAD SAMPLING PROJECT

SAMPLE LOCATION NO. 2

Sample Date	pH Units	Cond. umhos	TDS mg/l	COD mg/l	TOC mg/l	mg/l Ba	Cr(T)	Cr(VI)	Fe	Mn	Si	Zn
/7/79						0.05	0.02		0.64	12.0	8.8	0.15
/11/79						0.05	<0.01		1.40	1.1	6.4	0.18
/14/79	7.8	500		22	9	0.10	0.01		0.40	0.35	2.6	0.06
/1/79	7.95	495		7.2	11	<0.10	<0.01		2.5	0.60	4.4	0.27
2/14/79	7.70	460	338	2	<5	<0.05	<0.02		0.43	0.11	—	0.03
/16/80	8.0	500	256	<2	32	0.1	<0.02		1.90	0.51	4.0	0.27
/11/80	7.55	550	443	6	15	<0.1	<0.02	<0.01	0.21	0.25	3.8	0.13
/8/80	7.55	440	300	9	52	0.1	0.02		0.96	0.26	2.7	0.02
0/30/80	7.60	460	268	4	<5	<0.1	<0.02	<0.02	1.7	0.37	42	0.01
/7/81	7.2	565	617	<20	3		0.064	<0.005	0.156	0.116	2.5	<0.050
/7/81	7.71	510	412	40.6	7.8	<0.2	<0.005	<0.005	0.05	0.074	4.9	0.066
/22/81	7.50	430	300	26.7	2.3	<0.20	0.006	<0.005	0.05	0.133	8.2	0.046
0/29/81	7.45	450	310	32.5	15	<0.2	<0.005	<0.005	<0.05	0.156	0.20	0.015
/6/82	7.50	380	266	50.5	20.1	<0.2	<0.005	<0.005	<0.050	0.068	4.0	0.047
/14/82	7.75	360	294	2.26	11.0	<0.200	<0.005	<0.005	<0.050	0.064	4.0	<0.010
/27/82	7.61	280	374	47.5	17.9	<0.200	0.043	0.009	<0.050	0.106	5.40	<0.050
0/20/82	7.85	443	284	<5.0	26.7	<0.200	<0.005	<0.005	<0.050	0.200	6.84	<0.050
/1/83	7.55	360	354	11.0	46.6	<0.2	0.012	0.011	<0.05	0.083	4.3	<0.050
/21/83	7.99	280	240	24.7	31.1							
0/26/83	8.74	270	834	0.38	56.2							
/24/84	9.90	220	112	31.5	15.3	<0.2	<0.005	<0.005	<0.05	<0.005	2.5	<0.02
/11/84	9.46	210	140	11.7	6.0	0.04						
/13/84	11.08	675	142	<5.0	5							
0/11/84	10.91	330	150	24	5.3							

Continued on next page.

WITMER ROAD SAMPLING PROJECT

SAMPLE LOCATION NO. 2 (cont'd.)

Sample Date	pH Units	Cond. umhos	TDS mg/l	COD mg/l	TOC mg/l	Ba (mg/l)	Cr(T) (mg/l)	Cr(VI) (mg/l)	Fe (mg/l)	Mn (mg/l)	Si (mg/l)	Zn (mg/l)
1/8/85	11.73	870	36	26	18	0.047	0.028	0.012	0.160	<0.050	<0.4	0.003
4/3/85	11.58	1100	460	4.7	7							
7/25/85	11.65	2000	520	10	12							
10/31/85	11.43	2800	610	15	<10							
1/23/86	12.15	1900	570	16	6.0							
4/2/86	12.2	1500	480	17	<10	0.073	0.039	0.033	0.08	<0.03	2.50	0.115
8/4/86	12.20	2000	1100	20	6							
10/2/86	11.90	1700	410	17	<10							
1/28/87	11.80	2300	580	21	<10							
4/15/87	10.40	1500	380	<5	13	0.063	0.023	0.012	0.124	<0.005	3.08	0.010

SLC CONSULTANTS/CONSTRUCTORS, INC.

WITMER ROAD SAMPLING PROJECT

SAMPLE LOCATION NO. 2A

Sample Date	pH Units	Cond. umhos	TDS mg/l	COD mg/l	TOC mg/l	Ba (mg/l)	Cr(T) (mg/l)	Cr(VI) (mg/l)	Fe (mg/l)	Mn (mg/l)	Si (mg/l)	Zn (mg/l)
4/3/85	12.14	5000	1200	75	10							
7/25/85	12.23	6300	1300	43	<10							
10/31/85	11.7	2700	1300	19	<10							
1/23/86	12.61	5500	1300	20	870							
4/2/86	12.7	5300	1900	13	<10	0.46	0.517	0.428	0.242	<0.03	0.640	0.306
8/4/86	12.70	200	5000	14	4							
10/2/86	12.50	5800	1300	24	<10							
1/28/87	12.15	6100	1400	19	<10							
4/15/87	10.60	5900	1500	67	14	0.452	0.495	0.356	0.092	<0.005	0.536	<0.01

SLC CONSULTANTS/CONSTRUCTORS, INC.

WITMER ROAD SAMPLING PROJECT

SAMPLE LOCATION NO. 3

Sample Date	pH Units	Cond. umhos	TDS mg/l	COD mg/l	TOC mg/l	mg/l Ba	Cr(T)	Cr(VI)	Fe	Mn	Si	Zn
3/7/79	—	—		—	—	0.25	0.02		0.47	2.0	23.0	0.12
4/11/79	10.30	950		69	24	0.05	0.03		4.20	1.2	12.4	0.44
5/14/79	9.15	600		53	15	<0.05	0.03		9.0	0.75	4.8	0.28
6/11/79	8.80	600		42	26	<0.10	<0.01		10.3	0.27	2.9	0.14
12/14/79												
1/16/80	7.95	500	266	59	40	<0.1	<0.02		16.4	0.61	2.6	0.22
4/11/80	7.50	550	487	68	25	<0.1	<0.02		3.6	1.26	4.8	0.37
7/8/80	6.85	490	370	25	32	0.1	0.02		22	0.46	0.8	0.05
10/30/80	—	—	—	—	15	<0.1	<0.02	<0.02	42	1.07	2.8	0.22
3/7/81	9.1	350	307	180	40		0.021	<0.005	<0.050	0.020	3.0	<50
4/7/81	8.05	360	256	99.5	78	<0.2	<0.005	<0.005	0.16	0.028	3.0	0.010
6/22/81	7.97	350	238	92.1	5.5	0.24	<0.005	<0.005	0.07	<0.02	5.0	0.013
10/29/81	8.75	360	250	99.4	54	<0.2	<0.005	<0.005	<0.05	<0.020	3.40	0.050
1/6/82	8.55	310	236	101	32.5	<0.2	<0.005	<0.005	0.075	<0.020	3.5	0.010
4/14/82	7.95	400	276	118	12.0	0.226	<0.005	<0.005	<0.050	<0.020	1.70	<0.010
7/27/82	8.48	340	352	139	37.5	<0.200	<0.005	<0.005	0.114	0.029	1.48	<0.050
10/20/82	8.00	303	262	166	48.0	<0.200	<0.005	<0.005	0.054	<0.020	6.78	<0.050
3/1/83	9.28	245	198	132	40.6	<0.2	<0.005	——	0.069	<0.02	3.71	<0.050
7/21/83	9.70	230	204	42.2	43.3							
10/26/83	10.41	330	294	29.5	46.7							
2/24/84	9.37	240	244	65.0	50.0	*	*	*	*	*	1.8	*
4/11/84	10.02	2400	2000	116	5.0	*						
7/13/84			D R Y									
10/11/84	*	*	*	<5	2.3							

* = Insufficient Sample

Continued on next page.

WITMER ROAD SAMPLING PROJECT

SAMPLE LOCATION NO. 3 (cont'd.)

Sample Date	pH Units	Cond. umhos	TDS mg/l	COD mg/l	TOC mg/l	Ba (mg/l)	Cr(T) (mg/l)	Cr(VI) (mg/l)	Fe (mg/l)	Mn (mg/l)	Si (mg/l)	Zn (mg/l)
/8/85			D R Y									
/3/85	9.84	360	200	90	26							
/25/85		INSUFFICIENT SAMPLE OR DRY										
0/31/85		INSUFFICIENT SAMPLE										
/23/86		INSUFFICIENT SAMPLE OR DRY										
/2/86			D R Y									
/4/86			D R Y									
0/2/86			D R Y									
/28/87			D R Y									
/15/87			D R Y									

SLC CONSULTANTS/CONSTRUCTORS, INC.

WITMER ROAD SAMPLING PROJECT

SAMPLE LOCATION NO. 3A

Sample Date	pH Units	Cond. umhos	TDS mg/l	COD mg/l	TOC mg/l	Ba (mg/l)	Cr (T) (mg/l)	Cr (VI) (mg/l)	Fe (mg/l)	Mn (mg/l)	Si (mg/l)	Zn (mg/l)
4/3/85	I. S.											
7/25/85		INSUFFICIENT SAMPLE OR DRY										
10/31/85	I. S.											
1/23/86	10.12	330	280	41	23							
4/2/86	9.90	450	230	97	35	0.062	0.149	0.327	8.90	0.250	36.7	0.365
8/4/86	10.15	5200	380	130	19							
10/2/86	11.00	590	380	140	36							
1/28/87	10.89	610	330	56	11							
4/15/87	10.20	860	380	140	23	0.325	0.835	<0.01	42.0	1.62	67.0	0.429

I.S. = Insufficient Sample

SLC CONSULTANTS/CONSTRUCTORS, INC.

WITMER ROAD SAMPLING PROJECT

SAMPLE LOCATION NO. 4

Sample Date	pH Units	Cond. umhos	TDS mg/l	COD mg/l	TOC mg/l	Ba (mg/l)	Cr(T) (mg/l)	Cr(VI) (mg/l)	Fe (mg/l)	Mn (mg/l)	Si (mg/l)	Zn (mg/l)
3/7/79	7.45	1050		102	28	0.20	0.02		0.62	5.5	11.0	0.83
4/11/79	7.55	1150		4	6	0.15	0.01		0.41	3.8	11.5	0.38
5/14/79	7.35	1150		25	5	0.05	0.02		0.85	1.25	4.6	0.33
6/11/79	7.45	1100		9.6	18	<0.10	<0.01		1.6	0.99	4.6	0.44
12/14/79	7.45	950	596	40	<5	0.08	<0.02		0.32	0.01	—	0.060
1/16/80	7.45	1000	684	<2	80	<0.1	<0.02		0.15	1.18	5.0	0.19
4/11/80	6.90	1450	1380	<2	43	0.4	0.02	<0.01	0.05	0.57	5.4	0.67
7/8/80	7.05	1600	1290	6	100	0.2	<0.02		0.20	0.64	3.6	0.38
10/30/80	7.85	1050	642	2	<5	<0.1	<0.02	<0.02	0.56	0.28	4.7	0.19
1/7/81	7.4	960	803	<20	3		0.064	0.02240	<0.050	0.067	5.2	<0.050
4/7/81	7.35	1400	1290	16.1	13.9	<0.2	<0.005	<0.005	<0.05	0.475	7.4	0.468
6/22/81	6.85	2200	1970	22	1.5	0.75	0.007	<0.005	<0.05	0.770	<5.0	0.457
10/29/81	6.90	2250	1960	88	23	<0.2	<0.005	<0.005	<0.05	0.622	0.40	0.094
1/6/82	6.85	2650	2318	18.2	<1	<0.2	<0.005	<0.005	0.379	0.508	5.5	0.490
4/14/82	7.05	2600	2400	140	9.5	<0.200	0.029	0.027	<0.050	0.550	5.70	0.540
7/27/82	7.01	2700	2700	39.7	37.1	<0.200	0.295	<0.005	<0.050	0.532	4.98	0.160
10/20/82	7.65	2580	2070	14.9	37.8	<0.200	<0.005	<0.005	0.105	0.453	7.42	0.140
3/1/83	6.95	2520	2252	15.4	66.4	<0.2	0.0069	0.005	0.162	0.426	6.1	0.388
7/21/83	7.3	2250	1746	18.5	50.3							
10/26/83	7.38	1300	1040	14.9	96.4							
2/24/84	7.10	2100	1790	88.5	58.5	3.1	<0.005	<0.005	<0.05	0.813	4.6	0.19
4/11/84	6.86	1900	1780	19.5	4.4	0.04						
7/13/84	7.07	2700	1710	585	20							
10/11/84	7.16	1700	1300	<5	6.6							

Continued on next page.

WITMER ROAD SAMPLING PROJECT

SAMPLE LOCATION NO. 4 (cont'd.)

Sample Date	pH Units	Cond. umhos	TDS mg/l	COD mg/l	TOC mg/l	mg/l Ba	Cr(T)	Cr(VI)	Fe	Mn	Si	Zn
1/8/85	7.48	900	760	9.5	76	0.058	0.059	0.039	4.67	0.247	<0.4	0.299
4/3/85	6.87	1200	1400	80	12							
7/25/85	7.15	2000	1500	83	44							
10/31/85	7.20	1300	620	3.7	<10							
1/23/86	7.25	1800	1300	10	89							
4/2/86	7.45	2000	1500	11	12	0.105	0.010	<0.01	6.42	0.499	15.7	0.766
8/4/86	7.45	400	1500	13	8							
10/2/86	7.40	1600	960	10	<10							
1/28/87	7.10	1900	1200	18	31							
4/15/87	7.0	1900	1400	36	21	0.078	<0.01	<0.01	3.43	0.711	7.99	0.302

SLC CONSULTANTS/CONSTRUCTORS, INC.

WITMER ROAD SAMPLING PROJECT

SAMPLE LOCATION NO. 4A

Sample Date	pH Units	Cond. umhos	TDS mg/1	COD mg/1	TOC mg/1	mg/1 Ba	Cr (T)	Cr (VI)	Fe	Mn	Si	Zn
4/3/85	12.23	2500	1800	110	14							
7/25/85	12.25	7400	1700	82	38							
10/31/85	11.85	3000	1400	29	12							
1/23/86	12.70	7200	1800	30	10							
4/2/86	12.8	6000	2000	24	19	0.122	0.698	<0.01	0.082	<0.03	0.735	0.086
8/4/86	12.70	5900	1900	50	18							
10/2/86	12.55	6800	1500	36	18							
1/28/87	12.20	6800	1600	20	<10							
4/15/87	10.60	7900	2000	25	18	0.159	0.714	0.546	0.119	<0.005	0.386	<0.087

SLC CONSULTANTS/CONSTRUCTORS, INC.

WITMER ROAD SAMPLING PROJECT

SAMPLE LOCATION NO. 5

Sample Date	pH Units	Cond. umhos	TDS mg/l	COD mg/l	TOC mg/l	Ba (mg/l)	Cr(T) (mg/l)	Cr(VI) (mg/l)	Fe (mg/l)	Mn (mg/l)	Si (mg/l)	Zn (mg/l)
3/7/79	7.30	1200		8	<2	<0.50	0.01		4.1	2.5	7.8	0.37
4/11/79	7.55	1050		4	<2	0.05	0.01		5.9	1.4	7.0	0.15
5/14/79	7.40	7.40		24	<2	0.05	<0.01		6.0	1.35	4.6	0.30
6/11/79	7.40	1000		20	23	<0.10	<0.01		5.7	1.02	4.3	0.14
12/14/79												
1/16/80	7.65	1000	626	4	70	<0.1	0.02		5.90	0.52	5.3	0.07
4/11/80	7.00	1150	1410	10	62	0.1	0.08		0.91	1.10	3.6	0.15
7/8/80	7.20	950	754	5	95	<0.1	<0.02		2.1	0.62	3.2	0.05
10/30/80	7.50	1000	606	5	<5	<0.1	<0.02	<0.02	10.5	1.68	6.6	0.30
1/7/81	7.2	980	565	80	4		0.030	0.01310	<0.05	0.218	1.6	<0.050
4/7/81	7.48	940	708	47	20	<0.2	<0.005	<0.005	0.16	0.281	5.5	0.033
6/22/81	7.00	850	656	40	1.3	0.43	0.008	<0.005	<0.05	0.210	6.4	<0.010
10/29/81	7.08	900	640	36.9	31	<0.2	<0.005	<0.005	0.13	0.231	3.9	<0.050
1/6/82	7.10	880	674	32.3	10.4	<0.2	<0.005	<0.005	0.305	0.176	5.5	0.017
4/14/82	7.19	690	756	33.9	12.5	<0.200	<0.005	<0.005	<0.050	0.280	4.20	<0.010
7/27/82	7.27	700	684	53.1	48.2	<0.200	0.142	<0.005	<0.050	0.197	3.42	<0.050
10/20/82	7.65	906	712	86.2	59.4	<0.200	<0.005	<0.005	<0.050	0.137	7.92	<0.050
3/1/83	7.27	690	494	71.3	86.5	<0.2	0.009	0.009	<0.05	0.153	3.61	<0.050
7/21/83	7.33	700	454	51.9	30.5							
10/26/83	7.41	670	554	28.0	115.0							
2/24/84	7.58	780	670	35.0	7.5	1.8	<0.005	<0.005	<0.05	0.460	3.1	<0.02
4/11/84	7.07	760	600	29.3	6.4	0.08						
7/13/84	7.23	820	648	140	35							
10/11/84	7.21	800	580	157	48							

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WITMER ROAD SAMPLING PROJECT

SAMPLE LOCATION NO. 5 (cont'd.)

Sample Date	pH Units	Cond. umhos	TDS mg/l	COD mg/l	TOC mg/l	mg/l						
						Ba	Cr(T)	Cr(VI)	Fe	Mn	Si	Zn
1/8/85	7.53	620	570	23	110	0.128	0.089	0.056	48.5	0.579	<0.4	0.296
4/3/85	7.15	850	620	140	34							
7/25/85	7.20	960	740	31	14							
10/31/85	7.53	1000	690	22	14							
1/23/86	7.51	900	690	27	72							
4/2/86	8.00	900	550	32	25	0.101	0.040	<0.01	42.9	0.552	11.5	0.192
8/4/86	7.45	840	710	28	14							
10/2/86	7.40	820	680	29	13							
1/28/87	7.30	900	590	57	28							
4/15/87	7.0	870	570	32	25	0.076	<0.01	<0.01	27.6	0.493	5.92	0.087

SLC CONSULTANTS/CONSTRUCTORS, INC.

WITMER ROAD SAMPLING PROJECT

SAMPLE LOCATION NO. 5A

Sample Date	pH Units	Cond. umhos	TDS mg/l	COD mg/l	TOC mg/l	mg/l Ba	Cr(T)	Cr(VI)	Fe	Mn	Si	Zn
4/3/85	I.S.											
7/25/85	7.39	1600	1200	242	66							
10/31/85	7.62	1500	1100	360	100							
1/23/86	7.46	510	390	440	76							
4/2/86	7.85	440	320	41	25	0.142	0.143	0.060	4.32	1.59	13.4	0.172
8/4/86	7.90	930	380	490	16							
10/2/86	7.65	1000	620	67	22							
1/28/87	7.80	550	370	73	<10							
4/15/87	7.6	500	190	110	28	0.523	0.500	0.193	52.7	6.63	52.5	0.887

I.S. = Insufficient Sample

SLC CONSULTANTS/CONSTRUCTORS, INC.

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WITMER ROAD SAMPLING PROJECT

SAMPLE LOCATION NO. 6

Sample Date	pH Units	Cond. umhos	TDS mg/l	COD mg/l	TOC mg/l	Ba (mg/l)	Cr(T) (mg/l)	Cr(VI) (mg/l)	Fe (mg/l)	Mn (mg/l)	Si (mg/l)	Zn (mg/l)
3/7/79	11.75	4100		14	8	0.15	0.25		0.07	0.03	2.9	0.02
4/11/79	12.05	4100		6	7	0.10	0.23		0.06	0.01	1.5	<0.005
5/14/79	11.55	4000		41	2	0.10	0.30		0.04	0.01	1.6	0.01
6/11/79	11.85	3350		24	8	0.10	0.13		0.05	<0.01	4.4	<0.01
12/14/79	11.40	6000	1310	34	8	0.15	0.07		0.08	<0.005	—	0.015
1/16/80	12.30	6000	1230	10	15	0.1	0.19		0.06	0.02	0.5	0.02
4/11/80	11.70	3700	991	18	16	0.1	0.25	0.18	0.02	0.01	0.8	<0.01
7/8/80	11.30	4400	1160	19	10	0.3	0.16		0.02	0.02	0.6	0.01
10/30/80	12.10	4300	856	8	8	<0.1	0.06	<0.02	0.03	0.02	0.9	<0.01
1/7/81			STREAM FROZEN									
4/7/81	12.05	4000	1104	95.3	18.3	0.29	0.144	0.040	<0.05	<0.02	0.70	0.012
6/22/81	9.10	135	62	19.6	<1	<0.20	0.033	<0.005	<0.05	<0.02	3.4	0.020
10/29/81	11.30		NO FLOW									
1/6/82		2100	690	24.2	14.1	<0.2	0.248	0.042	0.058	<0.020	2.5	0.050
4/14/82	11.05	1450	658	18.1	11.0	0.250	0.195	0.053	<0.050	<0.020	1.80	<0.010
7/27/82			NO FLOW									
10/20/82			NO FLOW									
3/1/83	11.18	2210	746	34.3	60.3	<0.2	0.023	0.014	<0.05	<0.02	1.61	<0.050
7/21/83			DRY									
10/26/83	11.99	1460	506	21.5	18.4							
2/24/84	12.29	2200	970	34.0	40.0	4.9	0.33	0.17	<0.05	0.017	2.1	<0.02
4/11/84	11.68	1200	1020	22.5	15.3	0.12						
7/13/84			DRY									
10/11/84			NO FLOW									

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WITMER ROAD SAMPLING PROJECT

SAMPLE LOCATION NO. 6 (cont'd.)

Sample Date	pH Units	Cond. umhos	TDS mg/1	COD mg/1	TOC mg/1	mg/1 Ba	Cr(T)	Cr(VI)	Fe	Mn	Si	Zn
1/8/85	12.27	2500	1100	20	34	0.137	0.135	0.086	<0.050	<0,050	<0.4	0.016
4/3/85	11.41	1600	540	110	27							
7/25/85		INSUFFICIENT SAMPLE OR DRY										
10/31/85	9.40	240	180	83	24							
1/23/86	8.46	2100	700	18	9.1							
4/2/86	12.5	2800	840	36	27	0.113	0.179	0.116	0.063	<0.03	1.59	0.080
8/4/86	7.90	320	230	50	16							
10/2/86	11.30	540	190	30	11							
1/28/87		FROZEN										
4/15/87	11.50	2100	530	33	22	0.085	0.103	0.095	0.051	<0.005	2.27	<0.01

SLC CONSULTANTS/CONSTRUCTORS, INC.

WITMER ROAD SAMPLING PROJECT

SAMPLE LOCATION NO. 6A

Sample Date	pH Units	Cond. umhos	TDS mg/l	COD mg/l	TOC mg/l	Ba (mg/l)	Cr (T) (mg/l)	Cr (VI) (mg/l)	Fe (mg/l)	Mn (mg/l)	Si (mg/l)	Zn (mg/l)
1/16/80	12.20	5500	1070	10	15	0.1	0.30		0.05	<0.01	0.6	0.01
4/11/80	11.75	3650	1410	10	12	0.1	0.39		0.04	0.01	0.05	<0.01
7/8/80	11.55	4200	1140	9	15	0.4	0.72		0.02	0.01	1.1	<0.01
10/30/80	11.90	3200	546	6	6	<0.1	0.19	<0.02	0.04	0.02	1.5	0.01
1/7/81		STREAM FROZEN										
4/7/81	11.91	2900	858	18.9	18.3	0.21	0.300	0.100	<0.05	<0.02	3.6	<0.01
6/22/81	10.05	225	118	19.6	1	0.26	0.158	0.021	<0.05	<0.02	6.0	0.012
10/29/81	11.40	3400	125	35.1	25	<0.2	0.658	0.426	<0.05	0.020	0.2	<0.050
1/6/82	11.25	2380	742	44.4	25.6	<0.2	0.461	0.098	0.053	<0.020	3.5	0.067
4/14/82	11.15	1900	798	13.6	15.5	<0.200	0.469	0.243	<0.050	<0.020	2.50	<0.010
7/27/82		NO FLOW										
10/20/82		NO FLOW										
3/1/83	11.15	1925	718	29.9	6.94	<0.2	0.599	0.283	<0.05	<0.02	1.71	<0.050
7/21/83		DRY										
10/26/83	12.06	1760	662	21.9	12.0							
2/24/84	12.4	2700	1100	75.3	33.0	6.3	0.21	0.10	<0.05	0.018	1.9	<0.02
4/11/84	11.67	880	920	23	7.6	0.06						
7/13/84		DRY										
10/11/84		NO FLOW										
1/8/85	12.48	2200	870	25	31	0.180	0.305	0.258	0.215	<0.050	<0.4	0.016
4/3/85	11.48	1500	530	18	22							
7/25/85		INSUFFICIENT SAMPLE OR DRY										
10/31/85	11.54	2800	720	29	<10							
1/23/86		STREAM FROZEN										

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WITMER ROAD SAMPLING PROJECT

SAMPLE LOCATION NO. 6A (cont'd.)

Sample Date	pH Units	Cond. umhos	TDS mg/l	COD mg/l	TOC mg/l	Ba (mg/l)	Cr(T) (mg/l)	Cr(VI) (mg/l)	Fe (mg/l)	Mn (mg/l)	Si (mg/l)	Zn (mg/l)
4/2/86	12.3	4300	1100	28	26	0.275	0.463	0.450	0.159	<0.03	1.38	0.105
8/4/86	12.45	310	1200	45	8							
10/2/86	12.00	1900	520	27	16							
1/28/87			F R O Z E N									
4/15/87	11.40	3400	960	27	20	0.226	0.333	0.306	0.308	0.021	2.22	0.011

LC CONSULTANTS/CONSTRUCTORS, INC.

WITMER ROAD SAMPLING PROJECT

SAMPLE LOCATION NO. 7

Sample Date	pH Units	Cond. umhos	TDS mg/l	COD mg/l	TOC mg/l	Ba (mg/l)	Cr(T) (mg/l)	Cr(VI) (mg/l)	Fe (mg/l)	Mn (mg/l)	Si (mg/l)	Zn (mg/l)
/7/79	11.70	3500		19	10	0.05	0.48		0.06	0.01	3.3	0.01
/11/79	11.80	2800		10	8	0.10	0.59		0.18	0.03	5.0	0.01
/14/79	11.60	3950		22	12	0.20	0.95		0.02	0.01	2.5	0.01
/11/79	12.10	7000		28	9	0.20	1.1		0.02	<0.01	0.8	<0.01
2/14/79	11.40	6000		22	8	0.15	0.17		0.12	<0.005	—	0.015
/16/80	12.30	7000	1440	22	12	<0.1	0.35		0.06	<0.01	0.5	0.01
/11/80	11.75	3800	1520	12	14	0.2	1.6		0.02	<0.01	0.05	0.02
/8/80	11.65	7800	1950	17	15	0.9	2.2		<0.02	<0.01	<0.01	<0.01
0/30/80	12.30	7500	1520	2	8	0.5	0.82	0.03	0.07	0.02	0.5	0.01
/7/81			STREAM FROZEN									
/7/81	12.05	6100	1804	45.4	27.4	0.37	1.73	1.27	<0.05	<0.02	0.50	<0.01
/22/81	10.77	630	268	14.5	1.0	0.40	0.384	0.130	<0.05	<0.02	6.4	<0.010
0/29/81	11.52	4700	290	38	37	<0.2	1.800	0.860	<0.05	0.022	0.2	<0.05
/6/82	11.35	2170	680	52.5	24.1	<0.2	0.438	0.114	0.066	<0.020	3.0	0.029
/14/82	11.20	2400	1044	11.3	36.5	0.214	1.25	0.851	<0.050	<0.020	1.30	<0.010
/27/82			NO FLOW									
0/20/82			NO FLOW									
/1/83	11.55	5300	1694	25.5	6.54	<0.2	2.640	0.980	<0.05	<0.02	2.9	<0.050
/21/83			DRY									
0/26/83	12.29	2840	944	18.8	13.2							
/24/84	12.36	2700	1030	15.7	9.2	4.9	0.88	0.55	<0.05	0.014	1.9	<0.02
/11/84	11.71	900	900	32	9.8	0.06						
/13/84			DRY									
0/11/84			NO FLOW									

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SLC CONSULTANTS/CONSTRUCTORS, INC.

WITMER ROAD SAMPLING PROJECT

SAMPLE LOCATION NO. 7 (cont'd.)

Sample Date	pH Units	Cond. umhos	TDS mg/l	COD mg/l	TOC mg/l	Ba (mg/l)	Cr(T) (mg/l)	Cr(VI) (mg/l)	Fe (mg/l)	Mn (mg/l)	Si (mg/l)	Zn (mg/l)
1/8/85	7.69	3700	1500	15	40	0.276	0.927	0.561	<0.050	<0.050	<0.4	0.009
4/3/85	11.43	1500	500	4.1	25							
7/25/85	12.22	6800	1700	54	13							
10/31/85	11.70	1800	850	22	18							
1/23/86	12.12	3600	1100	26	8.3							
4/2/86	12.3	2700	770	25	25	0.181	0.403	0.371	0.202	<0.03	1.62	0.247
8/4/86	12.65	210	1600	26	5							
10/2/86	12.15	2600	710	320	63							
1/28/87			FROZEN									
4/15/87	11.10	2400	740	80	22	0.148	0.281	0.244	0.481	0.064	2.74	<0.01

SLC CONSULTANTS/CONSTRUCTORS, INC.

WITMER ROAD SAMPLING PROJECT

SAMPLE LOCATION NO. 12

Sample Date	pH Units	Cond. umhos	TDS mg/l	COD mg/l	TOC mg/l	Ba (mg/l)	Cr(T) (mg/l)	Cr(VI) (mg/l)	Fe (mg/l)	Mn (mg/l)	Si (mg/l)	Zn (mg/l)
1/16/80	7.70	1150	734	2	72	<0.1	0.02		0.26	0.11	4.5	0.06
4/11/80	7.00	1350	1220	<2	76	<0.1	<0.02		0.02	0.15	5.4	0.08
7/8/80	7.30	1450	1070	<2	130	<0.1	<0.02		0.27	0.21	3.8	0.02
10/30/80	7.90	1450	842	7	<5	0.5	<0.02	<0.02	3.8	1.39	9.8	0.05
1/30/81	7.5	1250	720	<20	1		0.124	0.01250	<0.050	0.105	2.8	<0.050
4/7/81	7.05	980	796	63	7.8	<0.2	0.017	<0.005	<0.05	0.217	5.5	0.023
5/22/81	7.15	900	706	<5	1.3	0.41	0.017	0.008	<0.05	0.133	6.0	0.101
10/29/81	7.11	1005	800	67.3	26.5	<0.2	<0.005	<0.005	<0.05	0.156	0.5	0.016
1/6/82	7.25	890	720	18.2	6.4	<0.2	<0.005	<0.005	<0.050	0.088	7.0	0.183
4/14/82	7.20	800	686	11.3	48.0	<0.200	<0.005	<0.005	<0.050	<0.020	6.10	0.018
7/27/82	7.49	910	810	37.2	37.1	<0.200	0.088	<0.005	<0.050	0.052	3.95	<0.050
10/20/82	7.80	1850	1540	5.32	39.4	<0.200	<0.005	<0.005	<0.050	0.134	6.78	<0.050
3/1/83	7.15	980	868	17.6	70.8	<0.2	0.053	<0.005	<0.05	0.038	6.51	<0.050
7/21/83	7.80	790	572	53.8	52.6							
10/26/83	8.39	670	518	50.3	102.0							
2/24/84	7.95	670	546	10.0	16.8	1.4	0.018	0.016	<0.05	0.019	4.6	<0.02
4/11/84	7.51	680	540	19.5	8.3	0.05						
7/13/84	7.56	775	514	<5.0	25							
10/11/84	7.58	940	550	12	10							
1/8/85	7.43	610	580	23	150	0.082	0.163	0.084	1.36	0.076	<0.4	0.034
4/3/85	7.20	740	520	23	10							
7/25/85	7.41	1100	800	38	11							
10/31/85	7.39	1400	930	11	20							
1/23/86	8.05	840	630	18	55							

Continued on next page.

WITMER ROAD SAMPLING PROJECT

SAMPLE LOCATION NO. 12 (cont'd.)

Sample Date	pH Units	Cond. umhos	TDS mg/l	COD mg/l	TOC mg/l	mg/l						
						Ba	Cr(T)	Cr(VI)	Fe	Mn	Si	Zn
4/2/86	7.60	890	580	13	17	0.068	0.027	0.023	0.068	0.034	6.84	<0.05
8/4/86	7.82	1300	630	12	17							
10/2/86	7.55	1200	840	16	<10							
1/28/87	7.48	960	610	15	12							
4/15/87	6.80	920	620	13	21	0.061	0.073	0.064	0.117	0.010	5.92	0.013

SLC CONSULTANTS/CONSTRUCTORS, INC.

WITMER ROAD SAMPLING PROJECT

SAMPLE LOCATION NO. 12A

Sample Date	pH Units	Cond. umhos	TDS mg/l	COD mg/l	TOC mg/l	Ba (mg/l)	Cr(T) (mg/l)	Cr(VI) (mg/l)	Fe (mg/l)	Mn (mg/l)	Si (mg/l)	Zn (mg/l)
4/3/85	I.S.											
7/25/85		INSUFFICIENT SAMPLE OR DRY										
10/31/85			D R Y									
1/23/86	7.49	630	460	84	88							
4/2/86	7.65	600	370	54	39	<0.03	<0.01	<0.01	<0.05	0.399	6.22	0.082
8/4/86			D R Y									
10/2/86			D R Y									
1/28/87	7.25	800	530	37	25							
4/15/87	6.60	720	450	26	30	0.032	<0.01	0.030	1.17	0.269	5.58	<0.01

I.S. = Insufficient Sample

WITMER ROAD SAMPLING PROJECT

SAMPLE LOCATION NO. 13

Sample Date	pH Units	Cond. umhos	TDS mg/l	COD mg/l	TOC mg/l	mg/l Ba	Cr(T)	Cr(VI)	Fe	Mn	Si	Zn
1/16/80	8.00	1000	682	4	110	<0.1	0.02		0.79	1.84	4.9	0.08
4/11/80	8.50	1050	1010	<2	25	0.3	0.02		0.60	0.28	5.0	0.14
7/8/80	7.75	1050	717	<2	70	<0.1	0.02		0.06	0.19	3.2	0.03
10/30/80	7.70	1100	582	2	<5	<0.1	<0.02	<0.02	3.4	1.83	7.1	0.23
1/30/81	7.6	1100	626	25	1		0.153	0.00810	<0.050	0.241	3.4	<0.050
4/7/81	8.25	970	742	4.9	10.8	0.23	<0.005	<0.005	<0.05	0.185	5.6	0.071
6/22/81	7.25	940	672	<5.0	1.5	0.22	0.016	0.013	<0.05	0.139	8.8	0.151
10/29/81	7.30	985	750	67.3	29	<0.2	0.022	<0.005	<0.05	0.180	0.6	0.054
1/6/82	7.40	865	700	10.1	2.5	<0.2	<0.005	<0.005	<0.050	0.137	6.5	0.089
4/14/82	7.32	800	702	29.4	16.0	<0.200	<0.005	<0.005	<0.050	0.136	5.50	0.056
7/27/82	7.48	760	658	22.5	23.0	<0.200	0.078	<0.005	<0.050	0.097	4.45	<0.050
10/20/82	8.08	1080	724	<5.0	20.4	<0.200	<0.005	<0.005	<0.050	0.155	7.58	<0.050
3/1/83	7.02	1060	934	11.4	59.5	<0.2	0.007	<0.005	<0.05	0.177	5.4	0.125
7/21/83	7.60	890	756	13.9	25.3							
10/26/83	7.55	800	682	9.60	107.0							
2/24/84	7.84	860	668	2.9	20.0	1.3	0.005	<0.05	<0.05	0.129	4.5	0.023
4/11/84	7.31	820	720	15.0	16.5	0.03						
7/13/84	7.48	970	636	<25	15							
10/11/84	7.53	760	760	11	16							
1/8/85	12.23	780	680	12	100	0.048	0.038	0.007	1.23	0.223	<0.4	0.042
4/3/85	7.20	860	660	53	12							
7/25/85	7.37	1000	840	27	13							
10/31/85	7.22	1000	710	3.7	12							
1/23/86	8.12	910	680	12	36							

Continued on next page.

WITMER ROAD SAMPLING PROJECT

SAMPLE LOCATION NO. 13 (cont'd.)

Sample Date	pH Units	Cond. umhos	TDS mg/l	COD mg/l	TOC mg/l	Ba (mg/l)	Cr(T) (mg/l)	Cr(VI) (mg/l)	Fe (mg/l)	Mn (mg/l)	Si (mg/l)	Zn (mg/l)
4/2/86	11.1	1200	740	15	25	0.087	<0.01	<0.01	6.32	0.372	17.2	0.311
8/4/86	7.59	1200	790	6.6	<1							
10/2/86	7.45	970	630	8.0	<10							
1/28/87	7.45	1000	690	<10	<10							
4/15/87	6.80	990	790	5.1	14	0.035	<0.01	<0.01	0.318	0.135	5.70	0.056

SLC CONSULTANTS/CONSTRUCTORS, INC.

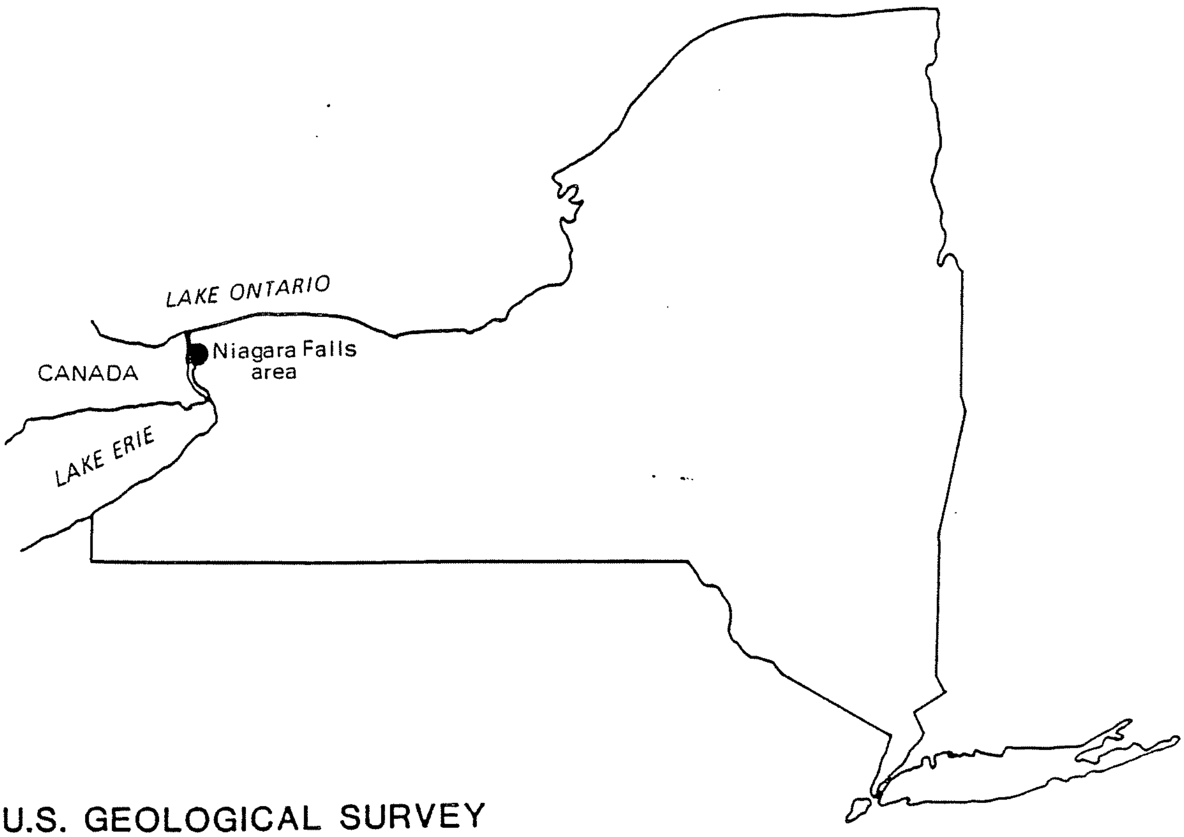
WITMER ROAD SAMPLING PROJECT

SAMPLE LOCATION NO. 13A

Sample Date	pH Units	Cond. umhos	TDS mg/l	COD mg/l	TOC mg/l	Ba (mg/l)	Cr(T) (mg/l)	Cr(VI) (mg/l)	Fe (mg/l)	Mn (mg/l)	Si (mg/l)	Zn (mg/l)
4/3/85	10.36	520	260	95	13							
7/25/85	INSUFFICIENT SAMPLE OR DRY											
10/31/85	10.51	540	320	26	15							
1/23/86	11.14	440	270	21	6.7							
4/2/86	12.3	440	180	15	19	<0.03	0.703	0.674	0.094	<0.03	11.5	0.095
8/4/86	11.35	2000	350	26	9							
10/2/86	11.15	580	310	26	11							
1/28/87	10.20	310	220	22	45							
4/15/87	9.60	310	200	20	<10	<0.01	0.714	0.632	0.040	<0.005	9.22	<0.01

REFERENCE NO. 12

Effect of Niagara Power Project on Ground-Water Flow in the Upper Part of the Lockport Dolomite, Niagara Falls Area, New York



U.S. GEOLOGICAL SURVEY
Water-Resources Investigations
Report 86-4130

Prepared in cooperation with the
U.S. ENVIRONMENTAL PROTECTION AGENCY
NEW YORK STATE DEPARTMENT OF
ENVIRONMENTAL CONSERVATION

of studies by the New York State Department of Environmental Conservation, private consultants, and by the U.S. Geological Survey to describe ground-water conditions at many waste-disposal sites in the Niagara Falls area.

Acknowledgments

The New York Power Authority provided construction details of the power-project facilities, water-level data from the forebay canal and pumped-storage reservoir, and assistance in measuring water levels in NYPA wells in the vicinity of the pumped-storage reservoir. The New York State Department of Environmental Conservation coordinated the water-level measurements at industrial sites. Several industries, including Occidental Petroleum and E.I. Dupont De Nemours and Company, provided water-level data. The City of Niagara Falls provided construction details on many sewer and building projects and assisted in obtaining permits and permission to drill observation wells within the city.

GEOHYDROLOGY OF THE LOCKPORT DOLOMITE

Stratigraphy and Lithology

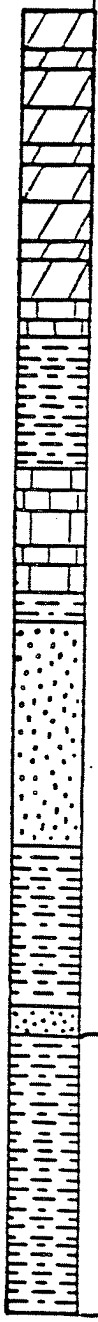
Unconsolidated glacial deposits of till and lacustrine silt and clay, generally 5 to 15 ft thick but ranging to 48 ft thick, overlie the 80- to 158-ft-thick Lockport Dolomite of Middle Silurian age within the Niagara Falls area (Tesmer, 1981). The thickest unconsolidated deposits (up to 48 ft) are in a shallow buried valley in the western part of the city (pl. 1B).

Underlying the Lockport Dolomite is a 27-ft-thick sequence of Middle Silurian shale, limestone, and dolomite in the lower part of the Clinton Group, which is underlain by a 113-ft-thick sequence of Lower Silurian sandstone and shale that is in turn underlain by 1,200-ft-thick Upper Ordovician shale. These rocks are exposed only in the Niagara River gorge and are shown in the stratigraphic column in figure 2. The strata are gently folded and dip slightly to the south-southwest at about 30 ft/mi (Fisher and Brett, 1981).

The Lockport Dolomite is a fine to coarse crystalline, thin to massive bedded dolomite, limestone, and shaly dolomite, with vugs containing gypsum (calcium sulfate) and calcite (calcium carbonate). Other minor minerals disseminated throughout the formation are sphalerite (zinc sulfide), pyrite (iron sulfide), and galena (lead sulfide) (Tesmer, 1981).

Hydraulic Conductivity

The Lockport can be divided into two zones on the basis of water-transmitting properties. The upper 10 to 25 ft of rock is a moderately permeable zone that contains relatively abundant bedding planes and vertical joints enlarged by dissolution of dolomite and abundant solution cavities left by dissolution of gypsum; the remainder of the formation contains low to moderately permeable bedding planes of which as many as seven may be major water-bearing zones that are surrounded by fine-grained crystalline dolomite of low permeability. Hydraulic-conductivity values obtained from model simulations and limited aquifer-test data (Maslia and Johnston, 1982) range from 5 to 15 ft/d in the upper part and from 1 to 2 ft/d in the lower part. Well yields commonly range from 10 to 100 gal/min.



System and series		Group	Formation	Thickness (feet)	Description
Silurian	Middle	Lockport	Lockport Dolomite	158	Dark-gray to brown, massive to thin-bedded dolomite locally containing algal reefs and small, irregularly shaped masses of gypsum. Near the base are light-gray coarse-grained limestone (Gasport Limestone Member, dark-gray shaley dolomite)
		Clinton	Rochester Shale	60	Dark-gray calcareous shale weathering light-gray to olive.
			Irondequoit Limestone	12	Light-gray to pinkish-white coarse-grained limestone.
			Reynales Limestone	10	White to yellowish-gray shaly limestone and dolomite.
			Neahga Shale	5	Greenish-gray soft fissile shale.
	Lower	Medina	Thorold Sandstone	8	Greenish-gray shaly sandstone.
			Grimsby Sandstone	45	Reddish-brown to greenish-gray cross-bedded sandstone interbedded with red to greenish-gray shale.
			Power Glen Shale	40	Gray to greenish-gray shale interbedded with light-gray sandstone.
			Whirlpool Sandstone	20	White, quartzitic sandstone
Ordovician	Upper	Richmond	Queenston Shale	1,200	Brick-red sandy to argillaceous shale.

Figure 2.--Stratigraphy of the Niagara Falls area. (Modified from Fisher, 1959.)

Ground Water

Occurrence

The Lockport Dolomite is the principal source of ground water in the Niagara Falls area. Although the effective primary porosity is negligible, significant ground-water movement occurs through secondary openings such as bedding joints (planes), vertical joints (fractures), and solution cavities, described below. The upper 25 ft of the Lockport has a greater potential for movement of ground water (and contaminants) than the deeper parts because it has more interconnected vertical and horizontal joints that have been widened by solutioning, which allows direct entry of contaminants from surface sources.

Bedding planes.--The bedding planes, which transmit most of the water in the Lockport (Johnston, 1964), are relatively continuous fracture planes parallel to the natural layering of the rock. These openings were caused by crustal movements and the expansion of the rock during removal of weight by erosion of overlying rock units and by retreat of the glaciers. Johnston (1964) identified seven water-bearing zones, which consist either of a single open-bedding plane or an interval of rock layers containing several open planes. The top 10 to 25 ft of rock may contain one or two significant bedding planes; these are probably connected by vertical joints, which are abundant in the upper part of the formation.

The lower part of the Lockport Dolomite contains fewer water-bearing bedding planes that are interconnected by vertical joints. These deeper water-bearing zones are underlain and overlain by essentially impermeable rock. Each water-bearing bedding plane can be considered a separate and distinct artesian aquifer (Johnston, 1964). The hydraulic head within each water-bearing zone is lower than that in the zone above it; this indicates a downward component of ground-water flow.

Vertical joints.--Vertical joints in the Lockport Dolomite are not significant water-bearing openings except (1) in the upper 10 to 25 ft of rock, (2) within about 200 ft of the Niagara River Gorge, and (3) in the vicinity of the buried conduits. Physical and chemical weathering have increased the number, continuity, and size of vertical fractures in the upper part of the Lockport. The major joints, oriented N 70°E to N 80°E, are generally straight, spaced 10 to 80 ft apart, and penetrate 10 to 25 ft (American Falls International Board, 1974). Intersecting the major joint set are less extensive high-angle joints that are confined to particular beds. Vertical joints become narrower, less numerous, and less connected with depth.

In addition to the major regional fractures, extensive tension-release fractures were formed near the gorge wall by the erosion and removal of the supporting rock mass in the gorge; openings up to 0.3 ft wide have been observed (American Falls International Board, 1974). Less developed tension-release joints and blasting-originated joints are common along the twin conduits. These fractures probably extend less than 100 ft from the trench walls.

Solution cavities.--Solution cavities are formed by the dissolution of gypsum pockets and stringers by percolating ground water. These cavities range in diameter from 1/16 in to 5 in; they are most abundant in the upper 10 to 15 ft of rock but occur also along water-bearing bedding zones throughout the Lockport. The solution cavities become less continuous with depth and therefore have little effect on the water-transmitting ability of the lower parts of the formation.

Recharge

Most of the recharge to the Lockport Dolomite results from infiltration of rainfall and snowmelt through the soil to the water table. Precipitation in the Niagara Falls area averages 30 in/yr and is fairly evenly distributed throughout the year (Dethier, 1966). Snow usually accumulates from mid-December to mid-March, during which time several thaws may reduce or entirely melt the snow pack. Seven 14-month hydrographs of U.S. Geological Survey wells installed in the upper part of the Lockport (fig. 3) and a 10-year hydrograph of a long-term observation well, Ni-69 (fig. 4) indicate that most recharge occurs from late fall through winter (November to April), when evapotranspiration is low. Generally, water levels fluctuate less than 6 ft annually.

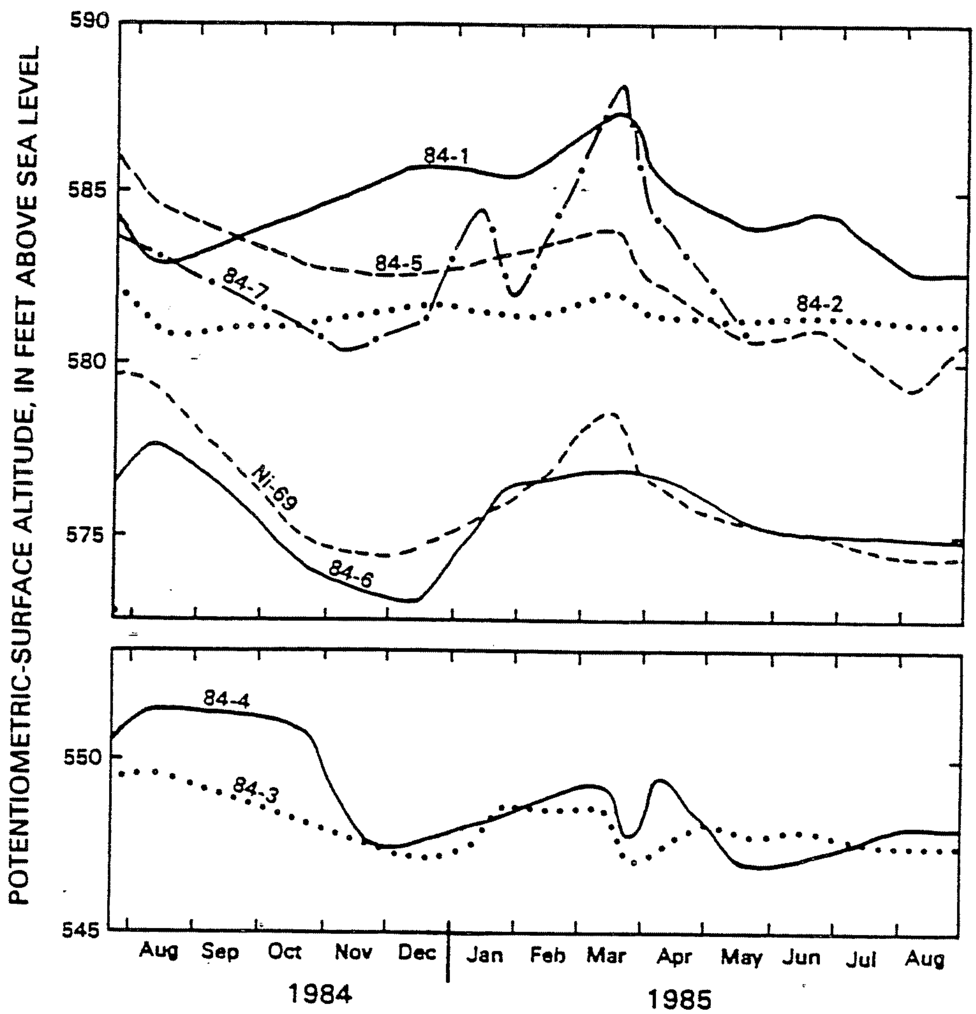


Figure 3.--Hydrographs of wells 84-1 through 84-7 in and near the City of Niagara Falls.

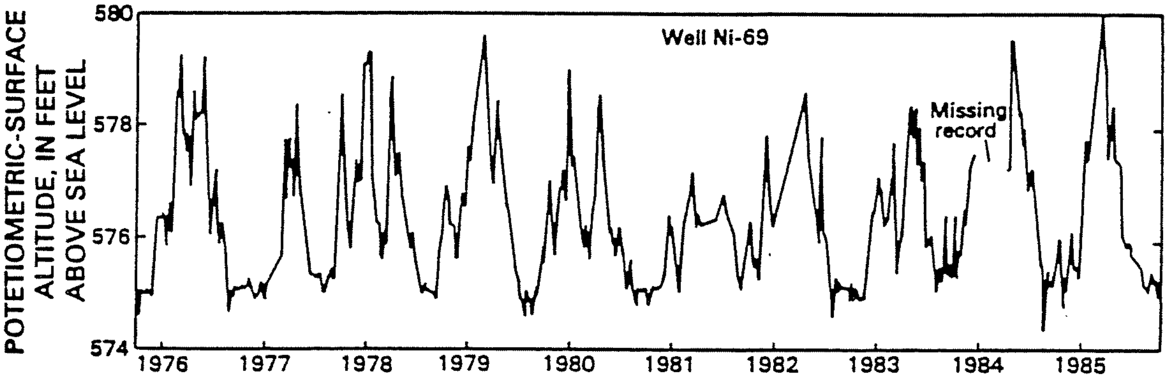


Figure 4.--Hydrograph of well Ni-69 in northern part of the city of Niagara Falls.

The rate and amount of recharge to a formation from precipitation depends on the permeability of the overlying lacustrine fine sand, silt, clay, and till, which in the Niagara Falls area is relatively low, with hydraulic conductivity ranging from 0.0014 to 0.27 ft/d. The average annual recharge from precipitation is estimated to be 5 to 6 in/yr (LaSala, 1967) but is probably greater in several small areas where the Lockport, whose hydraulic conductivity ranges from 5 to 15 ft/d, crops out at land surface.

Movement and Discharge

Before construction of Niagara Power project and Falls Street tunnel.--Little information is available on ground-water levels in the Niagara Falls area before 1960; therefore, interpretation of ground-water movement in the upper part of the Lockport Dolomite before that time is based largely on fundamental assumptions governing ground-water flow. These assumptions are that (1) ground-water divides coincide with topographic highs; thus the major divides in the region were at the Niagara Escarpment, north of the study area (fig. 1), and in the central part of the City of Niagara Falls (pl. 1A); (2) regional flow of ground water followed the south-southwestward slope of the land surface and the southwestward dip of major bedding planes, (3) local ground-water movement followed the configuration of the buried bedrock surface; and (4) ground water in the central and southern parts of the city discharged to the upper Niagara River, while water in the western part discharged to the lower Niagara River in the gorge. The general inferred directions of ground-water movement in the upper part of the Lockport Dolomite before any major construction or industrial pumping is shown in figure 5.

Effect of Falls Street tunnel.--In the early 1900's, the Falls Street tunnel was excavated through the upper part of the Lockport Dolomite from 56th Street to the Niagara gorge (fig. 6). This 3.5-mi-long unlined tunnel trends east-west and slopes 20 ft/mi beneath the southern part of the city approximately 0.65 mi north of the upper Niagara River (fig. 1). Runoff and ground water that drained into the tunnel flowed west with sewage to a treatment plant in the Niagara River gorge below the Falls.

The bottom of the Falls Street tunnel slopes westward from 549 ft above sea level at 56th Street to 533 ft at 27th Street (fig. 6), which places the tunnel at or above the altitude of the lowest part of the Niagara River channel in this reach. Thus, in the reach from 56th Street to 27th Street, water from the Niagara River (surface altitude about 560 ft) probably moves through the upper part of the Lockport northward toward the tunnel through the relatively permeable upper 15 to 20 ft of the Lockport. A shallow bedrock valley in this area (pl. 1B) may be a major zone of infiltration to the tunnel because the depth of weathering would be deepest under this channel. Ground water north and south of the tunnel probably drains into the tunnel also, but the size of the area affected by the tunnel is unknown.

The Falls Street tunnel from 24th Street west to the Niagara gorge is 25 ft or more below the relatively permeable upper zone of the Lockport. Thus, the tunnel in this area is overlain by less fractured, less permeable beds that limit downward flow. A study of ground-water infiltration into the tunnel (Camp, Dresser and McKee, 1982) found only minimal seepage to the Falls Street tunnel between 24th Street and the gorge. Although the amount of water that drained into the tunnel before construction of the conduits is unknown, the Falls Street tunnel east of 27th Street probably altered ground-water movement by creating a local ground-water low as water drained into the tunnel from the upper 25 ft of bedrock and possibly from the Niagara River.

During the 1930's and 1940's, several companies drilled and pumped water from an industrialized area within 2,000 ft of the Niagara River near Gill Creek (fig. 1); yields from these wells were as high as 1,800 gal/min. Johnston 1964) and Woodward-Clyde Consultants (1983) reported that most of the pumped water was induced recharge from the Niagara River that moves predominantly through the upper part of the Lockport Dolomite. The induced recharge from the Niagara River by industrial pumping and possibly some infiltration to the Falls Street tunnel are the only known changes in natural ground-water flow patterns in this part of the city before the construction of the Niagara Power Project.

HYDROLOGIC EFFECTS OF NIAGARA POWER PROJECT

The Niagara Power Project, constructed by New York Power Authority during 1958-62, has an electrical production capacity of 1,950,000 kw. Part of the flow of the upper Niagara River 2.5 mi above the Falls is diverted 4 mi north through the twin buried conduits to the L-shaped forebay canal, which is between the Robert Moses powerplant and the Lewiston powerplant (fig. 1). The conduits can divert 50,000 to 75,000 ft^3/s of water, which is at least 25 percent of the river's flow.

Table 1.--Flow of Niagara River over Horseshoe and American Falls.[1]

Season	Dates	Hours		Minimum flow over falls (ft^3/s)
Tourist season	Apr. 1 to Sept. 15	Day:	8:00 am to 10:00 pm	100,000
		Night:	10:00 pm to 8:00 am	50,000
	Sept. 1 to Oct. 31	Day:	8:00 am to 8:00 pm	100,000
		Night:	8:00 pm to 8:00 am	50,000
Non-tourist season	Nov. 1 to Mar. 30		12:00 am to 12:00 am	50,000

[1] The diverted water (average total flow of river, 204,000 ft^3/s, minus flow over falls) is divided between Canada and United States.

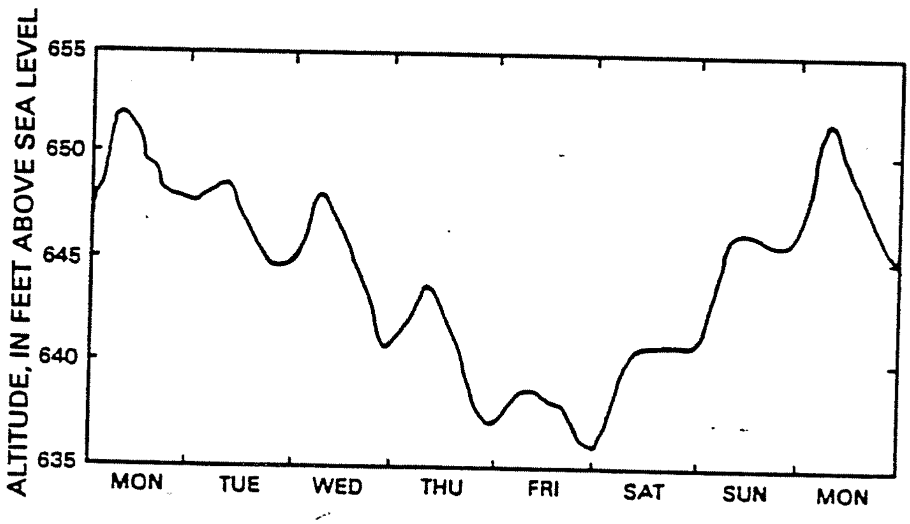


Figure 8.

Typical Lewiston Reservoir water levels during a weekly pumped-storage/release cycle.

Ground-Water Flow and Water Levels

Construction of the twin buried conduits, the forebay canal, and the pumped-storage reservoir has modified hydrologic conditions within the Niagara Falls area. The daily and seasonal regulation of water levels in the reservoir and forebay canal have changed the natural flow patterns and water levels in the upper part of the Lockport Dolomite. To determine the effect of the power project on ground-water movement, water levels in the upper part of the Lockport Dolomite were measured at 104 wells on October 23-24, 1984 and on March 26-27, 1985 (values are given in table 2, at end of report). The difference between water levels in October and those in March were relatively small (generally within 3 to 5 ft); therefore, only the water levels measured in March were used to construct a potentiometric-surface map (pl. 1A), which includes arrows showing the directions of ground-water flow.

Effect of Twin Buried Conduits

The twin buried conduits were constructed in two separate parallel bedrock trenches approximately 4 mi long. Each trench is 52 ft wide and penetrates 100 to 160 ft into the Lockport Dolomite; at the north end they penetrate the Lockport and upper part of the underlying Rochester Shale (fig. 9). The top of the conduits averages more than 40 ft below land surface. General construction details for the conduits are shown in figure 10.

Along the conduits are two dewatering stations--one at the intersection of the Falls Street tunnel at Royal Avenue, the other just south of the forebay canal (fig. 1). Each pumping station has direct access to water in both conduits and to water in the drain system that surrounds the conduits, which is in hydraulic contact with the surrounding bedrock. The pumping stations were designed to drain water from the bedrock surrounding each conduit through the drain system to reduce hydrostatic pressure, which could collapse the conduits should they need to be dewatered.

The drain system surrounding the conduits consists of formed, vertical 6-in-diameter drains placed every 10 ft along both sides of each conduit (fig. 11A), and two semicircular (2-ft radius) floor drains beneath the full length of the conduits at the bottom of each trench. The wall and floor drains are connected to continuous concrete-formed side drains in the lower corners of each bedrock trench (fig. 11A). All drains were formed into the concrete-conduit structure and are open to the bedrock walls and floor of conduit trenches but are not open directly to the river or forebay canal.

The only locations where water in the drain system can mix with water inside the conduits is at the two pumping stations. Each station has three sumps (fig. 11B)--a central sump connected to the conduit drain system that surrounds both conduits, and the two outer sumps, each of which is connected to the adjacent conduit. Both pumping stations have a pair of balancing weirs; one is near the Falls Street tunnel and operates at an altitude of 560 ft; the other is at the conduit outlet on the forebay canal and operates at an altitude of 550 ft. When the water level in the drain system exceeds the altitude of the balancing weir, water from the drains flows through the weir to the outer sumps and into the conduits, which discharge into the forebay canal.

<u>Ground-water discharge into the backfill</u>.--Backfill on top of the conduits was found to be relatively permeable where the Falls Street tunnel and conduits intersect (Koszalka and others, 1985, p. 56); however, no description of the backfill materials elsewhere along the conduits could be found. To determine whether the backfill is permeable elsewhere and forms a major pathway for ground-water movement, four wells were drilled during this study, three over the east conduit (wells 84-9, 84-10, and 84-11) and one over the west conduit (84-8, fig. 1). Drill cuttings indicated that the backfill consists of 2 to 5 ft of topsoil overlying 30 to 75 ft of shotrock (cobble- to boulder-size clasts of Lockport Dolomite that was blasted and removed during trench excavation), which overlies 5 to 15 ft of sandy, clayey silt fill of low permeability that overlies the conduits. The shotrock is permeable but unsaturated; only the lower part of the sandy, clayey silt was saturated. Water-level recorders installed on two wells in the sandy clayey silt (84-9 and 84-11, location shown in fig. 1) indicated that the water levels took several months to recover to a static level after the wells were pumped dry (fig. 12), which indicates that the sandy, clayey silt backfill has very low permeability and therefore transmits little ground water. Well 84-9 did not respond to fluctuations of water levels in the forebay canal, and water levels in well 84-11 fluctuated only when water levels in the forebay rose to altitudes greater

than 560 ft, which occurred at the end of January and beginning of February 1985, when NYPA raised the water level in the forebay canal to clear a large accumulation of pack ice from the conduit intakes along the upper Niagara River. When this occurred, the water level in well 84-11 rose 10 ft to an altitude of 556.11 ft, then began a slow, steady decline (fig. 12). Water-level altitudes greater than 560 ft at well 84-11 would have caused the lower zone of the permeable shotrock fill to become saturated. Water probably entered the well relatively rapidly by leakage down the side of the casing, which could explain the rapid rise of the water level in the well; normally this should not have occurred because the well was installed in relatively impermeable sediment. Well 84-11 does not respond to water-level fluctuations in the bedrock or forebay canal below this altitude.

The relatively impermeable, sandy, clayey silt in the saturated part of the backfill prevents significant ground-water movement in the backfill. An exception may be at the intersection of the Falls Street tunnel and the conduits, where more permeable backfill was found. The method of backfilling there may have been different from that used elsewhere along the conduits because the conduits dip where they pass under the Falls Street sewer (fig. 9).

Ground-water discharge into drains surrounding the conduits.--The drain system that surrounds the conduits has lowered ground-water levels near the conduit trenches, which causes ground water in the Lockport Dolomite to flow toward the conduits (pl. 1A). Ground water within 0.5 mi of the conduits that previously flowed southward now flows toward the conduits and discharges into the drain system. To determine the direction of flow in the drains, water levels were measured in the central chamber in the pumping stations and in several NYPA open-hole wells installed in the bedrock 5 to 10 ft from the vertical wall drains. Because the drain system is in direct hydraulic contact

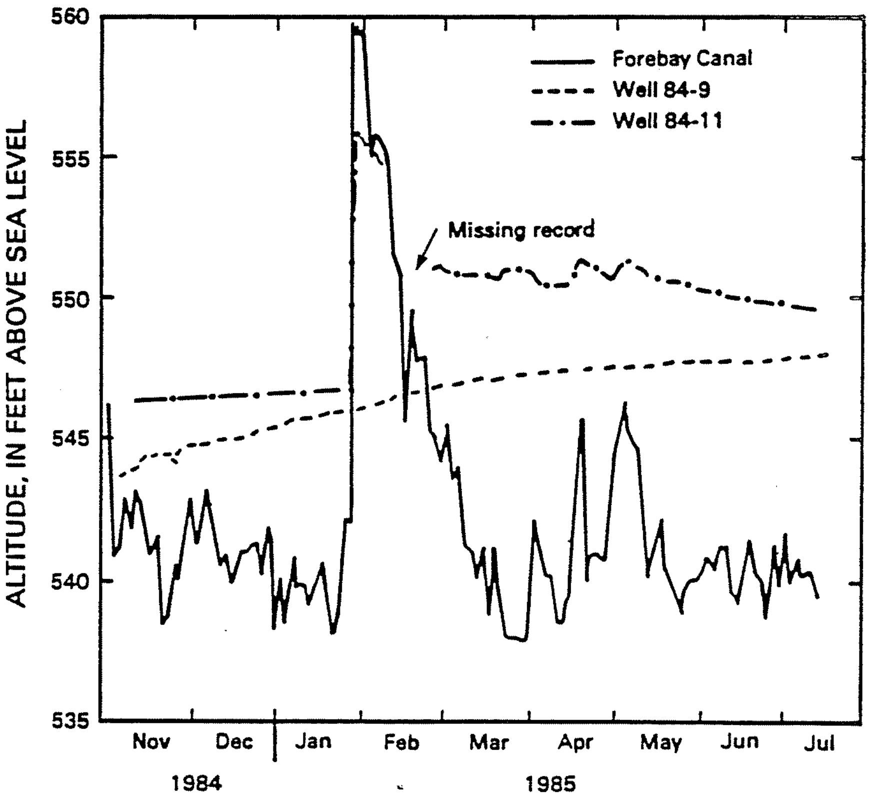


Figure 12.

Average daily water-level fluctuations in the forebay canal and recovery of water levels in wells 84-9 and 84-11 (installed in backfill atop conduits) after evacuation of water from the casing, November 1984 through July 1986.

with ground water in the Lockport Dolomite, the hydraulic heads measured in the NYPA wells are the same or nearly the same as water levels in the drains that surround the conduits (fig. 10). Water levels in wells adjacent to the conduits indicate that, most of the time, water from the vicinity of the forebay canal that enters the drains flows southward to where the Falls Street tunnel crosses the conduits (pl. 1A), whereas water from the upper Niagara River that enters the drains flows northward to the tunnel. The drain system acts as the path of least resistance to ground-water flow in and near the conduit trenches.

The major discharge point for water in the conduit drains is the Falls Street tunnel where it crosses the conduits (fig. 9). The method of construction at the conduit/tunnel intersection probably created this discharge zone. During construction of the conduit trenches, a 400-ft section of the Falls Street tunnel was rebuilt with precast concrete pipe sections, and the conduit trenches were then excavated beneath the Falls Street pipeline. After backfill was placed over the conduits and around the Falls Street tunnel pipe section, ground-water levels in the backfill fluctuated at or above the top of the rebuilt section of the Falls Street tunnel (fig. 13). Apparently the seals between the concrete pipe sections failed, and water from the drains began to leak into the Falls Street tunnel.

In 1982, the Falls Street tunnel was inspected for ground-water infiltration, and a large amount of inflow, estimated at approximately 6 Mgal/d, was found to leak into the Falls Street tunnel through joints in the concrete pipe where the tunnel passes over the conduits (Camp, Dresser and McKee, 1982). Most of this leakage is probably water from the conduit drain system, which drains ground water from 0.5 mi on both sides of the 4-mi-long trenches. The Lockport Dolomite is too impermeable to supply the quantity of water that

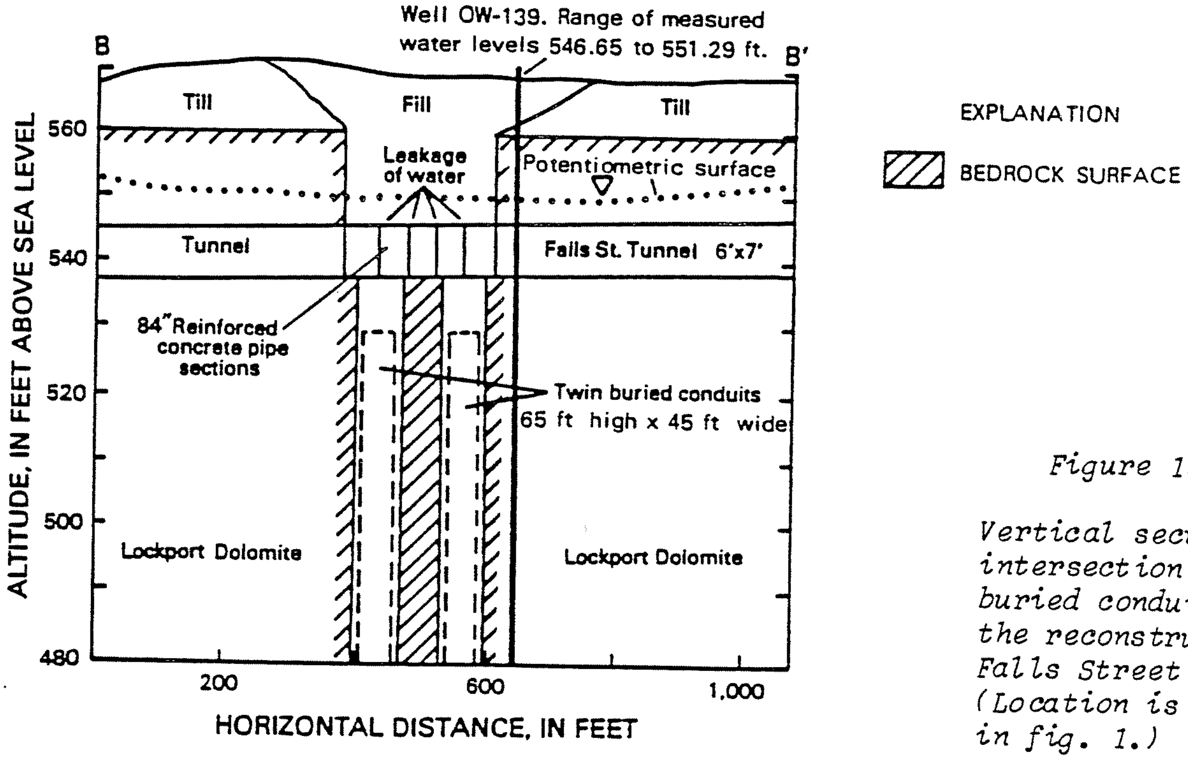


Figure 13.

Vertical section of intersection of twin buried conduits and the reconstructed Falls Street tunnel. (Location is shown in fig. 1.)

leaks into the tunnel. Estimation of how much water enters the Falls Street tunnel from either the north (powerplant) or south (river) side of the tunnel was beyond the scope of this project, however.

Effect of Forebay Canal

The forebay canal is an L-shaped excavation that penetrates the Lockport Dolomite and upper part of the Rochester Shale at the north end (outlet) of the twin conduits (fig. 1). It is 4,000 ft long, 500 ft wide, and 110 ft deep. The walls and floor are unlined. Water that enters the forebay canal from the conduits is routed to the Robert Moses powerplant, and some is pumped up to the Lewiston Reservoir, depending on the daily power-demand schedule.

The daily range of water-level fluctuations in the canal is dependent on the seasonal diversion schedule, the demand for power generation, and the flow of the Niagara River. During the summer and early fall, when the flow in the Niagara River is generally lower, daily fluctuations in the canal are greatest, as much as 25 ft. The water level in the forebay canal is increased by the release of water from the Lewiston Reservoir, which supplements the flow entering from the conduits. This combined flow into the forebay canal increases the hydraulic head in the canal to drive the Robert Moses powerplant turbines more efficiently. During high-flow periods (generally during spring) or when allowable diversions from the Niagara River are higher (table 1), daily water-level fluctuations in the forebay are less, usually ranging from 5 to 10 ft even during peak power-demand periods (fig. 7).

Ground-water discharge into the forebay canal.--The walls and floor of the forebay canal consist of bedrock. Observations of ground-water seepage from bedding planes in the forebay canal walls to the forebay canal (Lockport Dolomite) and higher water levels in nearby wells than in the forebay (pl. 1A and table 2) indicate that ground water generally discharges into the forebay canal. Little, if any, water enters the forebay canal from the underlying Rochester Shale, which has low permeability.

Effects of water-level fluctuations in the forebay canal.--The daily water-level fluctuations in the forebay canal, which can range to as much as 25 ft (fig. 7), cause instantaneous water-level fluctuations in wells along the conduits to as least 3.4 mi south of the forebay canal. The water-level fluctuations in the forebay canal also cause hydraulic-pressure changes in the drain system that surrounds the conduits. Instantaneous head responses in wells adjacent to the twin conduits to water-level fluctuations in the forebay canal suggest a direct hydraulic connection between the forebay canal and the drains. Water probably moves from the canal to the drains through gently southward dipping water-bearing bedding planes that are exposed in the walls of the forebay canal and is intercepted by the drain system that surrounds the conduits.

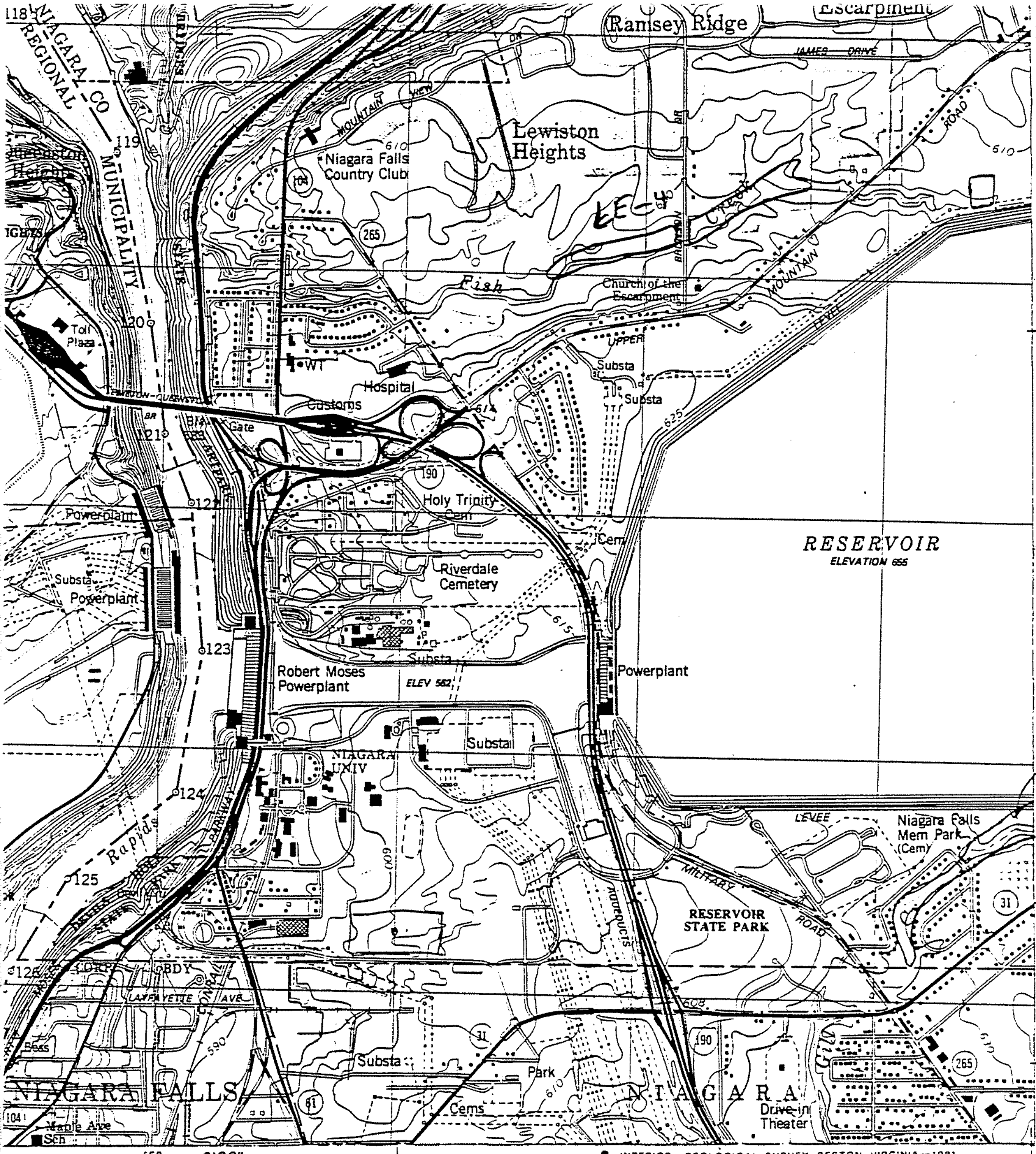
Water levels were recorded at four NYPA observation wells adjacent to the conduits at various distances south of the forebay canal; well OW-167 is at the outlet of the conduits, and wells OW-162, OW-152, and OW-139 are 0.8, 2.2,

REFERENCE NO. 13

3	.9144
4	1.2192
5	1.5240
6	1.8288
7	2.1336
8	2.4384
9	2.7432
10	3.0480

To convert feet to [cut off] multiply by .3048

To convert meters t[cut off] multiply by 3.2808



1 MILE

6000 7000 FEET

1 KILOMETER

FEET IN CANADA

ɔ

ɪR 242.8 FEET

ROAD CLASSIFICATION

Primary highway, hard surface	Light-duty road, hard or improved surface
Secondary highway, hard surface	Unimproved road

Interstate Route U. S. Route State Route

QUADRANGLE LOCATION

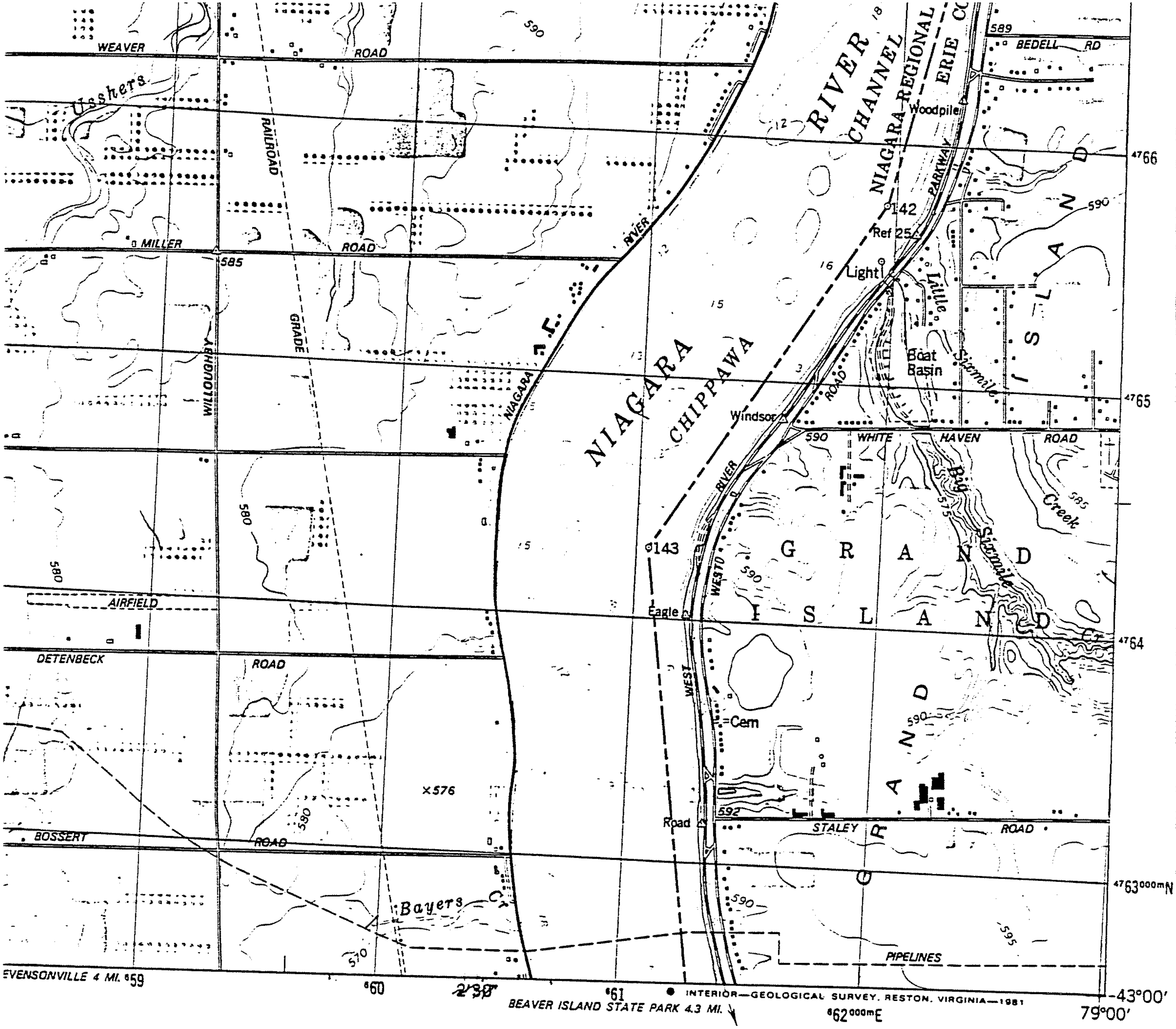
STANDARDS
ɪINIA 22092
LABLE ON REQUEST

LEWISTON, N. Y.–ONT.

NE/4 NIAGARA FALLS 15' QUADRANGLE
N4307.5–W7900/7.5

1980

DMA 5170 II NE–SERIES V821



1 MILE

5000 6000 7000 FEET

1 KILOMETER

AND 10 FEET IN CANADA
· 1929
OW WATER 568.6 FEET

ROAD CLASSIFICATION

Primary highway, hard surface

Light-duty road, hard or improved surface

Secondary highway, hard surface

Unimproved road

Interstate Route U. S. Route State Route

(BUFFALO NW)
5269 IV NW

QUADRANGLE LOCATION

ACY STANDARDS
, VIRGINIA 22092
AVAILABLE ON REQUEST

NIAGARA FALLS, N. Y.–ONT.

SE/4 NIAGARA FALLS 15' QUADRANGLE
N4300–W7900/7.5

1980

DMA 5170 II SE–SERIES V821

REFERENCE NO. 14

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF SOLID AND HAZARDOUS WASTE
INACTIVE HAZARDOUS WASTE DISPOSAL REPORT

CLASSIFICATION CODE: 3 REGION: 9 SITE CODE: 93200
EPA ID: NYD0021103

NAME OF SITE : SKW Alloy
STREET ADDRESS: Witmer Rd., at Maryland Ave.
TOWN/CITY: Niagara
COUNTY: Niagara
ZIP:

SITE TYPE: Open Dump- Structure- Lagoon-X Landfill- Treatment Pond-
ESTIMATED SIZE: 37 3.4 Acres

SITE OWNER/OPERATOR INFORMATION:
CURRENT OWNER NAME....: SKW Alloys, Inc.
CURRENT OWNER ADDRESS.: 3801 Highland Avenue, Niagara Falls, NY 14305
OWNER(S) DURING USE...: Vanadium Corp. of Am,AircoAlloys,SKW All
OPERATOR DURING USE...: Same
OPERATOR ADDRESS......: 3801 Highland Ave, N.F., NY 14305
PERIOD ASSOCIATED WITH HAZARDOUS WASTE: From To

SITE DESCRIPTION:
Located south of Witmer Road, east of Hyde Park Boulevard. The 3.4 +- acres was transferred when former owner, Airco Alloys, sold plant. Part of land retained by Airco Carbon, a subsidiary company. Previous to 1981, portions of the whole 37 acres had indiscriminate dumping on site. In addition to industrial wastes, old machinery,& ra material was placed on the site in a random manner. Land Fill Permit Issued to SKW Alloys on 10/20/81. Renewal permit is under review.

MUNICIPAL WASTE ID # 32N04

HAZARDOUS WASTE DISPOSED: Confirmed-X Suspected-

TYPE	QUANTITY (units)
Ferro chrome silicon Alloy Dust	50,000 Tons
Ferro Manganese Slag	6,000 Tons
Ferro chrome silicon Slag	21,000 Tons
Ferro silicon dust	25,000 Tons
Calcium hydroxide, refuse	Unknown

ANALYTICAL DATA AVAILABLE:
Air- Surface Water-X Groundwater-X Soil- Sediment- None-

CONTRAVENTION OF STANDARDS:
Groundwater- Drinking Water- Surface Water- Air-

LEGAL ACTION:

TYPE..: State- Federal-
STATUS: Negotiation in Progress- Order Signed-

REMEDIAL ACTION:

Proposed- Under design- In Progress- Completed-
NATURE OF ACTION:

GEOTECHNICAL INFORMATION:
SOIL TYPE: Clayey - Silt above Sandy silt above glacial till
GROUNDWATER DEPTH: Greater than 10

ASSESSMENT OF ENVIRONMENTAL PROBLEMS:

Present activities limited due to limited production. Past disposal practices at site and east of site have slightly increased background levels of trivalent chromium. During extremely dry weather, fugitive dust may be a problem in past disposal area. Area should continue to be monitored.

ASSESSMENT OF HEALTH PROBLEMS:

Medium	Contaminants Available	Migration Potential	Potentially Exposed Population	Need for Investigation
Air	Unlikely	Unlikely	Yes	Low
Surface Soil	Likely	Highly Likely	Yes	High
Groundwater	Identified	Highly Likely	Yes	High
Surface Water	Identified	Highly Likely	No	Medium

Health Department Site Inspection Date : 6/85

MUNICIPAL WASTE ID:

REFERENCE NO. 15

RADIAN
CORPORATION

November 6, 1984

Mr. Art Elmquest
SKW Alloys, Inc.
P. O. Box 368
Niagara Falls, New York 14302

Dear Mr. Elmquest:

Please find enclosed the analytical results of the solid waste samples that were gathered at the SKW Alloy Ferroalloy facility in Niagara Falls, New York. Please append this data to the trip report you received earlier.

Sincerely,

Ronald J. Dickson

Ronald J. Dickson
Environmental Engineer

RJD/ver

Enclosure

7655 Old Springhouse Road / McLean, Virginia 22102 / (703) 734-2600

ANALYSIS RESULTS FOR SKW - NIAGARA FALLS, NEW YORK

AMPLE: FERROSILICON EMISSION CONTROL DUST

OLLUTANT	EP TOXICITY (MG/L)	mn Conc	ASTM DISTILLED WATER LEACH (MG/L)	TOTAL ANALYSIS (MG/KG)
G	0.0060		<0.0020	<2.0000
S	0.0600		1.5000	73.0000
A	0.2700		0.1800	24.0000
D	0.0040		<0.0020	<1.8000
R	0.2500		0.1800	170.0000
U	0.6400		0.0680	170.0000
E	0.8400		0.0110	6000.0000
G	0.0009		<0.0005	0.2500
N	17.0000		0.5800	1000.0000
I	0.1700		0.0920	13.0000
B	0.2100		<0.0020	30.0000
B	<0.0300		<0.0300	<1.6000
E	2.0000	1,000	5.3000	0.6400
U	NA		NA	NA
V	NA		NA	NA
ZN	21.0000		0.0300	960.0000
CL	440.0000		1500.0000	NA
CNFREE	NA		NA	NA
CNTOTAL	NA		NA	NA
CR6	<0.0200		<0.0200	NA
F	26.0000		75.0000	NA
NO3	6.5000		<0.1000	NA
RADIOACT	NA		NA	NA
SO4	580.0000		1700.0000	NA
TDS	2200.0000		6100.0000	NA
Total phenolics	0.36		0.70	

ANALYSIS RESULTS FOR SKW - NIAGARA FALLS, NEW YORK

PLE: FERROCHROMESILICON EMISSION CONTROL DUST

LUTANT	EP TOXICITY (MG/L)	ASTM DISTILLED WATER LEACH (MG/L)	TOTAL ANALYSIS (MG/KG)
	<0.0020	<0.0020	<1.2000
	0.0600	0.0170	15.0000
	0.1100	0.0330	5.2000
	<0.0020	<0.0020	<0.1000
	14.0000 5	44.0000	1800.0000
	0.1300	<0.0010	24.0000
	0.1600	<0.0080	710.0000
	0.0008	<0.0005	0.3600
	8.9000	0.0090	260.0000
	0.2300	<0.0030	13.0000
	1.8000	<0.0020	18.0000
	0.3800	1.3000	28.0000
	0.0180	0.6000	2.7000
	NA	NA	NA
	NA	NA	NA
	35.0000	0.2900	1100.0000
	330.0000	160.0000	NA
REE	NA	NA	NA
OTAL	NA	NA	NA
	<0.0200	<0.0200	<0.0200
	1.1000	9.9000	NA
	6.9000	<0.1000	NA
IOACT	NA	NA	NA
	320.0000	1250.0000	NA
	4000.0000	2700.0000	NA

ANALYSIS RESULTS FOR SKW - NIAGARA FALLS, NEW YORK

MPLE: FERROCHROMESILICON SLAG

LLUTANT	EP TOXICITY (MG/L)	ASTM DISTILLED WATER LEACH (MG/L)	TOTAL ANALYSIS (MG/KG)
	<0.0020	<0.0020	<0.6300
	0.0030	0.0100	7.3000
	0.0300	0.0810	39.0000
	<0.0020	<0.0020	<0.0970
	-0.0140	0.0180	57.0000
	0.0080	<0.0010	91.0000
	0.4300	<0.0080	2100.0000
	0.0010	<0.0005	0.1900
	0.3100	0.0010	130.0000
	0.0060	0.0070	42.0000
	0.0460	0.0040	10.0000
	<0.0320	<0.0320	1.7000
	0.0120	0.0060	0.2900
	NA	NA	NA
	NA	NA	NA
N	0.3100	<0.0030	80.0000
	38.0000	5.3000	NA
FREE	NA	NA	NA
TOTAL	NA	NA	NA
36	<0.0200	<0.0200	<0.0200
	0.1600	1.0000	NA
33	0.5300	<0.1000	NA
ADIOACT	NA	NA	NA
34	8.2000	40.0000	NA
DS	455.0000	320.0000	NA

Organics Analysis
For Ferrosilicon Bag-
house Dust
SKW Alloys, Niagara Falls, NY

Compound	Concentration (ppm)
3,3-Dimethyl hexane[a]	4.5
1,2-Benzenedicarboxylic acid butyl-2-methyl propylester[a]	1.7

[a]This compound is a product of sample preparation and analysis.

REFERENCE NO. 16

Dangerous Properties of Industrial Materials

Sixth Edition

N. IRVING SAX

Assisted by:

Benjamin Feiner/Joseph J. Fitzgerald/Thomas J. Haley/Elizabeth K. Weisburger

5-137

recycled paper ecology and environment

VNR VAN NOSTRAND REINHOLD COMPANY

NEW YORK CINCINNATI TORONTO LONDON MELBOURNE

REFERENCE NO. 17

NIAGARA COUNTY HEALTH DEPARTMENT

MEMORANDUM

DATE: December 20, 1983

TO: Mr. Ronald Tramantano

FROM: Mr. J. A. Kehoe, P.E.

SUBJECT: DISPOSAL SITE INFORMATION

This writing is a response to your memorandum of October 26, 1983, which requested information regarding the involvement and concerns of this department for all hazardous waste sites in Niagara County. Attached are statements outlining our involvement and concerns for 116 sites in Niagara County. Copies of profile reports for sixty of these sites are also attached.

The requested information is presented in individual statements for each site. Each of these statements contains two sections. The first section of each statement is a summary of this department's involvement with that site since the writing of the 1980 registry. Only major areas of involvement are included. The second section of each statement outlines this department's most significant concerns regarding that site. These concerns are based on potential health impacts only. Environmental concerns are not addressed.

The attached profile reports are provided for your information. These reports summarize information obtained from site investigations conducted by this department from 1981 to 1983. Please note that some information contained in the 1981 and 1982 reports may already be outdated.

The department has expended a considerable amount of manpower over the last three years to investigate and monitor activities at waste disposal sites. We intend to continue this involvement. We feel that we are now in a position to provide information and judgement which would be necessary in the assessment and evaluation of potential risks and exposures at these sites. We request that we be kept informed of all actions taken by your office which are related to sites in Niagara County and would be happy to provide you with assistance whenever possible.

Please feel free to contact us with any questions.

MEH/JAK:cs
Attachments..

NAME:

Airco Alloys (DEC #932001)

LOCATION:

The former and active disposal areas are located on a 62-acre area southeast of Witmer Road, 1500 feet northeast of the intersection of Hyde Pa[illegible] Boulevard in the Town of Niagara.

A sketch is attached.

OWNERSHIP:

This area is currently owned by SKW Alloys, Inc. (37 acres), 3801 Highland Avenue, Niagara Falls, NY 14305 and by Airco Properties, Inc. (25 acres), 4861 Packard Road, Niagara Falls, NY 14302. Past owners include Airco Alloys, Inc. and the Vanadium Corporation of America.

The contact person for the Airco property is Ronald Spears of Airco Speer Carbon Graphite (285-9381) and for SKW, the contact is William Favero (285-1252).

HISTORY:

The site was first used from 1920 to 1964 by the Vanadium Corporation for disposal of slag and refuse. The volume of slag disposed of is estimated as 594,000 tons by the IATF and as 350,000 tons in the Application for a Solid Waste Management Facility for Airco Properties, Inc. The IATF also reports that 88,000 tons of refuse were disposed of. The majority of this waste was disposed of on the property now owned by Airco. A portion of the slag may have been removed after disposal for use as fill.

Airco Alloys began using the Witmer Road site in 1964 for wastes essentially the same as those of Vanadium. In 1971, baghouse collectors were installed at the Airco Plant and the dusts collected were disposed of at this site. Waste volumes disposed of by Airco Alloys included 6000 tons of ferrochrome silicon and 43,000 tons of ferrosilicon dusts (slurried). Again, most of this disposal occurred on the present Airco property although storage of various materials such as coke, ores and raw materials occurred on the present SKW property. Some of this material was never removed.

Part 360 permits to operate disposal facilities were issued to Airco Speer and SKW during the 1980's. Both firms now operate landfills for their own use. SKW disposes of slurried ferrosilicon and ferrochrome silicon baghouse dusts in two cells occupying about 5 acres total. Airco-Speer disposes of "hard" wastes such as brick, concrete, coke, etc., and collector dust and carbon fines in their facility. Airco's permit calls for closure of about 20 acres upon completion of disposal activities. This will close the majority of the former disposal area as well.

Monitoring of eight on-site wells and of surface water on-site is performed quarterly by a mutual consultant of Airco and SKW. The results are sent to DEC-Region 9 (Robert Mitrey).

Recent inspections (Winter 1983) of both the Airco and SKW properties have confirmed much of the above information. Both active facilities were found to be essentially in compliance with codes and permit conditions.

PREVIOUS SAMPLE RESULTS:

Groundwater and surface water samples have been taken prior to issuanc 360 permits and quarterly thereafter. Analytic parameters include pH, conductivity, COD, TOC, Barium, Chromium, Iron, Manganese, Silicon and Zinc. The results of 1979 and 1980 sampling are given in Application for Solid Waste Management Facility for the Airco Properties, Inc. (1980) and Support Document for Application to Construct and Operate a Solid Waste Management Facility for SKW Alloys, Inc. (1980). Subsequent analytical reports have been sent to DEC-Buffalo.

In general, the results show minimal or no contamination of groundwate but they do show increase in total chromium occurring across the site in the surface water samples. Chromium concentrations in surface water leaving the site ranged from 0.35 to 2.2 mg/l in 1980 and were higher than background concentrations by two to three times. It was noted that conductivity decrease across the site, apparently due to dilution.

EXAMINATION OF AERIAL PHOTOS:

Examination of aerial photographs provided no new information but confirmed that disposal occurred primarily on the present Airco property. USDA (1958 and 1966) and SKW Alloys (1980) photos were used.

SOILS/GEOLOGY:

Soils at this site were studied by Earth Dimensions, Inc. prior to the design of the active landfill facilities. Details and boring logs are available in the document accompanying SKW's and Airco's applications.

Essentially, soils are characterized as consisting of 1 to 9 feet of miscellaneous fill material (waste in some cases), over 2 to 12 feet of clay, over 0 to 7 feet of water sorted stratified sediments, over 1 to 7 feet of Glacial Till. Refusal occurred at depths of 11 to 24 feet. The fill thickness is the dominate factor affecting depth to bedrock.

Bedrock is Lockport Dolomite. Bedrock reportedly dips to the south at a slope of 1/2%. The Lockport Formation may contain several water bearing zones at various depths.

GROUNDWATER:

The Support Document accompanying SKW's 360 permit application indicat that two aquifers are present beneath the site. The first is an artesian aquifer in the Lockport Formation. The second is an unconfined aquifer in the unconsolidated material. The direction of flow of the unconfined aquifer is to the southwest. The direction of flow of the bedrock aquifer has not been determined.

The nearest known drinking water well is 3500 feet north. The locations of other wells are unknown. There are no industrial users of groundwater in this area.

SURFACE WATER:

An intermittent stream passes through the site. This stream may be dry during the late spring and summer. The nearest permanent body of surface water is the Niagara River, 6000 feet west. There are no water intakes within three miles downstream on the Niagara River.

The site is not in a 100 year flood plain and is not within one mile of a designated wetland.

AIR:

The only potentially significant air emission problem associated with this site is dust. No volatile or organic wastes are known to be present.

Approximately 2000 people live within one mile of this site. The nearest population is 2000 feet southwest.

Land use within two miles includes industrial, residential and commercial in roughly even proportions.

FIRE/EXPLOSION:

Due to the nature of the wastes present, there appears to be no potential for fire at this site.

DIRECT CONTACT:

Access is restricted to the public. The wastes present should not present significant health problems if contacted.

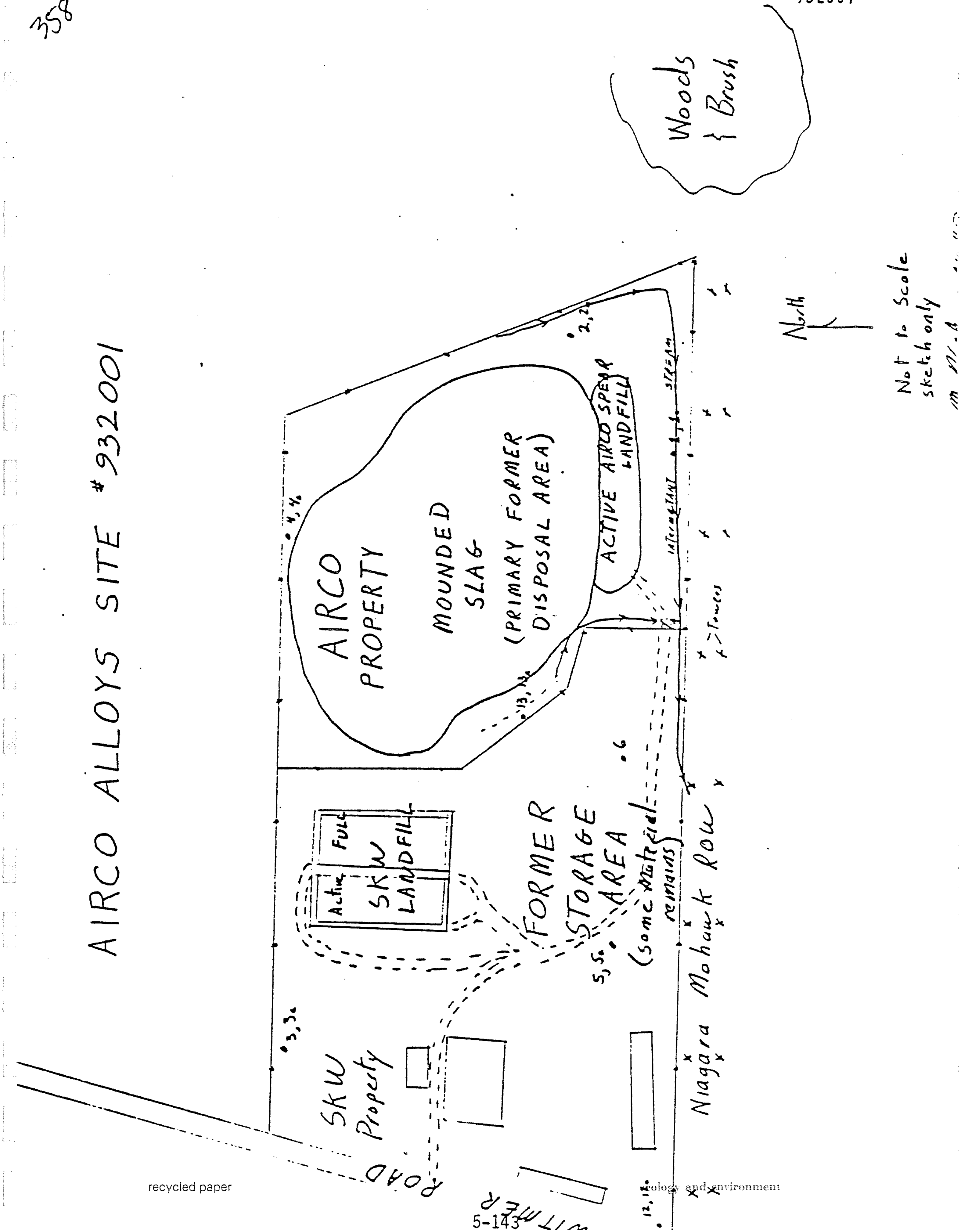
CONCLUSIONS:

This site has been used for disposal for over 60 years and is still active. The wastes present are primarily inorganic and largely consist of slag and collector dusts. The concentration of chromium in the wastes is not known. Chromium is apparently the primary contaminant of concern. The active facilities are permitted and are essentially in compliance with Part 360.

RECOMMENDATIONS:

Continued monitoring and closure of active facilities as provided by the operating permits should be adequate to prevent significant impacts from this site. No additional action beyond that specified in the operating permits is considered necessary.

358


AIRCO ALLOYS SITE #932001
Woods & Brush
North
Not to Scale
sketch only
AIRCO PROPERTY
MOUNDED SLAG
(PRIMARY FORMER DISPOSAL AREA)
ACTIVE AIRCO SPEAR LANDFILL
INTERMITTANT STREAM
Towers
2,2a
6
Active
Full
SKW LANDFILL
FORMER STORAGE AREA
(some material remains)
5,5a
3,3a
SKW Property
Niagara Mohawk Row
ROAD
WITMER R

REFERENCE NO. 18

INTERVIEW ACKNOWLEDGEMENT FORM

SITE NAME:	Power Authority Road Site, Ross Steel Site	I.D. NUMBER:	
PERSON CONTACTED:	Nancy Aungst Project Manager Hyde Park Oversight	DATE:	5/19/88
AFFILIATION:	Ecology and Environment, Inc.	PHONE NUMBER:	(716) 684-8060
ADDRESS:	368 Pleasantview Dr. Lancaster, New York	CONTACT PERSON(s):	Peggy Farrell
TYPE OF CONTACT:	Meeting		

INTERVIEW SUMMARY

Residential wells used for drinking water were located at 2633, 2645, and 2705 Pennsylvania Ave. As part of the Hyde Park Remedial Program, these homes were connected to a water line during January 1987. Two wells are currently used by two junkyards located at 2564 and 2989 Delaware Ave. These wells are not used for drinking. Less than 5 people use this water.

ACKNOWLEDGEMENT

I have read the above transcript and I agree that it is an accurate summary of the information verbally conveyed to Ecology and Environment, Inc. interviewer(s) (as revised below, if necessary).

Revisions (please write in any corrections needed to above transcript)

Signature: Nancy J. Aungst Date: 5/27/88

EPA	POTENTIAL HAZARDOUS WASTE SITE SITE INSPECTION REPORT PART 1 - SITE LOCATION AND INSPECTION INFORMATION	I. IDENTIFICATION 01 State: NY 02 Site Number: 932001

II. SITE NAME AND LOCATION

01 Site Name (Legal, common, or descriptive name of site)	02 Street, Route No., or Specific Location Identifier
SKW Alloys	Witmer Road

03 City	04 State	05 Zip Code	06 County	07 County Code	08 Cong. Dist.
Town of Niagara	NY	14305	Niagara		

09 Coordinates Latitude	Longitude	10 Type of Ownership (Check one)
43 07 22.N	079 02 56.W	[X] A. Private [ ] B. Federal ____ [ ] C. State [ ] D. County [ ] E. Municipal [ ] F. Other ____ [ ] G. Unknown

III. INSPECTION INFORMATION

01 Date of Inspection	02 Site Status	03 Years of Operation
8 / 26 / 87 Month Day Year	[X] Active [ ] Inactive	1920 (Beginning Year) | present (Ending Year) [ ] Unknown

04 Agency Performing Inspection (Check all that apply)

[ ] A. EPA [ ] B. EPA Contractor ____ (Name of Firm) [ ] C. Municipal [ ] D. Municipal Contractor ____ (Name of Firm)

[ ] E. State [X] F. State Contractor E & E (Name of Firm) [ ] G. Other ____ (Specify)

05 Chief Inspector	06 Title	07 Organization	08 Telephone No.
Dennis Sutton	Geologist	E & E	(716) 684-8060

09 Other Inspectors	10 Title	11 Organization	12 Telephone No.
Jon Sundquist	Chemical Engineer	E & E	(716) 684-8060
			( )
			( )
			( )
			( )

13 Site Representatives Interviewed	14 Title	15 Address	16 Telephone No.
Anthony H. Kruk	Manager-Engineer	3801 Highland, Niagara Falls	(716) 285-1252
Richard R. Snyder	P.E.	86 Countryside Lane, Grand Island	(716) 773-5661
Suzette Kosikowski	Environmental Supervisor	4861 Packard Road, Niagara Falls	(716) 285-9381
			( )
			( )

17 Access Gained By (Check one)	18 Time of Inspection	19 Weather Conditions
[X] Permission [ ] Warrant	10:00	Cloudy, approximately 70°F, winds 0-5 mph

IV. INFORMATION AVAILABLE FROM

01 Contact	02 Of (Agency/Organization)	03 Telephone No.
Walter E. Demick	NYSDEC	(518) 457-9538

04 Person Responsible for Site Inspection Form	05 Agency	06 Organization	07 Telephone No.	08 Date
M. J. Farrell		E & E	(716) 684-8060	9 / 4 / 87 Month Day Year

POTENTIAL HAZARDOUS WASTE SITE
SITE INSPECTION REPORT

PART 2 - WASTE INFORMATION

I. IDENTIFICATION	
01 State NY	02 Site Number 932001

II. WASTE STATES, QUANTITIES, AND CHARACTERISTICS

01 Physical States (Check all that apply)

[X] A. Solid
[X] B. Powder, Fines
[ ] C. Sludge
[ ] D. Other ______ (Specify)
[X] E. Slurry
[ ] F. Liquid
[ ] G. Gas

02 Waste Quantity at Site (Measure of waste quantities must be independent)

Tons 102,000
Cubic Yards ______
No. of Drums ______

03 Waste Characteristics (Check all that apply)

[X] A. Toxic
[X] B. Corrosive
[ ] C. Radioactive
[X] D. Persistent
[ ] E. Soluble
[ ] F. Infectious
[ ] G. Flammable
[ ] H. Ignitable
[ ] I. Highly volati
[ ] J. Explosive
[ ] K. Reactive
[ ] L. Incompatible
[ ] M. Not applicable

III. WASTE TYPE

Category	Substance Name	01 Gross Amount	02 Unit of Measure	03 Comments
SLU	Sludge			This site is two permitted landfills used by SKW Alloys and Airco Carbon to dispose of ferrochrome silicon alloy dust, and ferro silicon dust byproducts of ferroalloy production
OLW	Oily waste			
SOL	Solvents			
PSD	Pesticides			
OCC	Other organic chemicals			
IOC	Inorganic chemicals			
ACD	Acids			
BAS	Bases			
MES	Heavy Metals			

IV. HAZARDOUS SUBSTANCES (See Appendix for most frequently cited CAS Numbers)

01 Category	02 Substance Name	03 CAS Number	04 Storage/Disposal Method	05 Concentration	06 Measure of Concentrat
	The following is reported to be disposed of on site:				
IOC	Ferro chrome silicon alloy dust			50,000	Tons
IOC	Ferro manganese slag			6,000	Tons
IOC	Ferro chrome silicon slag			21,000	Tons
IOC	Ferro silicon dust			25,000	Tons
IOC	Calcium hydroxide, refuse			Unknown	

This site was also reported to have been used to dispose of coke, ores, slag, raw materials, and refuse from 1920 to 1964.

V. FEEDSTOCKS (See Appendix for CAS Numbers) (Production facilities not on site)

Category	01 Feedstock Name	02 CAS Number	Category	01 Feedstock Name	02 CAS Number
FDS	Quartz		FDS	Steel	
FDS	Coal		FDS		
FDS	Petroleum Coke		FDS		
FDS	Wood Chips		FDS		

VI. SOURCES OF INFORMATION (Cite specific references, e.g., state files, sample analysis, reports)

NYSDEC, Division of Solid and Hazardous Waste Inactive Hazardous Waste Disposal Report
E & E site inspection and photo log, 9/87
USGS 7.5-Minute topographic map, Niagara Falls, New York quadrangle

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POTENTIAL HAZARDOUS WASTE SITE
SITE INSPECTION REPORT

PART 3 - DESCRIPTION OF HAZARDOUS CONDITIONS AND INCIDENTS

I. IDENTIFICATION	
01 State NY	02 Site Number 932001

II. HAZARDOUS CONDITIONS AND INCIDENTS

01 [X] A. Groundwater Contamination — 02 [X] Observed (Date 4/87) [ ] Potential [ ] Alleged
03 Population Potentially Affected Unknown — 04 Narrative Description:

Groundwater on site was last sampled in April 1987. Laboratory analysis results indicate contamination from metals.

01 [X] B. Surface Water Contamination — 02 [ ] Observed (Date ______) [X] Potential [ ] Alleged
03 Population Potentially Affected Unknown — 04 Narrative Description:

Potential for surface water exists, Lower Niagara River is approximately 1.5 miles to the west and the Lewiston Reservoir is approximately 1 mile to the northeast. Groundwater discharges to the Niagara River.

01 [ ] C. Contamination of Air — 02 [ ] Observed (Date ______) [ ] Potential [ ] Alleged
03 Population Potentially Affected ______ — 04 Narrative Description:

None expected

01 [ ] D. Fire/Explosive Conditions — 02 [ ] Observed (Date ______) [ ] Potential [ ] Alleged
03 Population Potentially Affected ______ — 04 Narrative Description:

None expected

01 [X] E. Direct Contact — 02 [X] Observed (Date 8/87) [ ] Potential [ ] Alleged
03 Population Potentially Affected Unknown — 04 Narrative Description:

Waste is accessible to workers on site and the public. Personnel were observed walking on the landfill which is not covered.

01 [X] F. Contamination of Soil — 02 [ ] Observed (Date ______) [X] Potential [ ] Alleged
03 Area Potentially Affected Unknown (Acres) — 04 Narrative Description:

The potential for soil contamination exists since waste materials other than the ferrosilicon dusts were disposed of or stored on site at the time of the inspection.

01 [X] G. Drinking Water Contamination — 02 [ ] Observed (Date ______) [X] Potential [ ] Alleged
03 Population Potentially Affected ______ — 04 Narrative Description:

Potential exists, drinking water wells are 0.2 mile from site.

01 [X] H. Worker Exposure/Injury — 02 [ ] Observed (Date ______) [X] Potential [ ] Alleged
03 Workers Potentially Affected Unknown — 04 Narrative Description:

Potential exists for worker exposure from dust generated from the waste.

01 [ ] I. Population Exposure/Injury — 02 [ ] Observed (Date ______) [ ] Potential [ ] Alleged
03 Population Potentially Affected ______ — 04 Narrative Description:

None expected

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POTENTIAL HAZARDOUS WASTE SITE
SITE INSPECTION REPORT

PART 3 - DESCRIPTION OF HAZARDOUS CONDITIONS AND INCIDENTS

I. IDENTIFICATION	
01 State NY	02 Site Numb 932001

II. HAZARDOUS CONDITIONS AND INCIDENTS (Cont.)

01 [ ] J. Damage to Flora 02 [ ] Observed (Date ______) [ ] Potential [ ] Alleged
04 Narrative Description:

None expected

01 [ ] K. Damage to Fauna 02 [ ] Observed (Date ______) [ ] Potential [ ] Alleg
04 Narrative Description:

None expected

01 [ ] L. Contamination of Food Chain 02 [ ] Observed (Date ______) [ ] Potential [ ] Alleged
04 Narrative Description:

None expected

01 [X] M. Unstable Containment of Wastes (Spills/Runoff/Standing liquids, Leaking drums) 02 [ ] Observed (Date ______) [X] Potential [ ] Alleg
03 Population Potentially Affected Unknown 04 Narrative Description:

Disposal practices unknown for 1920's - 1960's.

01 [ ] N. Damage to Offsite Property 02 [ ] Observed (Date ______) [ ] Potential [ ] Alleg
04 Narrative Description:

There exists the potential for off-site migration of dust from lime slag piles.

01 [ ] O. Contamination of Sewers, Storm Drains, WWTPs 02 [ ] Observed (Date ______) [ ] Potential [ ] Alleged
04 Narrative Description:

None expected

01 [ ] P. Illegal/Unauthorized Dumping 02 [ ] Observed (Date ______) [ ] Potential [ ] Alleg
04 Narrative Description:

None expected

05 Description of Any Other Known, Potential, or Alleged Hazards

III. TOTAL POPULATION POTENTIALLY AFFECTED Unknown

IV. COMMENTS

It has been reported that indiscriminate dumping of industrial wastes, old machinery and raw material took place in a random manner on the entire 62-acre site.

V. SOURCES OF INFORMATION (Cite specific references, e.g., state files, sample analysis, reports)

USGS 7.5 Topographical Map, Niagara Falls Quadrangle
E & E Site Inspection 8/26/87
SLC Consultants Sample Lab Analysis 6/87
Niagara County Health Department, Niagara Falls personal communication
New York State Department of Environmental Conservation, Division of Solid and Hazardous Waste Inactive Hazardous Waste Disposal Report

POTENTIAL HAZARDOUS WASTE SITE SITE INSPECTION REPORT PART 4 - PERMIT AND DESCRIPTIVE INFORMATION	I. IDENTIFICATION	
	01 State NY	02 Site Number 932001

II. PERMIT INFORMATION

01 Type of Permit Issued (Check all that apply)	02 Permit Number	03 Date Issued	04 Expiration Date	05 Comments
[ ] A. NPDES				This facility contains 2 seperate landfills that are presently awaiting renewal of the two Part 360 permits to operate. Metals have been detected by groundwater sample analysis. Baghouse dust failed EP Toxicity tests for chromium and selenium.
[ ] B. UIC				
[ ] C. AIR				
[ ] D. RCRA				
[ ] E. RCRA Interim Status				
[ ] F. SPCC Plan				
[X] G. State (Specify)		10/20/81		
[ ] H. Local (Specify)				
[ ] I. Other (Specify)				
[ ] J. None				

III. SITE DESCRIPTION

01 Storage Disposal (Check all that apply)	02 Amount	03 Unit of Measure	04 Treatment (Check all that apply)	05 Other
[ ] A. Surface Impoundment			[ ] A. Incineration	[X] A. Buildings On Site
[ ] B. Piles			[ ] B. Underground Injection	
[ ] C. Drums, Above Ground			[ ] C. Chemical/Physical	
[ ] D. Tank, Above Ground			[ ] D. Biological	
[ ] E. Tank, Below Ground			[ ] E. Waste Oil Processing	
[X] F. Landfill	11,000	tons/yr	[ ] F. Solvent Recovery	06 Area of Site
[ ] G. Landfarm			[ ] G. Other Recycling Recovery	
[ ] H. Open Dump			[ ] H. Other ______ (Specify)	62 Acres
[ ] I. Other ______ (Specify)				

07 Comments: Portions of the 62-acre site allegedly had indiscriminate dumping on site. In addition to industrial wastes, old machinery and raw material were placed on site in a random manner.

IV. CONTAINMENT

01 Containment of Wastes (Check one)
[ ] A. Adequate, Secure [X] B. Moderate [ ] C. Inadequate, Poor [ ] D. Insecure, Unsound, Dangerous

02 Description of Drums, Diking, Liners, Barriers, etc.
Landfill is not covered, some waste other than the ferrosilicon dust has been placed on site outside the landfill area, and potentially is present under the landfill. The 25-acre landfill has a natural clay liner 2 to 12.5 feet thick.

V. ACCESSIBILITY

01 Waste Easily Accessible: [ ] Yes [X] No
02 Comments:
Landfill site is fenced and guarded, but not covered.

VI. SOURCES OF INFORMATION (Cite specific references, e.g., state files, sample analysis, reports)

E & E Site Inspection 8/26/87
SLC Consultants, groundwater sample analysis, 6/87
New York State Department of Environmental Conservation Division of Solid and Hazardous Waste, Inactive Hazardous Waste Disposal Report
SKW Alloys, Inc., update of December 5, 1980 Engineering Report Plan of Operating for Landfill Cell No. 2 at SKW Alloys, Inc.'s Witmer Road Site, 4/27/87

POTENTIAL HAZARDOUS WASTE SITE SITE INSPECTION REPORT

PART 5 - WATER, DEMOGRAPHIC, AND ENVIRONMENTAL DATA

I. IDENTIFICATION

01 State	02 Site Number
NY	932001

II. DRINKING WATER SUPPLY

01 Type of Drinking Supply (Check as applicable)

02 Status

	Surface	Well	Endangered	Affected	Monitored
Community	A. [X]	B. [ ]	A. [ ]	B. [ ]	C. [X]
Non-community	D. [ ]	D. [ ]	D. [ ]	E. [ ]	F. [ ]

03 Distance to Site

A Approx. 10 (mi)

B ______ (mi)

III. GROUNDWATER

01 Groundwater Use in Vicinity (Check one)

[ ] A. Only Source for Drinking

[X] B. Drinking (Other sources available) Commercial, Industrial, Irrigation (No other water sources available)

[ ] C. Commercial, Industrial, Irrigation (Limited other sources available)

[ ] D. Not Used, Unuseable

02 Population Served by Groundwater <5

03 Distance to Nearest Drinking Water well NA (mi)

04 Depth to Groundwater 10-15 (ft)

05 Direction of Groundwater Flow Southwest

06 Depth to Aquifer of Concern 10-15 (ft)

07 Potential Yield of Aquifer 2,880-158,400 (gpd)

08 Sole Source Aquifer [ ] Yes [X] No

09 Description of Wells (including usage, depth, and location relative to population and buildings)

Wells on site are used exclusively for groundwater monitoring; wells located 0.2 mile north of site used by two commercial facilities.

10 Recharge Area

[X] Yes [ ] No

Comments: Recharge via precipitation

11 Discharge Area

[ ] Yes [X] No

Comments:

IV. SURFACE WATER

01 Surface Water (Check one)

[X] A. Reservoir, Recreation, Drinking Water Source

[ ] B. Irrigation, Economically Important Resources

[ ] C. Commercial, Industrial

[ ] D. Not Currently Used

02 Affected/Potentially Affected Bodies of Water

Name:	Affected	Distance to Site
Niagara River	[ ]	1.5 (mi)
Lewiston Reservoir	[ ]	1.5 (mi)
	[ ]	(mi)

V. DEMOGRAPHIC AND PROPERTY INFORMATION

01 Total Population Within

One (1) Mile of Site	Two (2) Miles of Site	Three (3) Miles of Site
A. 5,540 No. of Persons	B. 34,035 No. of Persons	C. 58,299 No. of Persons

02 Distance to Nearest Population 0.2 (mi)

03 Number of Buildings Within Two (2) Miles of Site 12,824

04 Distance to Nearest Off-Site Building 500 ft. (mi)

05 Population Within Vicinity of Site (Provide narrative description of nature of population within vicinity of site, e.g., rural, village, densely populated urban area)

Densely industrialized area with highly urbanized areas within 1/2 mile of site.

POTENTIAL HAZARDOUS WASTE SITE
SITE INSPECTION REPORT

PART 5 - WATER, DEMOGRAPHIC, AND ENVIRONMENTAL DATA

I. IDENTIFICATION	
01 State NY	02 Site Number 932001

VI. ENVIRONMENTAL INFORMATION

01 Permeability of Unsaturated Zone (Check one)

[ ] A. 10^{-6} - 10^{-8} cm/sec [X] B. 10^{-4} - 10^{-6} cm/sec [ ] C. 10^{-4} - 10^{-3} cm/sec [ ] D. Greater Than 10^{-3} cm/sec

02 Permeability of Bedrock (Check one)

[ ] A. Impermeable (Less than 10^{-6} cm/sec) [ ] B. Relatively Impermeable (10^{-4} - 10^{-6} cm/sec) [X] C. Relatively Permeable (10^{-2} - 10^{-4} cm/sec) [ ] D. Very Permeable (Greater than 10^{-2} cm/sec)

03 Depth to Bedrock: 10 - 25 (ft)

04 Depth of Contaminated Soil Zone: Unknown (ft)

05 Soil pH: 5.6 - 7.3

06 Net Precipitation: 4.0 (in)

07 One Year 24-Hour Rainfall: 2.5 (in)

08 Slope — Site Slope: 0.5 % — Direction of Site Slope: East — Terrain Average Slope: 1.3 %

09 Flood Potential: Site is in NA Year Floodplain

10 [ ] Site is on Barrier Island, Coastal High Hazard Area, Riverine Floodway

11 Distance to Wetlands (5 acre minimum)

ESTUARINE A. NA (mi) OTHER B. 2.5 (mi)

12 Distance to Critical Habitat (of Endangered Species): NA (mi)

Endangered Species: NA

~~13 Land Use in Vicinity~~

Distance to:

COMMERCIAL/INDUSTRIAL	RESIDENTIAL AREAS, NATIONAL/STATE PARKS, FORESTS, OR WILDLIFE RESERVES	AGRICULTURAL LANDS PRIME AG LAND	AG LAND
A. 0.10 (mi)	B. 0.5 (mi)	C. 4 (mi)	D. 4 (mi)

14 Description of Site in Relation to Surrounding Topography

This site is located in the northerly section of the City of Niagara Falls, New York, approximately 1.5 miles east of the Whirlpool State Park. It is situated in a highly industrialized area with highly populated residential areas located approximately 0.5 mile to the south and east. The area is generally flat lying and surface water is not present on site.

VII. SOURCES OF INFORMATION (Cite specific references, e.g., state files, sample analysis, reports)

USGS 7.5 Minute Topographic Map, Niagara Falls and Lewiston, NY quadrangles

NYSDEC files, Region 9, Buffalo, New York

Johnson, Richard H., 1964, Groundwater in the Niagara Falls Area, New York, State of New York Conservation Department, Water Resource Commission, Bulletin GW-53

Barrett, K.W., S.S. Chang, S.A. Hans, A.M. Platt, 1982, Uncontrolled Hazardous Waste Site Ranking System Users Manual, Mitre Corporation

Higgins, B.A., P.S. Puglia, R.P. Leonard, T.D. Yoakum, W.H. Wirtz, 1972; Soil Survey of Niagara County, New York, USDA Soil Conservation Service

Graphical Exposure Modeling System, June 1987, Environmental Protection Agency, Office of Pesticides and Toxic Substances, Federal Plaza, New York, New York

POTENTIAL HAZARDOUS WASTE SITE
SITE INSPECTION REPORT

PART 6 - SAMPLE AND FIELD INFORMATION

I. IDENTIFICATION	
01 State NY	02 Site Number 932001

II. SAMPLES TAKEN

Sample Type	01 Number of Samples Taken	02 Samples Sent to	03 Estimated Date Results Available
Groundwater			
Surface Water			
Waste			
Air			
Runoff			
Spill			
Soil			
Vegetation			
Other	None		

III. FIELD MEASUREMENTS TAKEN

01 Type	02 Comments
Air	Air monitoring performed with an HNu photoionization detector; no readings noted above background.

IV. PHOTOGRAPHS AND MAPS

01 Type [X] Ground [ ] Aerial

02 In Custody of Ecology and Environment, Inc.
(Name of organization or individual)

03 Maps
[X] Yes
[ ] No

04 Location of Maps
NYSDEC, Region 9, Buffalo, New York

V. OTHER FIELD DATA COLLECTED (Provide narrative description of sampling activities)

VI. SOURCES OF INFORMATION (Cite specific references, e.g., state files, sample analysis, reports)

E & E Site Inspection Fieldbook and Photo Log, 8/26/87
NYSDEC Region 9 files, Buffalo, New York

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POTENTIAL HAZARDOUS WASTE SITE SITE INSPECTION REPORT PART 7 - OWNER INFORMATION	I. IDENTIFICATION	
	01 State NY	02 Site Number 932001

II. CURRENT OWNER(S) / PARENT COMPANY (If applicable)

01 Name	02 D+B Number	08 Name	09 D+B Number
SKW Alloys, Inc.			

03 Street Address (P.O. Box, RFD #, etc.)	04 SIC Code	10 Street Address (P.O. Box, RFD #, etc.)	11 SIC Code
3801 Highland Avenue			

05 City	06 State	07 Zip Code	12 City	13 State	14 Zip Code
Niagara Falls	NY	14305			

01 Name	02 D+B Number	08 Name	09 D+B Number
Airco Carbon Corp.			

03 Street Address (P.O. Box, RFD #, etc.)	04 SIC Code	10 Street Address (P.O. Box, RFD #, etc.)	11 SIC Code
4861 Packard Road			

05 City	06 State	07 Zip Code	12 City	13 State	14 Zip Code
Niagara Falls	NY	14303			

01 Name	02 D+B Number	08 Name	09 D+B Number
Niagara Mohawk Corp.			

03 Street Address (P.O. Box, RFD #, etc.)	04 SIC Code	10 Street Address (P.O. Box, RFD #, etc.)	11 SIC Code
535 Washington Street			

05 City	06 State	07 Zip Code	12 City	13 State	14 Zip Code
Buffalo	NY	14212			

01 Name	02 D+B Number	08 Name	09 D+B Number

03 Street Address (P.O. Box, RFD #, etc.)	04 SIC Code	10 Street Address (P.O. Box, RFD #, etc.)	11 SIC Code

05 City	06 State	07 Zip Code	12 City	13 State	14 Zip Code

III. PREVIOUS OWNER(S) (List most recent first) / IV. REALTY OWNER(S) (If applicable, list most recent first)

01 Name	02 D+B Number	01 Name	02 D+B Number
Airco Alloys		Airco, Inc.	

03 Street Address (P.O. Box, RFD #, etc.)	04 SIC Code	03 Street Address (P.O. Box, RFD #, etc.)	04 SIC Code
4861 Packard Road			

05 City	06 State	07 Zip Code	05 City	06 State	07 Zip Code
Niagara Falls	NY	14304		Del.	

01 Name	02 D+B Number	01 Name	02 D+B Number
Pittsburg Metallurgical			

03 Street Address (P.O. Box, RFD #, etc.)	04 SIC Code	03 Street Address (P.O. Box, RFD #, etc.)	04 SIC Code
4861 Packard Road			

05 City	06 State	07 Zip Code	05 City	06 State	07 Zip Code
Niagara Falls	NY	14304			

01 Name	02 D+B Number	01 Name	02 D+B Number
Vanadium Corp. of America			

03 Street Address (P.O. Box, RFD #, etc.)	04 SIC Code	03 Street Address (P.O. Box, RFD #, etc.)	04 SIC Code
Unknown			

05 City	06 State	07 Zip Code	05 City	06 State	07 Zip Code

V. SOURCES OF INFORMATION (Cite specific references, e.g., state files, sample analysis, reports)

SKW Alloys, Inc. Files, Niagara Falls, NY
E & E Site Inspection, 8/26/87

POTENTIAL HAZARDOUS WASTE SITE
SITE INSPECTION REPORT

PART 8 - OPERATOR INFORMATION

I. IDENTIFICATION	
01 State	02 Site Number
NY	932001

II. CURRENT OPERATOR (Provide if different from owner)

01 Name		02 D+B Number
SKW Alloys, Inc., Airco Carbon Corp.		
03 Street Address (P.O. Box, RFD #, etc.)		**04 SIC Code**
3801 Highland Avenue, 4861 Packard Road		
05 City	**06 State**	**07 Zip Code**
Niagara Falls	NY	14305
08 Years of Operation	**09 Name of Owner**	
7 yrs.		

OPERATOR'S PARENT COMPANY (If applicable)

10 Name		11 D+B Number
12 Street Address (P.O. Box, RFD #, etc.)		**13 SIC Code**
14 City	**15 State**	**16 Zip Code**

III. PREVIOUS OPERATOR(s) (List most recent first; provide only if different from owner)

01 Name		02 D+B Number
Airco Alloys		
03 Street Address (P.O. Box, RFD #, etc.)		**04 SIC Code**
4861 Packard Road		
05 City	**06 State**	**07 Zip Code**
Niagara Falls	NY	14304
08 Years of Operation	**09 Name of Owner During This Period**	
13 yrs.		
01 Name		**02 D+B Number**
Vanadium Corp. of America		
03 Street Address (P.O. Box, RFD #, etc.)		**04 SIC Code**
Unknown		
05 City	**06 State**	**07 Zip Code**
08 Years of Operation	**09 Name of Owner During This Period**	
44 yrs.		
01 Name		**02 D+B Number**
03 Street Address (P.O. Box, RFD #, etc.)		**04 SIC Code**
05 City	**06 State**	**07 Zip Code**
08 Years of Operation	**09 Name of Owner During This Period**	

PREVIOUS OPERATORS' PARENT COMPANIES (If applicable)

10 Name		11 D+B Number
Airco, Inc.		
12 Street Address (P.O. Box, RFD #, etc.)		**13 SIC Code**
14 City	**15 State**	**16 Zip Code**
10 Name		**11 D+B Number**
12 Street Address (P.O. Box, RFD #, etc.)		**13 SIC Code**
14 City	**15 State**	**16 Zip Code**
10 Name		**11 D+B Number**
12 Street Address (P.O. Box, RFD #, etc.)		**13 SIC Code**
14 City	**15 State**	**16 Zip Code**

IV. SOURCES OF INFORMATION (Cite specific references, e.g., state files, sample analysis, reports)

SKW Alloys Corp. files, Niagara Falls, New York
Niagara County Health Department Files, Niagara Falls, New York

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POTENTIAL HAZARDOUS WASTE SITE
SITE INSPECTION REPORT

PART 9 - GENERATOR/TRANSPORTER INFORMATION

I. IDENTIFICATION	
01 State	02 Site Number
NY	932001

II. ON-SITE GENERATOR

01 Name	02 D+B Number

03 Street Address (P.O. Box, RFD #, etc.)	04 SIC Code

05 City	06 State	07 Zip Code

III. OFF-SITE GENERATOR(S)

01 Name	02 D+B Number	01 Name	02 D+B Number
SKW Alloys			
03 Street Address (P.O. Box, RFD #, etc.)	**04 SIC Code**	**03 Street Address (P.O. Box, RFD #, etc.)**	**04 SIC Code**
3801 Highland Avenue			

05 City	06 State	07 Zip Code	05 City	06 State	07 Zip Code
Niagara Falls	NY	14305			

01 Name	02 D+B Number	01 Name	02 D+B Number
Airco Carbon Corp.			
03 Street Address (P.O. Box, RFD #, etc.)	**04 SIC Code**	**03 Street Address (P.O. Box, RFD #, etc.)**	**04 SIC Code**
4861 Packard Road			

05 City	06 State	07 Zip Code	05 City	06 State	07 Zip Code
Niagara Falls	NY	14305			

IV. TRANSPORTER(S)

01 Name	02 D+B Number	01 Name	02 D+B Number
03 Street Address (P.O. Box, RFD #, etc.)	**04 SIC Code**	**03 Street Address (P.O. Box, RFD #, etc.)**	**04 SIC Code**

05 City	06 State	07 Zip Code	05 City	06 State	07 Zip Code

01 Name	02 D+B Number	01 Name	02 D+B Number
03 Street Address (P.O. Box, RFD #, etc.)	**04 SIC Code**	**03 Street Address (P.O. Box, RFD #, etc.)**	**04 SIC Code**

05 City	06 State	07 Zip Code	05 City	06 State	07 Zip Code

V. SOURCES OF INFORMATION (Cite specific references, e.g., state files, sample analysis, reports)

POTENTIAL HAZARDOUS WASTE SITE
SITE INSPECTION REPORT

PART 10 - PAST RESPONSE ACTIVITIES

I. IDENTIFICATION	
01 State NY	02 Site Number 932001

II. PAST RESPONSE ACTIVITIES

01 [ ] A. Water Supply Closed 02 Date ________ 03 Agency ________
04 Description:

01 [ ] B. Temporary Water Supply Provided 02 Date ________ 03 Agency ________
04 Description:

01 [ ] C. Permanent Water Supply Provided 02 Date ________ 03 Agency ________
04 Description:

01 [ ] D. Spilled Material Removed 02 Date ________ 03 Agency ________
04 Description:

01 [ ] E. Contaminated Soil Removed 02 Date ________ 03 Agency ________
04 Description:

01 [ ] F. Waste Repackaged 02 Date ________ 03 Agency ________
04 Description:

01 [ ] G. Waste Disposed Elsewhere 02 Date ________ 03 Agency ________
04 Description:

01 [ ] H. On Site Burial 02 Date ________ 03 Agency ________
04 Description:

01 [ ] I. In Situ Chemical Treatment 02 Date ________ 03 Agency ________
04 Description:

01 [ ] J. In Situ Biological Treatment 02 Date ________ 03 Agency ________
04 Description:

01 [ ] K. In Situ Physical Treatment 02 Date ________ 03 Agency ________
04 Description:

01 [ ] L. Encapsulation 02 Date ________ 03 Agency ________
04 Description:

01 [ ] M. Emergency Waste Treatment 02 Date ________ 03 Agency ________
04 Description:

01 [ ] N. Cutoff Walls 02 Date ________ 03 Agency ________
04 Description:

01 [ ] O. Emergency Diking/Surface Water Diversion 02 Date ________ 03 Agency ________
04 Description:

01 [ ] P. Cutoff Trenches/Sump 02 Date ________ 03 Agency ________
04 Description:

01 [ ] Q. Subsurface Cutoff Wall 02 Date ________ 03 Agency ________
04 Description:

POTENTIAL HAZARDOUS WASTE SITE SITE INSPECTION REPORT PART 10 - PAST RESPONSE ACTIVITIES	I. IDENTIFICATION	
	01 State NY	02 Site Number 932001

II. PAST RESPONSE ACTIVITIES (Cont.)

01 [ ] R. Barrier Walls Constructed 02 Date ________ 03 Agency ________
04 Description:

01 [ ] S. Capping/Covering 02 Date ________ 03 Agency ________
04 Description:

01 [ ] T. Bulk Tankage Repaired 02 Date ________ 03 Agency ________
04 Description:

01 [ ] U. Grout Curtain Constructed 02 Date ________ 03 Agency ________
04 Description:

01 [ ] V. Bottom Sealed 02 Date ________ 03 Agency ________
04 Description:

01 [ ] W. Gas Control 02 Date ________ 03 Agency ________
04 Description:

01 [ ] X. Fire Control 02 Date ________ 03 Agency ________
04 Description:

01 [ ] Y. Leachate Treatment 02 Date ________ 03 Agency ________
04 Description:

01 [ ] Z. Area Evacuated 02 Date ________ 03 Agency ________
04 Description:

01 [ ] 1. Access to Site Restricted 02 Date ________ 03 Agency ________
04 Description:

01 [ ] 2. Population Relocated 02 Date ________ 03 Agency ________
04 Description:

01 [ ] 3. Other Remedial Activities 02 Date ________ 03 Agency ________
04 Description:

III. SOURCES OF INFORMATION (Cite specific references, e.g., state files, sample analysis, reports)

D1773

6

6. ASSESSMENT OF DATA ADEQUACY AND RECOMMENDATIONS

After assessing the information gathered for this site, and applying it to an HRS worksheet, it is determined that existing information is adequate to score the site. Further investigations are recommended to determine the extent and quantity of possible waste migration.

Sample analysis indicates that some parameters exceed New York State groundwater criteria. In addition, the baghouse dust failed EP Toxicity tests for chromium and selenium. E & E recommends a screening program for the entire site consisting of continued groundwater monitoring of existing wells and installation of new wells to better define the source of groundwater contamination. Soil samples also should be collected from surface to a depth of 2 feet and analyzed for priority pollutants and RCRA hazardous waste characteristics. Additionally, groundwater samples should be analyzed for priority pollutants not currently tested for by SKW under their landfill permit.

This screening program can be developed in conjunction with NYSDEC Region 9 since they are in the process of reviewing an application from SKW to construct and operate a third landfill on site.

In addition, the potential for fugitive dust emissions from the waste piles and use of the site by dirt bikers and all-terrain vehicles (ATVs) should be investigated.

Based on these tests and investigations, the quantity and extent of contamination can further be defined and recommendations for remediation can then be made. This information will also lead to a more accurate HRS scoring of the site.

7. REFERENCES

Brown, Dean, 1987, personal communication, Town of Niagara Water Department.

Ecology and Environment, Inc., August 26, 1987, Site Inspection Logbook and Photo Log.

Graphical Exposure Modeling System, June 1981, Environmental Protection Agency, Office of Pesticides and Toxic Substances, Federal Plaza, New York, New York.

Higgins, B.A., P.S. Puglia, R.P. Leonard, T.D. Yoakum, W.A. Witz, 1972, Soil Survey of Niagara County, New York, USDA Soil Conservation Service.

Johnston, R.H., 1964, Groundwater in the Niagara Falls Area, New York, State of New York Conservation Department, Water Resources Commission, Bulletin GW-53.

Kruk, Anthony, 1987, personal communication, Engineering and Maintenance Manager, SKW Alloys, Inc., 3801 Highland Avenue, Niagara Falls, New York.

New York State Department of Environmental Conservation, Division of Solid and Hazardous Waste, Inactive Hazardous Waste Disposal Report, 1986.

New York State Department of Environmental Conservation, Wetlands Maps, Region 9 Offices, Buffalo, New York.

Niagara County Health Department, 1984, Profile report on Airco Alloys site and personal communication.

SLC Consultants/Contractors, Inc., June 1987, groundwater sample analysis results for SKW Alloys, Inc.

Snyder, Richard R., 1980, Support Document for Applications to Construct and Operate a Solid Waste Management Facility at SKW Alloys, Inc., Witmer Road Site, Town of Niagara, New York, Landfill Cell Number Two.

Spears, Ronald F., July 31, 1984, personal communication, Airco Carbon, letter to Stuart M. Fox, NYSDEC Region 9, Buffalo, New York.

USGS, 7.5 Minute Topographical Maps, 1980, Niagara Falls and Lewiston, New York Quadrangles.

APPENDIX A

PHOTOGRAPHIC RECORD

ecology and environment, inc.

PHOTOGRAPHIC RECORD

Client: NYSDEC E & E Job No.: ND2031

Camera: Make ____ SN: ____

Photographer: D. Sutton

Date/Time: 8/26/87; 11:30

Lens: Type: ____

SN: ____

Frame No.: No. 1

Comments*: Photo shows disposal cell No. 2 and leachate collection standpipe, looking east from access road, also shows ferrosilicon dust slurried with water in disposal cell No. 2.

Photographer: D. Sutton

Date/Time: 8/26/87; 11:35

Lens: Type: ____

SN: ____

Frame No.: No. 2

Comments*: Photo shows waste piles of metal, wood chips, wood scrap, and baghouse dust, looking west from access road near disposal cell No. 2.

*Comments to include location

D1773

ecology and environment, inc.

PHOTOGRAPHIC RECORD

Client: NYSDEC | E & E Job No.: ND2031

Camera: Make ______ SN: ______

Photographer: D. Sutton

Date/Time: 8/26/87; 11:40

Lens: Type:

SN:

Frame No.: No. 3

Comments*: Photo shows ferrosilicon dust slurried with water and disposed of in cell No. 1, looking south access road.

Photographer: D. Sutton

Date/Time: 8/26/87; 11:45

Lens: Type:

SN:

Frame No.: No. 4

Comments*: Photo shows runoff runnels in slurried dust, looking northeast from edge of access road near cell No. 1. Note: Fence is boundary between SKW and Airco property.

*Comments to include location

ecology and environment, inc.

PHOTOGRAPHIC RECORD

Client: NYSDEC

E & E Job No.: ND2031

Camera: Make

SN:

Photographer: D. Sutton

Date/Time: 8/26/87; 11:48

Lens: Type:

SN:

Frame No.: No. 5

Comments*: Photo shows old Vanadium Corp. building foundation and loading ramp. Also shows piles of mixed spill of raw materials/ cleanup from facility. Looking south from road embankment on disposal cell.

Photographer: D. Sutton

Date/Time: 8/26/87; 11:55

Lens: Type:

SN:

Frame No.: No. 6

Comments*: Photo shows low area with standing water. View looking south from access road on disposal cell No. 2.

*Comments to include location

D1773

Niagara. It is bounded as follows: West-Witmer Road; North-Niagara Mohawk Power Company right-of-way; East-Airco Properties, Inc.; and South-Niagara Mohawk Power Company. The total site drainage area includes twenty-five acres (Airco Properties, Inc.) in addition to the thirty-seven acres of SKW Alloys, Inc. The only surface water entering the site is an intermittent stream which originates to the East of the site. However, this stream dries up during the late spring and summer months. Surface drainage is away from the drainage shed, along natural contours (refer to Dwg. AAD-3). The percentage of run-off is dictated both by ground slopes and soil permeabilities.

2.4.2 Floodplain Considerations

The SKW Alloys, Inc. site is not a floodplain. This is predicated upon the Federal Insurance Administration's Flood Hazard Boundary Map No. H02 for the Town of Niagara, N.Y. (Niagara County) revised on April 30, 1976.

2.4.3 Quality and Potential Environmental Effects

The proposed solid waste management facility will provide adequate environmental protection against surface water contamination. Further information concerning this matter is found in Section 3 (Operations) and Section 4 (Site Monitoring) of this Report.

Implementation of this project will not have any effect on wetlands. In a verbal communication between Mr. Cameron O'Connor (New York State Department of Environmental Conservation) and Mr. Donald J. Kuhn (Secured Landfill Contractors, Inc.), on May 31, 1979, it was stated by Mr. O'Connor that neither the site or adjacent property contains a wetland. Appendix A.

2.5 Atmospheric Factors

2.5.1 Precipitation and Evaporation

The site is located in a region with a humid continental type climate. Due to its nearness to Lake Ontario and Lake Erie, it is subject to less extremes in temperature than most of upstate New York. In addition, due to both its location and its flat topography, this area is notable for the smallest annual precipitation in the State. For this area, the rate of precipitation is approximately 6 inches/yr. greater than the rate of evaporation.

The prevailing westerly winds enter the area mainly via the narrow strip of land separating Lake Erie from Lake Ontario. These winds are less moisture laden than if they had passed over the lakes. Even those winds which are moisture laden from evaporated lake water may retain most of their moisture until they reach the more hilly areas east of Lake Ontario.

ecology and environment, inc.

PHOTOGRAPHIC RECORD

Client: NYSDEC | E & E Job No.: ND2031

Camera: Make ______ | SN: ______

Photographer: D. Sutton

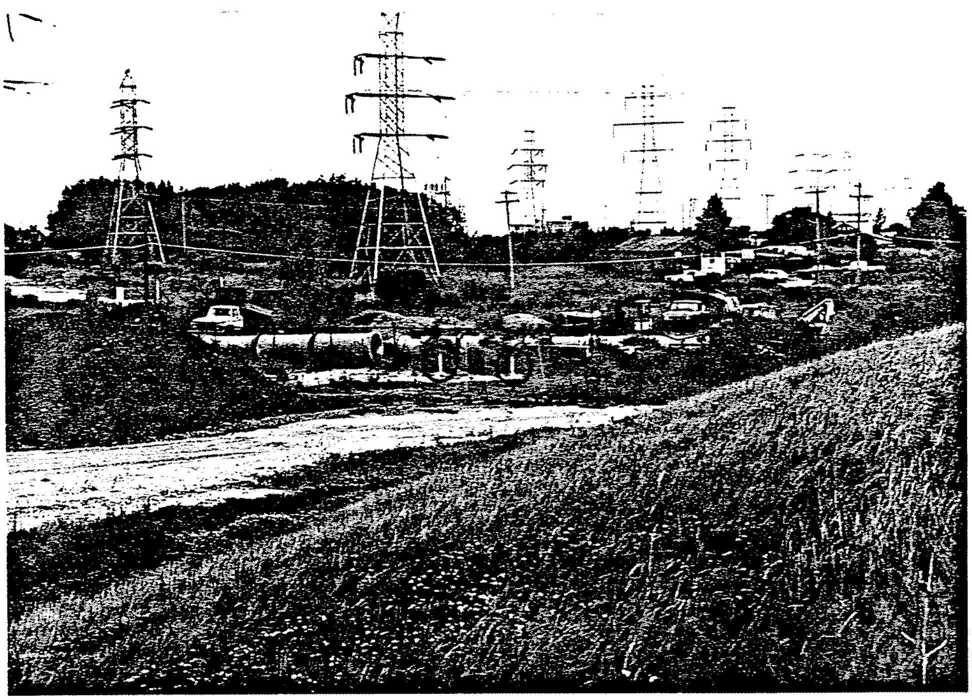
Date/Time: 8/26/87; 11:58

Lens: Type:

SN:

Frame No.: No. 7

Comments*: Photo shows buildings on site, looking south from access road on disposal cell No. 2.



Photographer: D. Sutton

Date/Time: 8/26/87; 12:10

Lens: Type:

SN:

Frame No.: No. 8

Comments*: Photo shows two monitoring wells on site, looking north from access road adjacent to disposal cell No. 2; also shows waste piles.

*Comments to include location

ecology and environment, inc.

PHOTOGRAPHIC RECORD

Client: NYSDEC E & E Job No.: ND2031

Camera: Make SN:

Photographer: D. Sutton Date/Time: 1/25/89 13:50

Lens: Type SN: Frame No.: 1

Comments: Photo showing construction debris and carbon waste, facing east from top of landfill area on Airco Carbon property.

ecology and environment, inc.

PHOTOGRAPHIC RECORD

Client: NYSDEC

E & E Job No.: ND2031

Camera: Make

SN:

Photographer: D. Sutton

Date/Time: 1/25/89 13:50

Lens: Type

SN:

Frame No.: 2

Comments: Continuation of Frame #1.

ecology and environment, inc.

PHOTOGRAPHIC RECORD

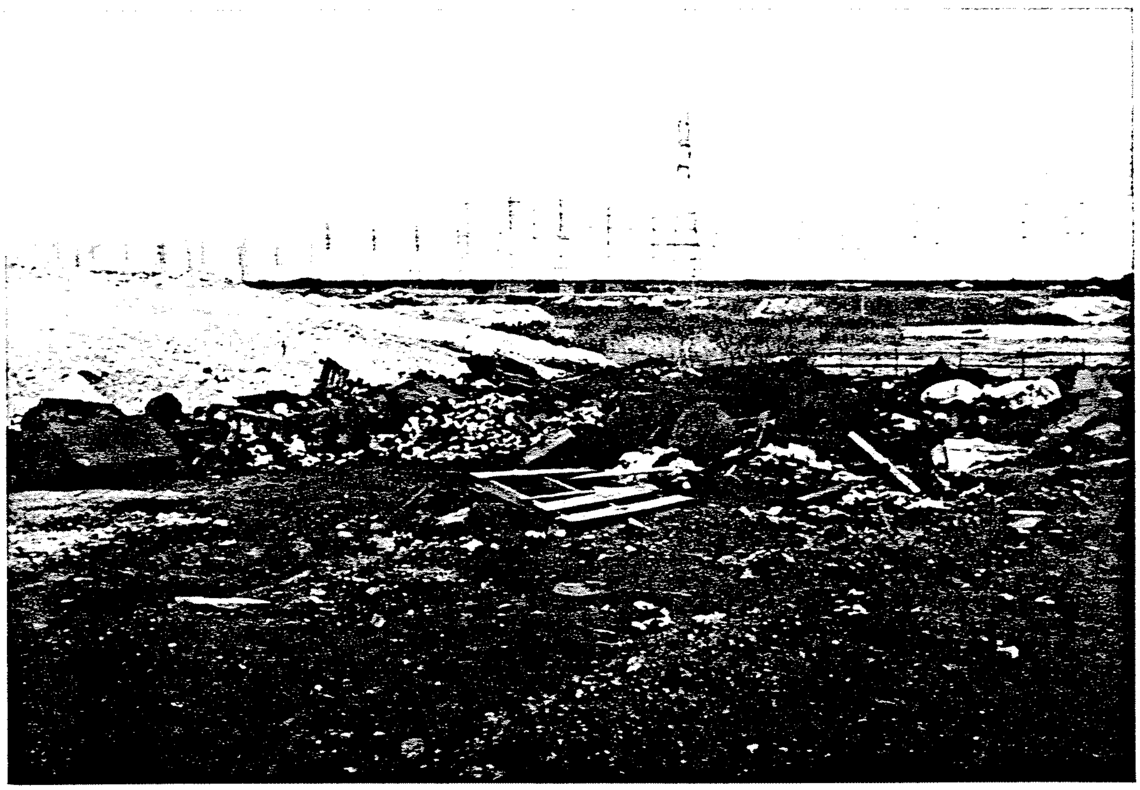
Client: NYSDEC
E & E Job No.: ND2031

Camera: Make
SN:

Photographer: D. Sutton
Date/Time: 1/25/89 13:50

Lens: Type
SN:
Frame No.: 3

Comments: Continuation of Frame #2, showing lime slag pile.



ecology and environment, inc.

P H O T O G R A P H I C   R E C O R D

Client: NYSDEC

E & E Job No.: ND2031

Camera: Make

SN:

Photographer: D. Sutton

Date/Time: 1/25/89 14:00

Lens: Type

SN:

Frame No.: 4

Comments: Looking west from top of closed area, Airco Carbon landfill, showing access road and entrance to landfill.

ecology and environment, inc.

P H O T O G R A P H I C   R E C O R D

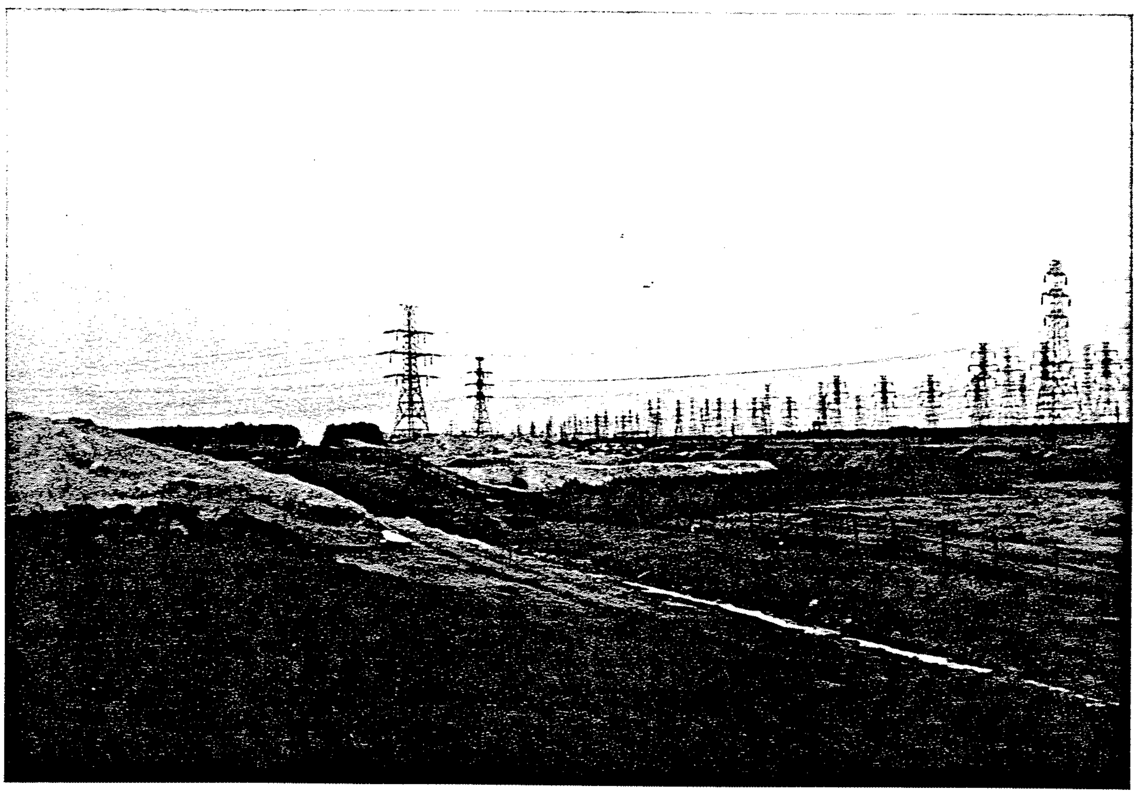
Client: NYSDEC E & E Job No.: ND2031

Camera: Make SN:

Photographer: D. Sutton Date/Time: 1/25/89 14:05

Lens: Type SN: Frame No.: 5

Comments: Photo showing lime slag pile on the Niagara Mohawk right-of-way, looking north from top of closed landfill area.



ecology and environment, inc.

P H O T O G R A P H I C   R E C O R D

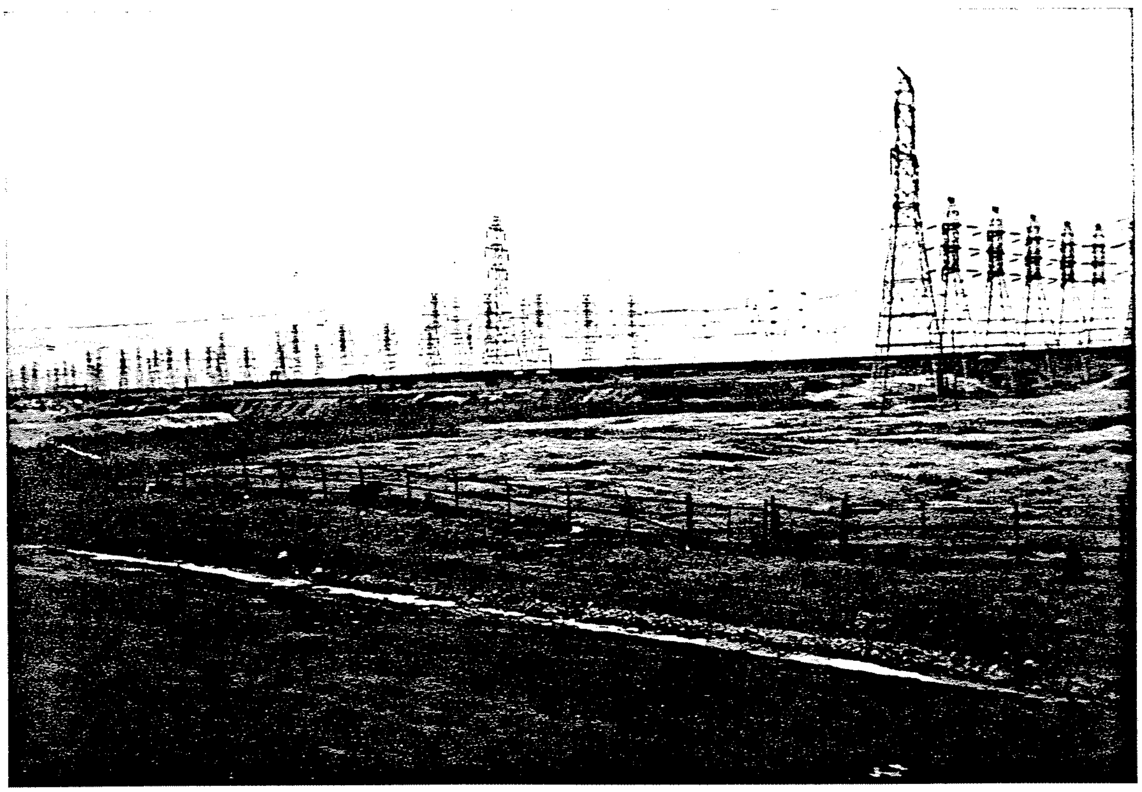
Client: NYSDEC E & E Job No.: ND2031

Camera: Make SN:

Photographer: D. Sutton Date/Time: 1/25/89 14:06

Lens: Type SN: Frame No.: 6

Comments: Photo looking northeast onto Niagara Mohawk right-of-way from Airco Carbon property, showing monitoring wells #2 and 2H, rusted drums, graded lime slag. Note dirt bike riders in background.



ecology and environment, inc.

PHOTOGRAPHIC RECORD

Client: NYSDEC E & E Job No.: ND2031

Camera: Make SN:

Photographer: D. Sutton Date/Time: 1/25/89 14:10

Lens: Type SN: Frame No.: 7

Comments: Photo looking east from Airco Carbon access road showing construction debris and carbon waste in landfill area.

339088

ecology and environment, inc.

PHOTOGRAPHIC RECORD

Client: NYSDEC E & E Job No.: ND2031

Camera: Make ______ SN: ______

Photographer: D. Sutton Date/Time: 1/25/89 14:12

Lens: Type ______ SN: ______ Frame No.: 8

Comments: Photo showing rusty drums on Niagara Mohawk property, facing north from Airco Carbon land-fill perimeter road. Note lime slag on ground surface.

ecology and environment, inc.

P H O T O G R A P H I C   R E C O R D

Client: NYSDEC   E & E Job No.: ND2031

Camera: Make   SN:

Photographer: D. Sutton   Date/Time: 1/25/89 14:15

Lens: Type   SN: Frame No.: 9

Comments: Photo facing northeast, showing white lime material on Niagara Mohawk property.

ecology and environment, inc.

P H O T O G R A P H I C   R E C O R D

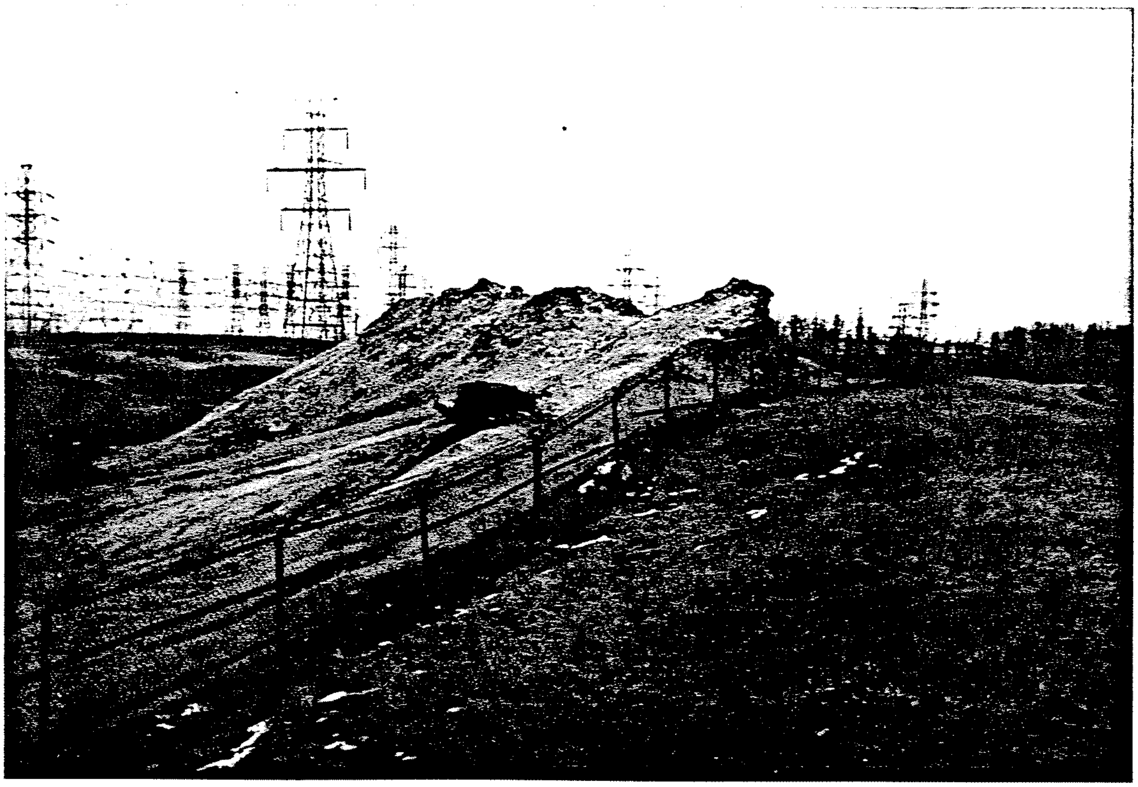
Client: NYSDEC | E & E Job No.: ND2031

Camera: Make ______ SN: ______

Photographer: D. Sutton | Date/Time: 1/25/89 14:20

Lens: Type ______ SN: ______ Frame No.: 10

Comments: Photo facing south looking onto Niagara Mohawk proerty showing lime slag piles.



ecology and environment, inc.

P H O T O G R A P H I C   R E C O R D

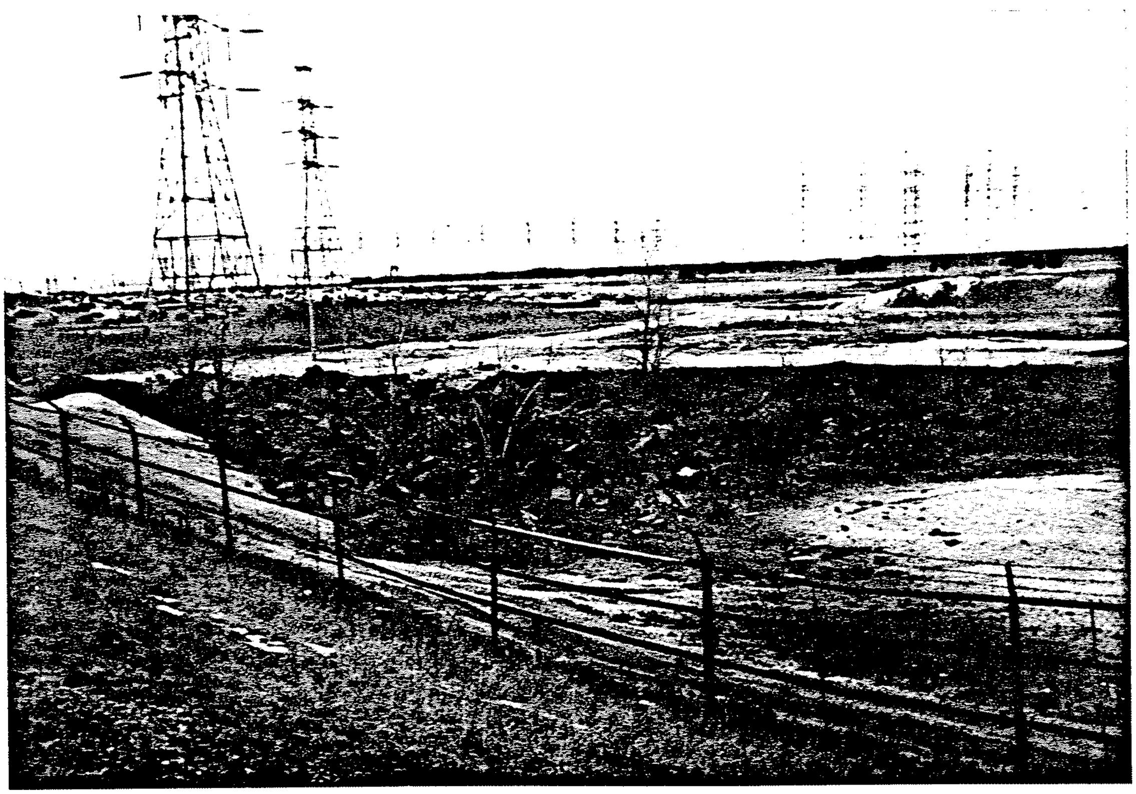
Client: NYSDEC E & E Job No.: ND2031

Camera: Make SN:

Photographer: D. Sutton Date/Time: 1/25/89 14:25

Lens: Type SN: Frame No.: 11

Comments: Photo looking north onto Niagara Mohawk property showing waste debris piles.



ecology and environment, inc.

PHOTOGRAPHIC RECORD

Client: NYSDEC E & E Job No.: ND2031

Camera: Make SN:

Photographer: D. Sutton Date/Time: 1/25/89 14:30

Lens: Type SN: Frame No.: 12

Comments: Photo looking west showing piles of waste on Airco Carbon property, looking toward SKW property.

ecology and environment, inc.

PHOTOGRAPHIC RECORD

Client: NYSDEC

E & E Job No.: ND2031

Camera: Make

SN:

Photographer: D. Sutton

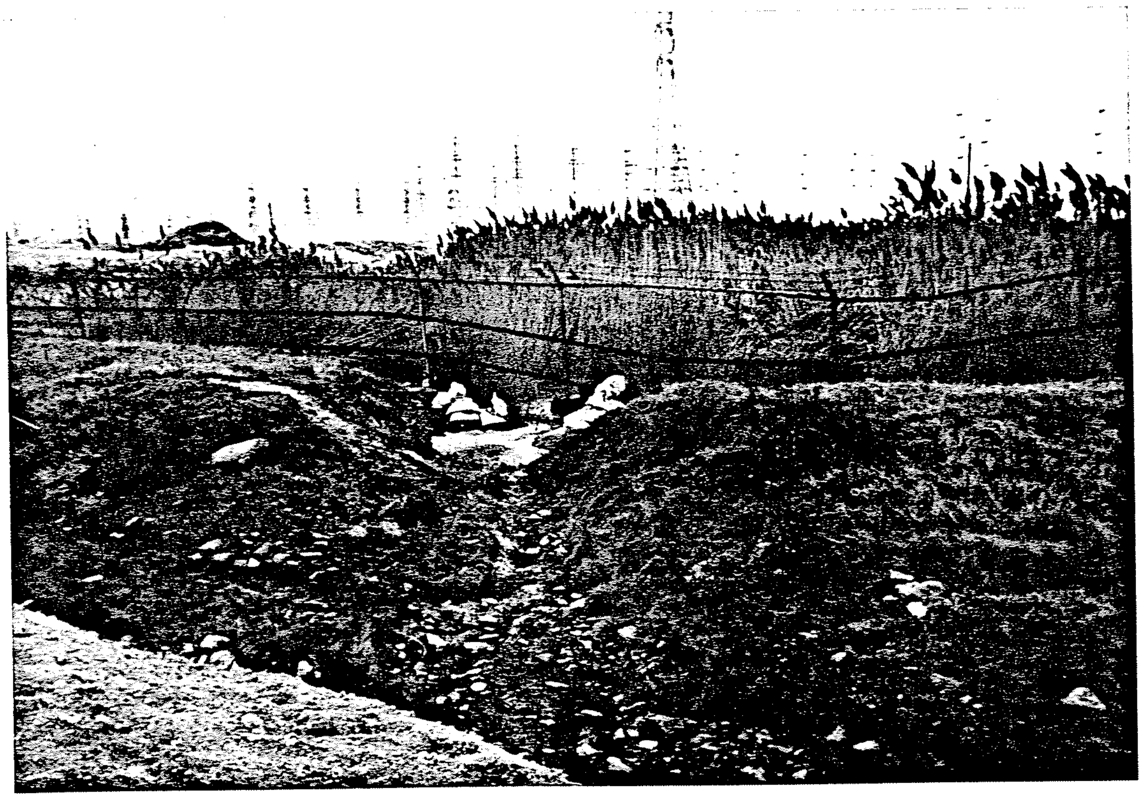
Date/Time: 1/25/89 14:15

Lens: Type

SN:

Frame No.: 13

Comments: Photo taken from access road showing drainage ditch, looking northeast onto Niagara Mohawk right-of-way.



ecology and environment, inc.

PHOTOGRAPHIC RECORD

Client: NYSDEC E & E Job No.: ND2031

Camera: Make SN:

Photographer: D. Sutton Date/Time: 1/25/89 14:35

Lens: Type SN: Frame No.: 14

Comments: Photo taken from top of landfill area facing northwest on Arico Carbon property, showing waste on top of landfill.

ecology and environment, inc.

P H O T O G R A P H I C   R E C O R D

Client: NYSDEC E & E Job No.: ND2031

Camera: Make SN:

Photographer: D. Sutton Date/Time: 1/25/89 14:40

Lens: Type SN: Frame No.: 15

Comments: Photo of drainage ditch between SKW and Airco Carbon property, facing north. Note white milky surface water.

APPENDIX B

NYSDEC INACTIVE HAZARDOUS WASTE
DISPOSAL SITE REPORT

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

DIVISION OF SOLID AND HAZARDOUS WASTE

INACTIVE HAZARDOUS WASTE DISPOSAL SITE REPORT

Priority Code: 3 Site Code: 932001

Name of Site: SKW Alloys, Inc. Region: 9

Street Address: Witmer Road

Town/City: Town of Niagara County: Niagara

Name of Current Owner of Site: SKW Alloys, Inc.; Airco Carbon Corp.; Niagara Mohawk Corp.

Address of Current Owner of Site: 3801 Highland Avenue, Niagara Falls

Type of Site: [X] Open Dump [ ] Structure [ ] Lagoon
[X] Landfill [ ] Treatment Pond

Estimated Size: 62 acre(s)

Site Description:

The SKW Alloys, Inc. site is a 62-acre industrial landfill located on Witmer Road, Town of Niagara. Included in the 62-acre area is a 25-acre landfill area owned by Airco Carbon Corp. The area is primarily industrial with private residences to the west. The landfill accepts baghouse dust waste from SKW Alloys' plant on Highland Avenue in Niagara Falls and construction debris and carbon waste from Airco Carbon Corp. on Packard Road, Niagara Falls. Wastes have also been disposed of or stored on other various locations on site. The primary concern is migration of contaminants found in the groundwater on site. The groundwater flow appears to be toward the Niagara River 1.5 miles to the west. There is also a possibility of soil contamination. Airborne dust could be a potential problem caused by the lime slag piles on site and the use of the area by dirt bikers and ATVs.

Hazardous Waste Disposed: [ ] Confirmed [X] Suspected

Type and Quantity of Hazardous Wastes Disposed:

Type	Quantity (Pounds, Drums, Tons, Gallons)
Ferro chrome silicon alloy dust	50,000 tons
Ferro manganese slag	6,000 tons
Ferro chrome silicon slag	21,000 tons
Ferro silicon dust	25,000 tons
Calcium hydroxide, miscellaneous refuse	Unknown

Time Period Site was Used for Hazardous Waste Disposal:

______________________, 19 20 To Present, 19 87

Owner(s) During Period of Use: Vanadium Corp., Airco Carbon Corp., SKW Alloys

Site Operator During Period of Use: SKW Alloys, Airco Carbon Corporation

Address of Site Operator: 3801 Highland Avenue, Niagara Falls, New York

Analytical Data Available: [ ] Air [ ] Surface Water [X] Groundwater
[ ] Soil [ ] Sediment [ ] None

Contravention of Standards: [X] Groundwater [ ] Drinking Water
[ ] Surface Water [ ] Air

Soil Type: Odessa-Lakemont-Ovid Association

Depth to Groundwater Table: 10-15 feet

Legal Action: Type: ______________________ [ ] State [ ] Federal

Status: [ ] In Progress [ ] Completed

Remedial Action: [ ] Proposed [ ] Under Design
[ ] In Progress [ ] Completed

Nature of Action: ______________________

____

Assessment of Environmental Problems:

Contamination of groundwater

Assessment of Health Problems:

Person(s) Completing This Form:

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION	NEW YORK STATE DEPARTMENT OF HEALTH
Name: ______________	Name: ______________
Title: ______________	Title: ______________
Name: ______________	Name: ______________
Title: ______________	Title: ______________
Date: ______________	Date: ______________

APPENDIX C

PHOTOCOPIED REFERENCES

New York State Department of Environmental Conservation
600 Delaware Avenue, Buffalo, NY 14202-1073

Henry G. Williams
Commissioner

October 7, 1987

Mr. Jon Sundquist
Ecology and Environment, Inc.
195 Holtz Road
P.O. Box D
Buffalo, NY 14225

Dear Mr. Sundquist:

SKW Alloys, Inc., 32N04

Enclosed, as you requested, please find a copy of SKW's most recent Part 360 Permit to Operate. If you have any questions, contact me at 716-847-4585.

Very truly yours,

James P. Goehrig
Assistant Sanitary Engineer

JPG:jd
Enc.

Permit File

New York State Department of Environmental Conservation
600 Delaware Avenue, Buffalo, New York 14202

Robert F. Flacke
Commissioner

October 20, 1981

Mr. William J. Bernat, Executive
Vice President
SKW Alloys, Inc.
3801 Highland Avenue
Niagara Falls, New York 14305

Re: Permit to Construct and Operate
Permit #2585 - Facility #32N04
SKW Alloys, Inc.
Niagara (T), Niagara County

Gentlemen:

Transmitted herewith is your permit for the construction and operation of Landfill #2.

Your application for variance from the requirements of daily cover has been approved, however, in the event of fugitive dusts arising from the facility, this variance may be withdrawn unless other steps are taken to eliminate the fugitive dust problem. You will also note that the permit includes a requirement for the submission for the financial undertaking of your choice in the amount of $5,000, payable to the Commissioner of the NYS Dept. of Environmental Conservation, to cover closure and post-closure monitoring in the event of default. This financial undertaking shall be for the life of the permit and should be forwarded within 60 days to this office. If not received and accepted by this Department within 60 days, the permit shall be considered null and void.

Copies of the approved plans and report will be forwarded under separate cover.

Should you have any questions, please contact this writer at 716/847-4585.

Very truly yours,

John S. Tygert, P.E.
Senior Sanitary Engineer

JST:las
cc: Mr. D. O'Toole, NYSDEC-Albany, Watrano Road
Mr. M. Vaughn, Niagara County Health Department
Secured Landfill Contractors, Inc.

NEW YORK STATE DEPARTMENT OF E...

2565

PERMIT

Under the Environmental Conservation Law, Article 27, Title 7, Part 360

EXPIRATION DATE October 31, 1984

EFFECTIVE DATE - October 20, 198

[X] CONSTRUCTION [X] OPERATION

[X] INITIAL ISSUE [ ] RENEWAL

[ ] REISSUANCE [ ] MODIFICATION

PERMIT ISSUED TO: SKW ALLOYS, INC.	ADDRESS OF PERMITTEE: 3801 Highland Avenue, Niagara Falls, NY 14305	TELEPHONE NO.: 716/285-1252
LOCATION OF PROJECT: Town Niagara	County Niagara	Environmental Conservation Regional Office: Region 9 Headquarters, 600 Delaware Avenue, Buffalo, NY 14202
DESCRIPTION OF PROJECT: Construct and Operate SKW Alloys, Inc. Landfill #2		ON-SITE SUPERVISOR: William Lozow

GENERAL CONDITIONS

1. The permittee shall file in the office of the Environmental Conservation Region specified above, a notice on intention to commence work at least 48 hours in advance of the time of commencement and shall also notify said office promptly in writing of the completion of the work.
2. The permitted work shall be subject to inspection by an authorized representative of the Department of Environmental Conservation who may order the work suspended if the public interest so requires.
3. As a condition of the issuance of this permit, the applicant has accepted expressly, by the execution of the application, the full legal responsibility for all damages, direct or indirect, of whatever nature, and by whomever suffered, arising out of the project described herein and has agreed to indemnify and save harmless the State from suits, actions, damages and costs of every name and description resulting from the said project.
4. All work carried out under this permit shall conform to the approved plans and specifications. Any amendments must be approved by the Department of Environmental Conservation prior to their implementation.
5. The permittee is responsible for obtaining any other permits, approvals, easements and rights-of-way which may be required for this project.
6. By acceptance of this permit, the permittee agrees that the permit is contingent upon strict compliance with Part 360 and the special conditions. Any variances granted by the Department of Environmental Conservation to Part 360 must be in writing and attached hereto.

SPECIAL CONDITIONS

1. Your application for a variance from 6NYCRR Part 360.8(b) (exemption from daily cover) is hereby approved. In the event that the deposited ferro silicon sludges become dried and create a fugitive dust problem, either on or off site, steps shall be taken to remedy the situation.

2. Upon the filling of the landfill, two feet of cover material shall be applied to the surface of the landfill. The top 6 inches shall be of a soil suitable for sustaining a vegetative cover crop to avoid erosion.

3. Quarterly reports shall be submitted indicating the volume of material which has been placed into the landfill and shall be submitted on the first business day of the month of November, February, May and August.

4. Semi-annual reports shall be submitted to the Region 9 Office containing the analytical results of the monitoring well sampling program and surface water sampling program as included in the permit for Landfill #1.

5. Within 60 days of the effective date of this permit, a certificate of deposit, bond or other negotiable instrument, payable to the Commissioner of the NYS Department of Environmental Conservation, shall be forwarded to this Region 9 Office in the amount of $5,000 to cover costs of closure and monitoring. The life of this undertaking shall be for the permit life (October 31, 1984).

6. The issuance of this permit does not relieve the applicant from the compliance with other State, Federal or local laws, ordinances or regulations.

7. Prior to the expiration date of this permit, the landfill shall be properly closed and maintained to prevent adverse environmental health impacts, such as contravention of surface or groundwater quality standards, gas migration, odors, and vectors. Proper (CONT'D)

ISSUE DATE	ISSUING OFFICER		SIGNATURE
	Robert J. Mitrey, P.E.	C-4	X

SKW ALLOYS, INC.
3801 Highland Avenue
Niagara Falls, NY 14305

Permit to Construct and
Operate - Permit #2585
Expiration Date - 10/31/84
Facility #32N04

SPECIAL CONDITIONS (cont'd)

7. closure includes covering with a minimum of 2 feet of final cover, establishment of a grass cover crop, and sufficient grading to divert water off the fill area in order to minimize infiltration and to preclude ponding.

Robert J Mitrey, P.E. #4

Permit Administrator

20 Oct '81

Date

Carbon
Division of Airco, Inc.

P.O. Box 828
Niagara Falls
New York 14302
Telephone: 716-285-6971

File Airco ...

July 31, 1984

Mr. Stuart M. Fox
Environmental Analyst
New York State Department of
Environmental Conservation
Region 9 Office
600 Delaware Avenue
Buffalo, New York 14202-1073

Subject: Submission of Requested Items for the Renewal of the Permit to Operate Airco Properties, Inc. Witmer Road Landfill Site, DRA #90-84-0293

Dear Mr. Fox:

This letter with the appropriate attachments is in response to your letter of May 8, 1984, in which you requested that several items be submitted to the NYSDEC in order to complete our permit renewal application for the Airco Properties, Inc. Witmer Road Landfill Site. All items requested are enclosed herewith except for item 6, the variance requests. Further additional work is required on these variances. It is therefore respectfully requested that a 3-day extension until August 3, 1984 be granted in order to submit said variances.

In addition to the attachments, further background information and a discussion outlining our specific response to each item requested, follows below (responses numbered per your May 8, 1984 letter):

1. Accepted Waste List Modification

Airco Carbon respectfully requests that miscellaneous scrap wood and cardboard be approved by the NYSDEC as materials acceptable for deposition in the Witmer Road site. As in the case with all presently approved materials, these new items are non-hazardous, thus they pose no contamination threat (migratory) to the groundwater. Similarly, the cardboard poses minimal threat of becoming airborne or causing a littering problem as the quantities to be deposited at the landfill are minor compared with the other heavier material placed in the landfill and are likely to be weighted down and/or covered over by these other materials. Per our existing permit conditions, no loose paper, office wastes and putrescible wastes will be deposited in the landfill.

The above request was made previously in letters dated August 30, 1982, copied to Mr. J. Tygert, NYSDEC, and March 30, 1984 addressed to the same. The Town of Niagara has previously approved our request. (Reference attachments A, B and C, respectively.)

2. Revised Fill Progression and Closure Plan

A revised fill progression plan was prepared jointly by SLC Consultants/Constructors, Inc. and Mr. Richard R. Snyder, P.E. (Reference attachment D with appropriate blueprints.) Both parties referenced were the primary personnel who assisted Airco Properties, Inc. in procurement of its initial permit to operate the Witmer Road site and thus are extremely knowledgable of the landfill and its operation.

In general, the new fill progression in the landfill will still proceed in annular rings around the site, gradually progressing inward and upward to the peak of the landfill. However, rather than placing final cover subsequent to the completion of a full annular ring, fill progression in each ring will be concentrated in approximate one (1) acre increments so that final cover can be achieved in a more expeditious time frame. It is estimated that one (1), one (1) acre area will be closed each year, with the first to be closed in the spring/summer of 1985.

3. "Shallow Well" Construction, Boring Logs and Perched Water Table Depth

A. "Shallow Well" Construction

The construction of the "shallow wells" is identical to that of the deep wells as described in the initial application for a "Solid Waste Management Facility for Airco Properties, Inc Witmer Road, Niagara Falls, N.Y., Site" dated April 23, 1980 and prepared for Airco by Mr. Richard R. Snyder, P.E. (hereafter referred as the initial application). Attachment E is a diagram of a typical well at the landfill site.

B. Boring Logs for the "Shallow Wells"

The installation of the "shallow wells" was done after the installation of the deep wells with the exception of "shallow well" numbered 13A. Installation was per the following schedule:

A) deep wells installed at positions numbered 1, 2 and 4 - December 29, 1978

B) "shallow wells" installed at positions numbered 1A, 2A and 4A - March 19, 1979

C) deep and "shallow well" installed at position numbered 13 and 13A - June 12, 1979

(Reference attachment F for well location)

When installed, the "shallow wells" were positioned adjacent to the deep wells of corresponding number identification. As a result of their close proximity to each other, it was reasonable to assume that the boring logs for the deep wells would have been similar to those of the "shallow wells", thus no boring analyses were performed on the shallow wells. For reference, as reported in the initial application, enclosed as attachment G find the boring analyses for the deep wells.

C. <u>Perched Water Table Depth</u>

The historical and present perched water table depth measurements from the shallow wells are included as attachment H. As indicated in the data, the depth to the perched water table is variable throughout the year and is at times completely non-existent at two (2) points in the landfill.

The existence of the intermittent perched water table is the result of the natural sub-surface soil conditions which exist at the landfill. As indicated in the soil boring analyses below the existing surface of the landfill there exists a layer of natural clayey silt varying from 2.0' to 12.5' in thickness (see attachment I), with permeabilities measured at less than 3.5×10^{-6} cm/sec (see attachment J). With such a low permeability, this layer is considered to be "impervious" (D.K. Todd, "Groundwater Hydrology", John Wiley and Sons, Inc., 1959), thus precipitation on the surface of the landfill is held above the natural clay layer and is prevented from totally migrating to the permanent groundwater table located below in the glacial till and sorted stratified sediments. This natural "impervious" clay layer acts as a more than suitable barrier between the materials presently deposited at the landfill and the permanent groundwater table located below the natural clay layer. This is further supported by the lack of a significant change in the chemical analyses performed on the deep wells since beginning operation of the landfill in 1982. Once the final cover is placed on the landfill, the clay enclosure created will protect against any significant environmental impact on the permanent groundwater table.

Although Attachment I, submitted with the initial application indicates that the natural clay layer depth is variable at various points in the landfill, to have upgraded this layer by adding more clay would have required the removal of ≈398,000 tons of material placed in the landfill over a period of 50 years by previous owners of the site prior to 1982. At that time and to date, if upgrading of the clay layer was required, the operation of the landfill would have been impractical and cost prohibitive.

Further, the addition of additional clay would have created a fur~~ther~~ perched water table between the new clay and the materials deposited by Airco.

4. Source and Permeability of Cover Material

A potential source of cover material and the permeability of the material is enclosed as part of attachment D.

5. EP Toxicity Test Results for Category II Materials

Category II materials are those containing carbon dusts and carbon fines from air pollution control equipment. Attachment K contains the results of the EP Toxicity Tests performed on the wastes generated at our facility, including those considered to be category II. These analyses were performed at our Murray Hill, N.J. Research Lab utilizing the procedure outlined in 40 CFR Part 261, Appendix II. At the time of the analyses due to the nature of the materials used by it in its processes, Airco Carbon had no logical reason to believe that the pesticides or herbicides listed as part of the EP Toxicity Test were present in these materials, thus they were not analyzed. It is still Airco Carbon's contention that these herbicides and pesticides are not logically present.

6. Variance Requests

See page 1.

7. Closure and Post-Closure Maintenance Monitoring Program

The program referenced above is enclosed as part of attachment D.

If there are any questions concerning this matter or if we can be of any assistance, please feel free to contact us.

Yours very truly,

AIRCO CARBON, a Division of BOC, INC.

BY Ronald F. Spears, Jr.

Ronald F. Spears, Jr.
Supervisor, Environmental Compliance

RFS:vp
Encs.

ATTACHMENT D

CLOSURE AND POST CLOSURE MAINTENANCE AND MONITORING PLAN FOR AIRCO CARBON DIVISION, AIRCO INC.'S NON-HAZARDOUS INDUSTRIAL WASTE FACILITY NO. 32S39 - PERMIT NO. 2298

1.0 Introduction

The primary objective of this closure plan is to help insure that the Airco Carbon Division, Airco, Inc.'s non-hazardous industrial landfill located near Witmer Road in the Town of Niagara will not present any danger after closure to either human health or the environment. Implementation of this plan will minimize the need for future maintenance and control, minimize, or eliminate to the extent necessary to protect human health and the environment the escape of waste constituents, leachate, contaminated rainfall, or waste decomposition products to the groundwater, surface water, or atmosphere.

As noted in the landfill's original permit, the facility is constructed in stages as required to satisfy waste deposition requirements. While this procedure will be continued, it is important to note that Airco's generation rate for wastes which are deposited in this landfill has fallen by approximately 75 percent since 1981. This is due to a combination of reduced plant production rates and successful implementation of measures to sell the plant's generated waste.

All cost estimates provided in this plan are based on July 1984 costs. Therefore, these estimates should be adjusted on an annual basis for inflation. In addition, a new estimate will be required whenever an approved (by NYSDEC and Town of Niagara) change in the closure plan might affect the cost of closure.

2.0 Closure

As previously noted this landfill is unique in that the operational and closure plan are closely related. The landfill's operation is in effect a progressive closure. As previously noted the landfill's fill rate to date has been significantly less than the original design rate. At present fill rates it will take a minimum of 30 years to complete the progressive closure plan for the entire 25 acre site (approximately 20 acres will be dedicated to solid waste managememt).

For purposes of closure a maximum area of one acre will be utilized for waste deposition (refer to Part 360 Engineering Report and August 22, 1980 correspondence from Donald J. Kuhn and Richard R. Snyder to Jack Tygert of NYSDEC for description of fill procedure). Therefore the maximum area of newly deposited waste (material deposited after receipt of NYSDEC permit No. 2298) uncovered during any point in the implementation of the progressive closure plan will be one acre.

Assumptions basic to closure cost development are as follows:

1) All prices are based on July 1984 costs,
2) Clay to meet 10^{-5} cm/sec specification will be obtained from an area within 15 miles of the Airco Witmer Road site and its cost will be $10.00 per cubic yard (in place),
3) Soil capable of supporting vegetal growth will be obtained from an area within 15 miles of the Airco Witmer Road site and its in-place cost will be $15.00 per cubic yard (in place),
4) Seeding (including fine grading of topsoil with landscaping equipment will cost $2,000/acre, and
5) Maximum area to be closed at any time during site's progressive closure will be 1 acre.

Table 1 illustrates the cost estimate for final closure of the Airco landfill.

Table 1

Closure Cost Estimate

Clay	$32,300
Soil capable of supporting vegetative cover	$12,100
Seeding and Fine Grading	$ 2,000
Subtotal	$46,400
Contingency (10% of total)	$ 4,640
Administration (5% of total)	$ 2,320
Total	$53,360

3.0 Site Monitoring

The monitoring program for Airco Carbon Division, Airco, Inc.'s non-hazardous industrial waste landfill has been designed to accomodate all phases of the site's life (operation-progressive closure and post closure periods). This plan incorporates monitoring of both surface and ground waters, (refer to Section 4 of "Application for a Solid Waste Management Facility for the Airco Properties, Inc. Witmer Road, Niagara Falls, New York Site", May 1980 for details concerning site monitoring program). To date, no significant environmental problems have been detected. With this in mind, Airco anticipates continuing this program on a semi annual basis until one year after the completion of landfilling and application of the final portion of the progressive cover. At that time, such monitoring will be reduced to an annual basis. However, in the unlikely event that a problem should be detected, additional monitoring will be implemented. Upon attainment of final elevation and completion of the progressive closure program, the site's monitoring program will consist of sampling monitoring wells # 1,2,4, and 13, and surface water monitoring points #6 and 6A.

Each sample will be analyzed for pH, conductivity, total dissolved solids, chemical oxygen demand, total organic carbon, barium, chromium (trivalent), chromium (hexavalent), iron, maganese, silicon, and zinc. Each complete sampling and analysis will cost $1,000.

4.0 Post Closure Maintenance

The goals of the post closure maintenance plans for the Witmer Road site are as follows:

1) Insure that integrity of waste cover and site drainage ditch are maintained,

2) Correct any problems that might occur at the site before they have a chance to develop to a degree which could result in adverse environmental impacts, and

3) Follow a program in which all parties (Airco, regulatory agencies, and the public) have a sense of confidence that the site will not create problems which cannot be reasonably handled with minimum impacts.

The post closure maintenance plan is as follows:

1) Airco will designate a person or persons who will be responsible for filing a Waste Management Facility maintenance report. Included in this maintenance report will be a check list as follows:
   a) Bank and cover erosion
   b) Settlement
   c) Cover soil integrity
   d) Condition of vegetative cover
   e) Condition of site drainage ditch
   f) Condition of monitoring wells.

2) The site will be physically walked by the responsible individual or individuals once every three months for the first year after site closure and semi-annually for the duration of the site's life.

3) If any problems are encountered that may be of any significant environmental concern, immediate corrective action will be undertaken. Notice of these actions will be reported to the NYSDEC explaining the nature and location of the problem and the corrective action taken.

If the progressive landfill closure plan is followed according to the Part 360 Engineering plan and report, the possibility for development of significant post closure problems is minimal. Therefore, such costs are not expected to exceed $2,500 per year.

5.0 Plan Revision

This closure and post closure plan will be kept on file by the Airco Carbon Division of Airco, Inc. It will be revised whenever a change is made which affects either the method and/or cost of closure.

Richard R. Snyder

Richard R. Snyder, P.E.

7-30-84

DESCRIPTION AND SOURCE OF LANDFILL COVER

Low permeability cover soil can be obtained from a location near the Huntley Power Station on River Road in the Town of Tonawanda. This location presently represents one of the primary sources in this locality of low permeability soil for utilization in landfill construction. Soil from this location typically exhibits a permeability of less than 10^{-7} cm/sec and therefore far exceeds the maximum permeability requirement of 10^{-5} cm/sec as specified in the approved Part 360 Engineering Report and Plans.

While it may become necessary or prove economically attractive to use alternate sources in the future all cover material utilized at the Witmer Road site will satisfy the specifications as given in the approved Part 360 Engineering Report and Plans.

DESCRIPTION OF REVISED FILL PROGRESSION PLAN

The revised landfill cross section drawings (D-04802, D-04803, and D-04804) indicate changes in site topography since inception of construction and operation of the Witmer Road landfill. As noted in previous submittals the topography of the existing site is variable, irregular and inconsistent. This makes it impractical to provide a detailed operational plan for each specific area over the entire 25 acre site.

Since the inception of the landfill's operation, the Airco plant's waste generation rate has only been approximately 25 percent of the rate utilized in making the original estimate of a 10 year site life.

In order to apply final cover on a more timely basis, the work-fill area of the site at any given time will be reduced. This will reduce the amount of "newly" deposited waste material which is exposed to the elements during any point in time. With this exception the fill progression plan (as outlined in the Part 360 Engineering Report and August 22, 1980 correspondence from Donald J. Kuhn and Richard R. Snyder to Jack Tygert of NYSDEC) will continue to be followed.

Depending upon the rate at which sections reach their designated elevations, it will probably be practical to place the two feet of low permeability cover over completed fill areas either once or twice per year. The six inches of soil capable of supporting vegetal cover should be placed every year.

January 10, 1979

EARTH DIMENSIONS, INC.

Soil Investigations and Natural Resource Assessments

797 Center Street • East Aurora, New York 14052 • (716) 655-1717

SOILS REPORT

Airco Alloys

Niagara Falls, New York

The purpose of this endeavor was to sample and describe the soils at the proposal monitoring well sites on Airco Alloys' landfill site and to install these wells. The wells sites were selected by P. Michael Terlecky, Vice President of Frontier Technical Associates, Inc., Gary W. Catlin, Vice President of Secured Landfill Contractors, Inc., and Donald W. Owens, Soil Scientist of Earth Dimensions, Inc. This well pattern is designed to identify the apparent water table characteristics under this landfill.

The soils were described with the wells installed December 15, 27-29, 1978. The soil descriptions were based on split spoon samples secured below the hollow stem auger of every major soil horizon or every five feet in the thicker horizons. The wells consisted of two inch PVC or carbon steel with the bottom two feet of these wells slotted. The wells were placed in a gravel pack and sealed with a 2/3 bentonite - 1/3 concrete mixture to prevent the surface water or perched water table from seeping downward along the pipe.

Industrial waste fill was identified as the surficial material at all of the boring sites. Also described at all boring sites as original soils, were a SILTY-CLAY mostly stone free lake sediment of various thickness over dense loamy glacial till to refusal. Water sorted stratified sediments were described in the two westerly boring sites, and the most eastern bore site between the lake sediment and glacial till. The SILTY-CLAY lake sediment with silt lenses and occasional silt strata has very uniform characteristics while the water sorted stratified materials and glacial till are more heterogeneous. The water sorted sediments were distinctly more sandy in the two westerly borings in comparison to the high silt content in the eastern location. The textures of the dense glacial till ranged from sandy loam (SILTY-SAND) to heavy silt loam (CLAYEY-SILT).

Continued on page #2 ...

This SILTY-CLAY lake sediment is an impervious zone typically having a very low coefficient of permeability rate. A vertical desiccation cracking pattern was described in this sediment that likely will increase this permeability rate. The water sorted stratified sediments, particularly the sandy stratas will readily allow liquids to travel laterally with different head pressures. The glacial till is intermediate in permeability with liquids moving through the till in a more diffuse pattern.

A natural perched water table exists above the SILTY-CLAY most of the year. The internal water sorted stratified layers also tends to be saturated most of the year.

Prepared by:

Don Owens

Donald W. Owens
Soil Scientist

DWO/dew
4L78

DIMENSIONS, INC.

Test Borings and Logs
797 Center Street • East Aurora, New York 14052 • (716) 655-1717

.178 HOLE NO. 1 SURF. ELEV. ______

PROJECT Piezometer Installation
Airco Alloys - Niagara Falls

LOCATION See survey

CLIENT Secured Landfill Contractors,Inc. DATE STARTED 12/15/78 COMPLETED 12/15/78

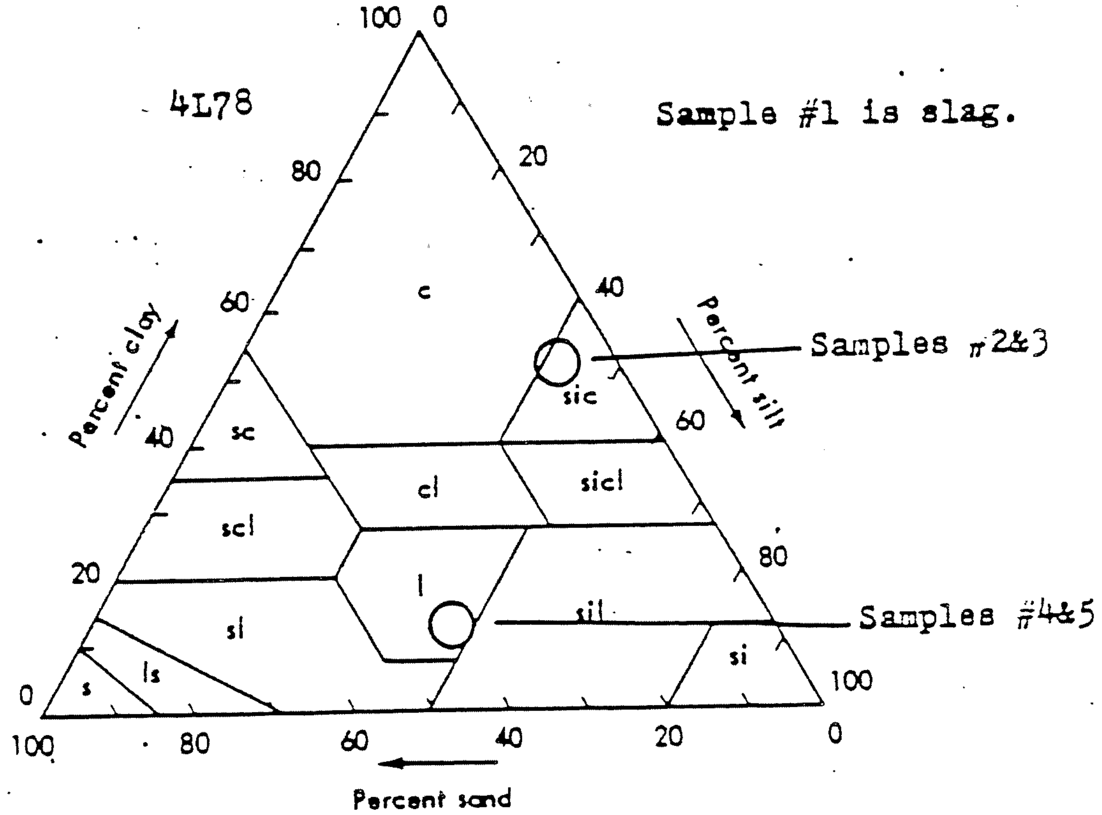
DEPTH (feet)	SAMPLE NO.	BLOWS ON SAMPLER 0/6	6/12	12/18	18/24	N	DESCRIPTION & CLASSIFICATION	Well	WATER TABLE & REMARKS
							Moist whitish gray slag, variable size, loose 1.3	Bentonite (to 1.0)	Industrial waste fill to 1.3 feet over clayey stone free lake sediment to 7.5 feet over dense loamy glacial till containing stone fragments to end of boring.
	1								
	2	13	10	16	27	26	Moist distinctly mottled reddish brown SILTY-CLAY with gray vertical desiccation cracks, extremely firm (stiff), plastic, sticky	Clay Cuttings (to 3.4)	
							---------clear transition to---3.5		
5	3	16	20	24	29	44	Moist reddish brown SILTY-CLAY with ½ to 1½ inch extremely moist SILT lenses, non-silt lenses contains thinly laminated clays, sticky, plastic	Bentonite & Concrete (to 8.0)	SILT lenses spaced about ½ foot apart.
							-------clear transition to-----7.5		
	4	8	20	25	12	45	Moist reddish brown gravelly loam (SANDY-SILT) with 15 to 20% hard gray subrounded dolomitic gravel, very firm, nonplastic, nonsticky	Gravel	Well notes: 2 in. inside diameter PVC well with bottom 2 ft. slotted every ¼-½" installed with 3 ft. stickup above ground.
10	5	100/1"					11.1		
							Refusal encountered at 11.1 feet.		Water table 8 feet below surface at completion. Well installed to 11.1 feet below surface.
15									

dew

N = NUMBER OF BLOWS TO DRIVE 2" SPOON 12" WITH 140 lb. WT. FALLING 30" PER BLOW.

LOGGED BY Owens & Smith SHEET 1 OF 1 24

HOLE #1:



c	Clay	scl	Sandy clay loam
si	Silt	sicl	Silty clay loam
s	Sand	cl	Clay loam
l	Loam	sil	Silt loam
sc	Sandy clay	sl	Sandy loam
sic	Silty clay	ls	Loamy sand

Textural triangle showing the percentages of clay (less than 0.002 mm), silt (0.002-0.05 mm), and sand (0.05-2.0 mm) in the basic soil textural classes (adapted from Soil Survey Staff, 1951).

DIMENSIONS, INC.

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4L78 HOLE NO. 2

PROJECT Piezometer Installation Airco Alloys - Niagara Falls

LOCATION See survey

SURF. ELEV. ______

CLIENT Secured Landfill Contractors, Inc.

DATE STARTED 12/27/78 COMPLETED 12/27/78

DEPTH (feet)	SAMPLE	BLOWS ON SAMPLER 0/6	6/12	12/18	18/24	N	DESCRIPTION & CLASSIFICATION	Well	WATER TABLE & REMARKS
	1						Moist brownish gray and gray powdery slag fill		Fill material and disturbed soil to 4.5 feet over clayey lake sediments to 7.5 feet over water sorted stratified sediment to 12.1 feet over dense loamy glacial till to refusal.
2.5	2	22	20	21		41	Moist brownish gray to gray disturbed silty clay loam (CLAYEY-SILT) with 2-3% fine dolomitic gravel fragments, very firm, slightly plastic	2 in. PVC with bottom 2 ft. slotted; Bentonite & Concrete	
5	3	11	17	20		37			
4.5							Moist highly mottled brownish gray SILTY-CLAY with fine size desiccation cracks, very firm, (stiff), plastic		
7.5							Moist to extremely moist reddish, brown heavy silt loam (SAND-SILT-CLAY) with 5 to 15% fine subangular gravel, and gray densely packed SILT lenses, firm to friable, slightly plastic		
10	4	6	7	17		24			
		8	8	20	17	30			
12.1	5						------clear transition to------ Extremely moist reddish gray heavy silt loam (CLAYEY-SILT) with 5 to 10% gravel, soft	Gravel	Sample #5 contains limestone rock fragments.
15 / 14.5							Refusal encountered at 14.5 feet		Well notes: 2 in. inside diameter PVC well with bottom 2 ft. slotted every ¼-½" installed with 3 ft. stickup above ground. Water table 7.5 ft. below surface at completion.

dew

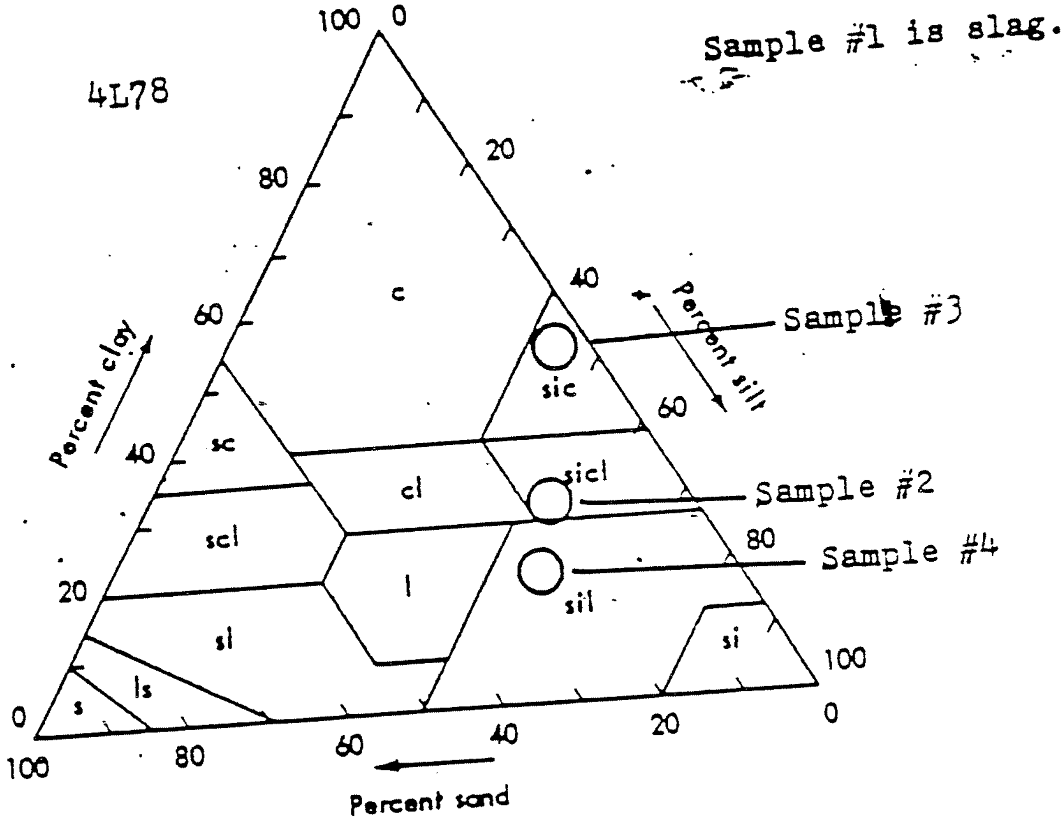
N = NUMBER OF BLOWS TO DRIVE 2 " SPOON 12 " WITH 140 lb. WT. FALLING 30 " PER BLOW.

LOGGED BY Owens

C-25

SHEET 1 OF 1

HOLE #2:



c	Clay	scl	Sandy clay loam
si	Silt	sicl	Silty clay loam
s	Sand	cl	Clay loam
l	Loam	sil	Silt loam
sc	Sandy clay	sl	Sandy loam
sic	Silty clay	ls	Loamy sand

Textural triangle showing the percentages of clay (less than 0.002 mm), silt (0.002-0.05 mm), and sand (0.05-2.0 mm) in the basic soil textural classes (adapted from Soil Survey Staff, 1951).

DIMENSIONS, INC.

Test Borings and Logs
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SURF. ELEV. ______

4L78 HOLE NO. 4

PROJECT Piezometer Installation
Airco Alloys - Niagara Falls

LOCATION See survey

CLIENT Secured Landfill Contractors, Inc.

DATE STARTED 12/29/78 COMPLETED 12/29/78

DEPTH (feet)	SAMPLE NO.	BLOWS ON SAMPLER 0/6	6/12	12/18	18/24	N	DESCRIPTION CLASSIFICATION	Well	WATER TABLE & REMARKS
		36	55	61		116	Moist light gray powdery fill with 25% fine slag fragments, very firm in place, nonplastic	2 in. PVC pipe with bottom 2 ft. slotted	Slaggy fill to 6 feet over silty lake sediments to 10 feet over gravelly glacial till to refusal.
	1						4.0 ------clear transition to--------		
5							Coarse slag fill	Bentonite & Concrete	Pipe notes: 2 in. inside diameter PVC well with bottom two feet slotted every ¼-½ in. installed with 28 inches stickup above ground.
							6.0		
		2	11	13	17	30	Moist dark grayish brown silt loam (CLAYEY-SILT) topsoil, friable, slightly plastic		
							7.0 -----clear transition to-----		
			18	23		41	Moist reddish brown SILTY-CLAY with fine desiccation cracks, finely laminated clays, very firm, plastic		
	3	Shelby tube sample taken							
10							10.0		
		7	5	6		11	Extremely moist becoming wet brown loam (SAND-SILT-CLAY) with 20% dolomitic gravel, soft, nonplastic		13.5
	4							Gravel	Water at 15.0 feet at completion
15									
							16.7		
							Refusal at 16.7 feet		

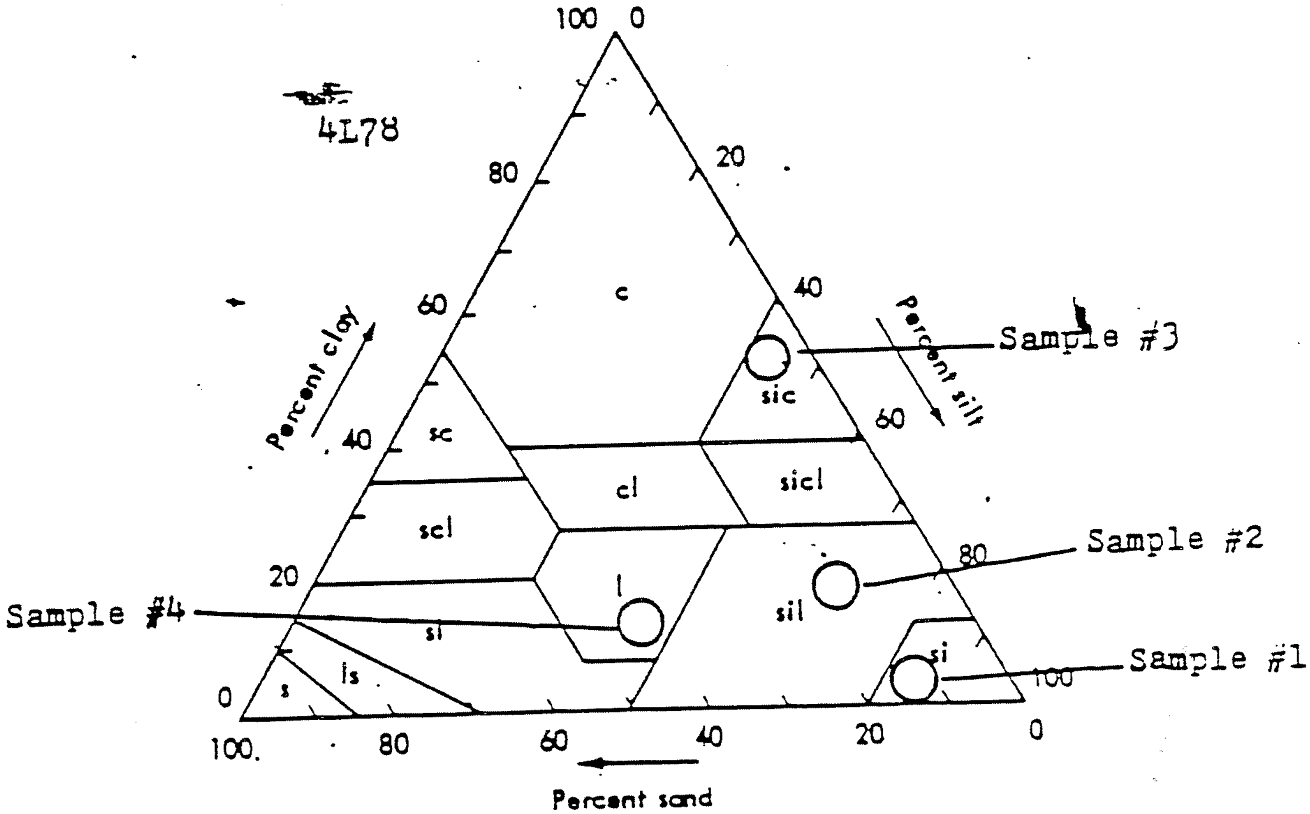
N = NUMBER OF BLOWS TO DRIVE 2 " SPOON 12 " WITH 140 lb. WT. FALLING 30 " PER BLOW

dew

SHEET 1 OF 1

LOGGED BY Lenhardt & Pitt

HOLE #4:



c	Clay	scl	Sandy clay loam
si	Silt	sicl	Silty clay loam
s	Sand	cl	Clay loam
l	Loam	sil	Silt loam
sc	Sandy clay	sl	Sandy loam
sic	Silty clay	ls	Loamy sand

Textural triangle showing the percentages of clay (less than 0.002 mm), silt (0.002-0.05 mm), and sand (0.05-2.0 mm) in the basic soil textural classes (adapted from Soil Survey Staff, 1951).

June 20, 1979

DIMENSIONS; INC.
Soil Investigations and Natural Resource Assessments
797 Center Street • East Aurora, New York 14052 • (716) 655-1717

SOILS REPORT

Additional monitoring well installation

Airco Alloys, Niagara Falls, New York

Two additional pair of wells were installed, June 17, 1979, in or adjacent to Airco Alloy's landfill in the City of Niagara Falls. Both sets of monitoring wells were designed to characterize the perched water table at the more impervious silty and clayey lake sediment - fill/topsoil boundary and the deeper apparent water table at refusal. This perched water table is anticipated to evaporate during the summer months.

At both sites, a thin zone of fill/topsoil mantled an impervious silty and clayey lake sediment that rests on a coarse silty (lake laid) more permeable zone 2.5 to 5.3 feet thick over loamy glacial till to refusal. The sequence of sediments were similar at both locations.

The deeper wells consist of four inch PVC pipe with the lower two feet slotted 1/16 inches wide horizontal slots spaced approximately 1 inch apart. A stainless screen was placed around the slots. A bentonite plug was placed around the monitoring well through most of the impervious lake sediment zone to prevent water seepage from the perched water table.

The shallow wells consisted of 2 inch PVC pipe with a slotted pattern similar to the deep wells. The augered hole penetrated three to four feet into the impervious lake sediments below the fill/topsoil zone.

Prepared by:

Don Owens

Donald W. Owens
Soil Scientist

RECEIVED
JUN 29 1979
SECURED LANDFILL CONTRACTORS, INC

DWO/dew
2F79

EARTH DIMENSIONS, INC.

Test Borings and Logs
797 Center Street • East Aurora, New York 14052 • (716) 655-1717

WELL & HOLE NO 13 SURF ELEV

2F79 PROJECT Airco Alloys, Niagara Falls, New York Monitoring well installation LOCATION See survey

CLIENT Secured Landfill Contractors, Inc. DATE STARTED 6/12/79 COMPLETED 6/12/79

DEPTH (feet)	SAMPLE NO.	BLOWS ON SAMPLER 0/6	6/12	12/18	18/24	N	DESCRIPTION & CLASSIFICATION	WELL	WATER TABLE & REMARKS	WELL
	1	7	5	5	7	5	Moist black and whitish gray indistrial fill consisting of fly ash, slag and very dense gray material, friable but very firm in place	4 inch PVC pipe	1.0	2 inch PVC pipe
3.0										
5	2	5	5	6	6	6	Moist reddish brown, highly mottled SILTY-CLAY with gray vertical desiccation cracks and silt lenses, occasional stone fragments, very firm, plastic, sticky	Bentonite	4.5	Sand pack
									6.5	
									7.0	Sand
10	3	5	4	5	6	5			10.0	
									① Bentonite	
13.0							------ celar transition to -- 13.0			
15	4	2	2	4	6	4	Extremely moist to wet brownish red coarse silt loam (SANDY-SILT), medium consistance, nonplastic	Sand pack		

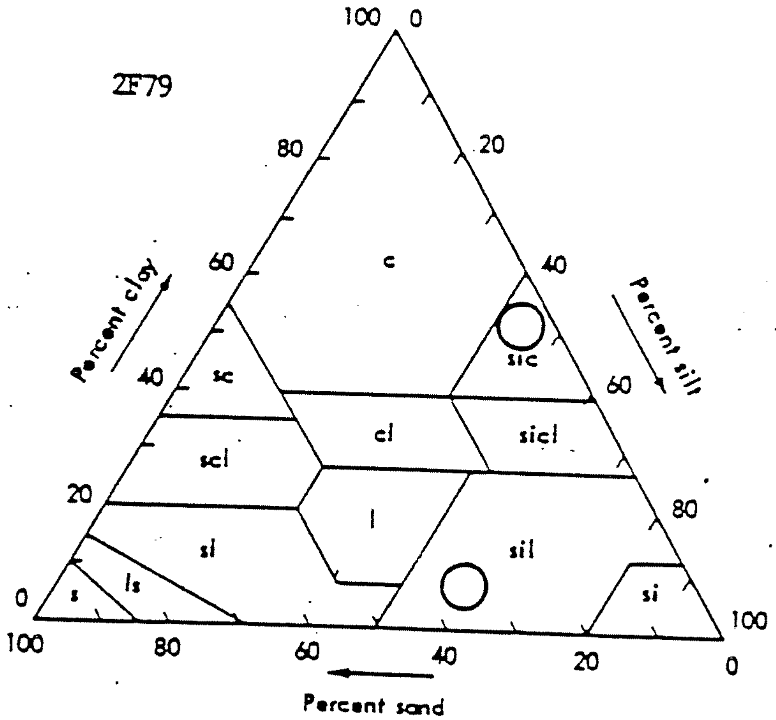
Continued on page #2

dew N = NUMBER OF BLOWS TO DRIVE 2 " SPOON 6 " WITH 300 lb. WT FALLING 30 " PER BLOW

LOGGED BY Steven J. Pitt, Soil Scientist SHEET 1 OF 2

WELL & HOLE #13

2F79



Sample #1 was from the nonsoil fill.

Samples #2 & 3

Sample #4

c	Clay	scl	Sandy clay loam
si	Silt	sicl	Silty clay loam
s	Sand	cl	Clay loam
l	Loam	sil	Silt loam
sc	Sandy clay	sl	Sandy loam
sic	Silty clay	ls	Loamy sand

Textural triangle showing the percentages of clay (less than 0.002 mm), silt (0.002-0.05 mm), and sand (0.05-2.0 mm) in the basic soil textural classes (adapted from Soil Survey Staff, 1951).

EARTH DIMENSIONS, INC.

Test Borings and Logs
797 Center Street • East Aurora, New York 14052 • (716) 655-1717

WELL & HOLE NO. 13, continued SURF ELEV. ______

2F79 PROJECT Airco Alloys, Niagara Falls, New York LOCATION See survey
Monitoring well installation

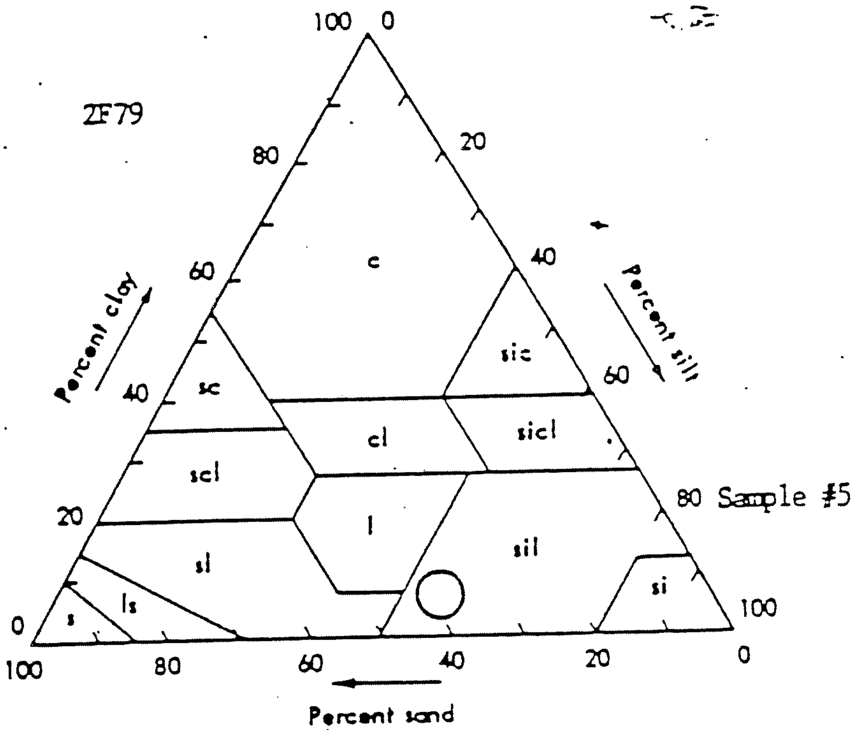
CLIENT Secured Landfill Contractors, Inc. DATE STARTED 6/12/79 COMPLETED 6/12/79

DEPTH (feet)	SAMPLE NO.	BLOWS ON SAMPLES 0/6	6/12	12/18	18/24	N	DESCRIPTION & CLASSIFICATION	WELL	WATER TABLE & REMARKS
							Same as previous page 18.3		18.0
20	5	Grab sample					Extremely moist to wet brownish red coarse silt loam (SANDY-SILT) with 10 to 15% subangular and subrounded gravel, very firm, nonplastic 20.0	Sand Pack	
							Refusal at 20.0 feet.		Water level 12.0 ft. below surface at completion.
							Shallow well #13-A notes: 10 ft. by 2 in. PVC pipe slotted 2 ft. on bottom was placed in a 7.0 ft. hole. Well sits on top of 6 in. of sand, with sand packed along sides to 10.0 ft., a bentonite seal was placed to surface, this left a 3.5 ft. stick-up.		Nonsoil industrial waste fill to 3.0 ft. over clayey lake sediments to 13.0 ft. over coarse silty lake sediments to 18.3 ft. over loamy glacial till to refusal.
							Deep well notes: 20 ft. X 4 in. PVC pipe slotted 2 ft. on bottom with stainless steel rapped around slots. Well sits on top of 2 ft. of sand with sand packed along sides to 10.0 ft. A bentonite seal was placed from 10.0 ft. to surface. There was a 2 ft. stick-up.		

dew N = NUMBER OF BLOWS TO DRIVE 2 " SPOON 6 " WITH 300 lb WT FALLING 30 " PER BLOW

LOGGED BY Steven J. Pitt, Soil Scientist SHEET 2 OF 2

WELL & HOLE #13, continued



c	Clay	scl	Sandy clay loam
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Textural triangle showing the percentages of clay (less than 0.002 mm), silt (0.002-0.05 mm), and sand (0.05-2.0 mm) in the basic soil textural classes (adapted from Soil Survey Staff, 1951).

SUPPORT DOCUMENT FOR

AN APPLICATION TO CONSTRUCT AND OPERATE

A SOLID WASTE MANAGEMENT FACILITY

AT

SKW ALLOYS, INC.

WITMER ROAD SITE

TOWN OF NIAGARA,

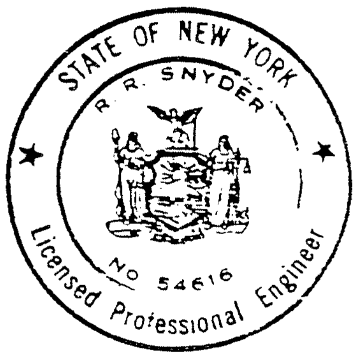
NEW YORK

LANDFILL CELL NUMBER TWO

This report has been prepared under the guidance and direction of Richard R. Snyder, P.E. State of New York Licensed Professional Engineer No. 54616

Richard R. Snyder,
December 5, 1980

Alteration of this report by any person not acting under the direction of a Professional Engineer Licensed to practice in New York is a violation of the law.



SECTION 2

SITE ANALYSIS

2.1 Introduction

The purpose of this section is to evaluate the site's physical suitability for the proposed operation. Consideration will be given to the following factors:

1. geology and soils,
2. hydrology,
3. surface water,
4. atmospheric factors, and
5. site ecology and land utilization.

A thorough investigation of each area is essential, since severe environmental impacts can result if any potential site deficiencies are not properly provided for.

Much of the information concerning the site's geological and hydrological characteristics has been provided in work done by P. Michael Terlecky, Ph.D. P.G. (Frontier Technical Associates, Inc.) and Mr. Donald Owens, (Soil Scientist, Earth Dimensions, Inc.).

2.2 Geology and Soils

2.2.1 Bedrock

The bedrock underlying the SKW Alloys, Inc. site is Lockport Dolomite, (Ca, Mg $(CO_3)_2$) with minor amounts of sulfate (gypsum) and sulfide (pyrite, galena, sphalerite) minerals. The dolomite lies nearly flat, but does exhibit a regional dip of approximately ½% to the south or locally approximately 30 to 40 feet per mile. Variations in the erosional surface result in local differences in the dip of the bedding and contour of the bedrock surface.

Interpretation of the data relating to the depth of refusal indicates that the bedrock gently dips to the south with a pronounced low in the bedrock surface around monitoring well #5. More detailed information concerning bedrock contours is found on Dwg. AAD-10 (Structure Contour Map on the Lockport Dolomite).

2.2.2 Unconsolidated Sediments and Fill

Overlying the site's bedrock is a layer of dense loamy glacial till which varies in thickness from approximately 0.6 to 7 feet. This material presents an extreme range in texture, from clay and silt to gravel and occasional boulders.

Water sorted stratified sediments (found between lake sediment and glacial till) were encountered in borings 2, 3, 5, 6, 8, 9, 10 and 11. This material is characterized by the mixing of dolomitic rock fragments of varying dimensions with the overlying clay.

A silty-clay mostly stone free lake sediment was found at all boring sites. Its thickness varies from two to 12.5 feet. This sediment also contains fine silt lenses and vertical dessication cracks.

Most borings indicated the presence of a fill-type material. Both the depth and types of fill are variable. Its depth varies from zero feet to 9.0 feet, while its texture ranges from a loose powdery slag to coarse size slag.

A summary of the original soil boring logs obtained during the installation of the piezometers and site characterization borings is presented by Table 2-1. Additional borings have been taken and are presented in Tables 2-2 and 2-3. In addition, a series of drawings have been prepared (refer to Dwgs. AAD-8, 9 and 10) to show the depth and lateral distribution of the bedrock, thickness of silty clay unit, and thickness of overburden (fill plus natural overburden).

2.3 Hydrology

In order to determine the occurrence, direction of movement, and the quality of the site's groundwater, a total of 10 wells were originally installed at five locations on the original 62 acre Airco-SKW site (refer to Dwg. AAD-5). Since this time, 4 more wells have been installed at monitoring points #12 and #13.

At each site, two wells (one shallow and one deep) were installed. All shallow wells were installed to a depth of between 8.5 and 11.0 feet, while the deep wells were installed in the glacial till overlying the bedrock.

TABLE 2-1

THICKNESS OF VARIOUS UNCONSOLIDATED SEDIMENT AND TILL LAYERS*

Boring Number	Fill Thickness	Clay Thickness	Water Sorted Stratified Sediments Thickness (ft)	Glacial Thickness (ft)	Depth To Refusal (ft)
1	1.3	6.2	—	3.6	11.1
2	4.5	3.0	4.6	2.4	14.5
3	6.0	2.0	5.0	2.2	15.2
4	6.0	4.0	—	6.7	16.7
5	2.5	11.0	7.0	3.7	24.2
6	8.5	7.0	5.0	2.5	23.0
7	9.0	5.5	—	3.5	18.0
8	2.5	12.5	6.0	0.6	21.6
9	4.5	10.5	1.5	4.2	20.7
10	1.3	2.2	9.5	3.1	16.1
11	2.8	5.6	0.6	3.8	12.8

* Original Site Exploration - 1979

Data Source: Earth Dimensions, Inc. Soil Logs

TABLE 2-2 2-3

THICKNESS OF VARIOUS UNCONSOLIDATED

SEDIMENT & TILL LAYERS

TABLE 2-2

oring	Fill	Silty & Clayey Lake Sediments	Coarse Silty Lake Sediments	Loamy Glacial Till	Depth to Refusal	Date
✓12	0-2.0	2.0 - 14.5	14.5 - 17.0	17.0 - 18.0	18.0	6/12/79
✓13	0-3.0	3.0 - 13.0	13.0 - 18.3	18.3 - 20.0	20.0	6/12/79
14	0-1.9	1.9 - 14.0	——	14.0 - 18.8	18.8	1/29/79
15	0-2.8	2.8 - 12.3	——	12.3 - 17.5	17.5	1/30/79

Data Source: Earth Dimensions, Inc. Soil Logs

TABLE 2-3

oring umber	Mostly slag fill	CLAYEY-SILT fill	CLAYEY-SILT lake sediment	SANDY-SILT lake sediment	SILTY-SAND lake sediment	SANDY-SILT/CLAYEY-SILT lake sediment	Glacial till	Refusal	Date
16	0-1.0		1.0-10.0	10.0-15.5			15.5-16.5	16.5	9/19/80
17	0-1.5	1.5-2.0	2.0-4.5	4.5-12.0	12.0-16.0		16.0-19.3	19.3	9/19/80
18	0-3.5	3.5-5.0	5.0-7.0	7.0-17.5			17.5-18.8	18.3	9/20/80
19	0-2.0	2.0-2.8	2.8-6.0	6.0-12.0		12.0-16.5	16.5-17.1	17.1	9/20/80

Data Source: Earth Dimensions, Inc. Soil Logs

This arrangement of the wells allows data to be obtained concerning water levels and water quality in both the zone that would be most affected by the landfill operations and in a zone where there is close proximity to a regional aquifer.

Measurements of the depth to the water in the original "deep" wells were made twenty times over a period from February, 1979 through October, 1980. Samples were taken to analytically determine the ground water quality. Tables 2-4 and 2-5 presents a summary of water depth measurements obtained from "deep" wells. Measurements of static water levels in the original "shallow" wells were made seventeen times from April, 1979 through October, 1980. Tables 2-6 and 2-7 present a summary of the static ground water levels obtained from the "shallow" wells. Tables 2-5 and 2-6 present the data from the wells installed during June, 1979. These wells are 12, 12A, 13 and 13A.

Examination of the data from the paired wells indicates that groundwater on the site exists under two distinct regimes: (1) under artesian conditions (water rises above the till layer and in some instances, above the groundwater levels in the lacustrine silty-clay) and (2) water table conditions (unconfined aquifer) which are characteristic of the silty-clay unit. Data from

TABLE 2-4

WELLS INSTALLED TO REFUSAL
2/19/79 - 7/24/79

ll ber	Top of casing elevation in feet	ELEVATION OF WATER IN FEET 2/19/79	3/6/79	3/7/79	4/6/79	4/10/79	4/18/79	5/2/79	5/8/79	5/14/79	6/8/79	6/11/79	7/24/79
1	604.11	597.44	599.94	599.55	599.75	599.14	599.21	598.55	598.26	597.78	595.84	595.66	592.43
2	607.18	598.85	600.6	592.58	599.76	597.14	599.88	599.86	599.45	598.53	598.12	598.13	596.05
3	608.49	604.28	605.91	594.85	605.53	599.21	600.56	604.66	604.16	598.83	604.23	596.25	602.88
4	609.9	604.19	607.04	606.23	605.27	605.31	606.04	604.49	604.98	604.62	601.88	600.94	599.4
5	601.48	582.65	583.19	582.88	582.04	581.73	581.98	581.85	581.64	581.48	581.21	581.04	580.48

12/15, 12/27, 12/28, 12/29—INSTALLATION
2/19/79 INITIAL MEASUREMENT AFTER INSTALLATION AND TWO MONTH STABILIZATION PERIOD AND BEFORE PUMPING OUT.
3/6/79 MEASURED THEN PUMPED OUT
3/7/79 MEASURED AND SAMPLED
4/6/79 MEASURED AND PUMPED
4/10/79 MEASURED AND SAMPLED
4/18/79 MEASURED ONLY
5/2/79 MEASURED ONLY
5/8/79 MEASURED AND PUMPED OUT
5/14/79 MEASURED AND SAMPLED
6/8/79 MEASURED AND PUMPED
6/11/79 MEASURED AND SAMPLED
7/24/79 MEASURED ONLY

TABLE 2-5

WELLS INSTALLED TO REFUSAL
1/14/80 - 10/30/80

ell mber	Top of Casing Elevation in feet	ELEVATION OF WATER IN FEET 1/14/80[1]	1/16/80[2]	4/10/80[1]	4/11/80[2]	6/30/80[1]	7/8/80[2]	10/28/80[1]	10/30/80[2]
3	608.49	606.19	596.81	604.59	595.98	604.41	600.42	601.11	594.99
5	601.48	579.88	580.09	589.3	580.81	579.42	579.12	580.48	580.6
12	597.55	585.35	586.62	587.64	586.15	584.98	584.67	584.62	584.66
13	603.16	592.36	588.15	593.07	590.06	591.4	591.82	590.58	590.6

TABLE 2-6

SHALLOW WELLS
1/14/80 - 10/30/80

ell mber	Top of Casing Elevation in feet	ELEVATION OF WATER IN FEET 1/14/80[1]	1/16/80[2]	4/10/80[1]	4/11/80[2]	6/30/80[1]	7/8/80[2]	10/28/80[1]	10/30/80[2]
3A	610.31	606.01	606.06	606.03	606.08	604.91	606.8	603.58	603.76
5A	600.76	594.96	596.96	596.79	596.83	596.37	596.28	597.03	596.83
12A	597.81	593.31	593.23	593.21	593.64	586.53	590.67	590.89	DRY
13A	604.87	599.57	599.45	599.52	599.6	594.92	594.94	DRY	DRY

- Evacuated only

- Sampled

TABLE 2-7

SHALLOW WELLS
4/6/79 - 7/24/79

1	Top of casing elevation in feet	ELEVATION OF WATER IN FEET								
		4/6/79	4/10/79	4/18/79	5/2/79	5/8/79	5/14/79	6/8/79	6/11/79	7/24/79
	605.14	599.78	599.59	599.73	598.76	598.84	598.2	596.98	596.91	595.23 (dry)
	608.36	601.86	601.70	601.98	601.40	601.33	600.62	599.01	598.79	598.54
	610.30	606.14	605.83	606.31	605.9	605.97	605.85	605.64	605.52	604.6
	611.81	605.29	605.21	606	604.55	604.3	604.02	603.65	603.25	603.09
	600.76	597.07	597.08	596.88	596.51	596.47	596.43	596.33	597.06	595.88

TALLATION DATE 3/19/79

2 inch PVC

observation wells 5 and 5A are particularly noteworthy in this regard, with groundwater levels dipping sharply in the till-bedrock unit while the "perched" water mimics the lower groundwater to a lesser degree.

Previous studies of the Lockport Dolomite (Groundwater in the Niagara Falls Area, New York, by Richard H. Johnston, Geologist, U.S. Geological Survey 1964) indicates that water movement occurs primarily through horizontal bedding plane fractures, which have been widened very slightly by solution of the rock. Vertical joints are not important factors in the dolomite water bearing characteristics. These joints are fractures in the rock which must be widened by solution before they can become effective water-bearing openings. The porosity of Lockport Dolomite is low.

Most recharge to this dolomite occurs where the dipping bedding planes intersect the surface or surficial deposits. Cavities in the dolomite result from solution of gypsum. These cavities increase the ability of the dolomite to store water but probably have little effect on the water-transmitting ability of the formation. Therefore, the continuous bedding and joints determine the permeability of the bedrock rather than the large but isolated cavities resulting from solution of gypsum.

The character and interrelationships of the three types of water-bearing openings result in two distinct sets of ground-water conditions in the dolomite: (1) a moderately permeable zone at the top of the rock, generally 10 to 15 feet thick, characterized by both vertical and bedding joints that have been widened by solution and by gypsum cavities, and (2) remainder of formation consists of bedding joints surrounded by essentially impermeable rock.

2.3.1 Unconsolidated Sediments - Glacial Till and Water Sorted Stratified Sediment

The water in the "deep" wells represents water which flows into the SKW site along the top of the rock in the glacial till and where present in the water sorted stratified sediment. The water-sorted stratified sediments, particularly the sandy strata, will allow ground water to travel laterally. Near the bedrock, groundwater is expected to move with relative ease through the glacial till material.

Using average values from Table 2-4 for the period 2/19 - 5/8/79, an isopotential contour map was constructed (Dwg. AAD-11). Individual data points for that period did not exhibit wide variations, so that average values were employed. This isopotential map illustrates an imaginary surface connecting points to which water rises in tightly cased wells from a given point in the glacial till (top of bedrock). Groundwater flow is perpendicular to the isopotential lines in the direction of higher to lower potential. The net flow of groundwater in the deeper aquifer can be seen to be towards the south to southwest. The spacing of the isopotential contours is indicative of the slope of the potentiometric surface and therefore, the hydraulic gradient under which the groundwater is flowing within that aquifer. The glacial till unit materials are not uniform with respect to particle size or sorting. The hydraulic conductivity of the zone is generally estimated to be in the range of 1×10^{-4} to 1×10^{-6} cm/sec.

A pronounced trough or low exists on the piezometric surface in the southwest corner of the property. This observation is consistent with the depth-to-bedrock data presented earlier. The concentric and radial shape of the isopotential lines with flow to the southwest tends to indicate a discharge zone or groundwater "sink" somewhere to the southwest of the property. This "sink" may be a fissure, joint intersection, bedding plane, a nearby pumped well or some other industrial activity.

2.3. Unconsolidated Sediments

A clay layer of varying thickness underlies the site. Tables 2-1, 2-2 and 2-3 present this data in columnar form. These tables are based upon the soil logs. A series of undisturbed soil samples (Shelby tube samples) were taken. Locations are indicated on AAD-5. These samples were taken to determine permeabilities. The results of these tests which were performed by Calspan Corporation are presented in Table 2-8. Values of 10^{-8} to 10^{-9} cm/sec are extremely low and represent a suitable material acting as a barrier to discharge of water from the materials which are proposed for disposal in the third landfill cell.

Examination of the "shallow" well data demonstrates that the groundwater flow direction in the silty-clay region is similar to the direction of movement in the lower layers.

2.3.4 Fill

Examination of the site boring logs (refer to Tables 2-1, 2-2 and 2-3 for summary) indicates that a layer of industrial fill varying in thickness from zero to 9.0 feet is found on the site. The large majority of this fill, however, is not found on the site of the proposed third landfill cell. It will, therefore, have little impact on the proposed disposal facilities. This fill consists primarily of slag, cinders and fly ashes.

2.4 Surface Water

2.4.1 Site Watershed and Drainage

The site watershed is located within the Town of

TABLE 2-8

SOIL CHARACTERISTICS

ample #	Date Collected	Natural Moisture Content	Plastic Limit	Liquid Limit	Plasticity Index	Soil Classification	% Passing #200 Sieve	Coefficient of Permeability k, cm/sec
	12/29/79	—	21	36	15	CL	98%	3.5×10^{-6}
	12/29/79	—	21	22.5	1.5	ML	98%	0.7×10^{-8}
	6/8/79	22%	23	43	20	CL	90%	5×10^{-9}
	6/8/79	18%	23	29	6	CL-ML	48%	5×10^{-8}
	6/9/79	15%	13	23	10	CL	83%	1×10^{-9}
	6/9/79	11%	9	18	9	CL	64%	6×10^{-8}
	6/11/79	8%	21	43	22	CL	67%	3×10^{-9}
	6/11/79	22%	24	47	23	CL	58%	1.8×10^{-9}
	1/29/80	N.D.	N.D.	N.D.	N.D.	N.D.	89%	3.8×10^{-8}
	1/30/80	N.D.	N.D.	N.D.	N.D.	N.D.	90%	8.8×10^{-9}

D. = No Data