932001

Admin. Record

PHASE I WORK PLAN
OPERABLE UNIT 3

VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

New York State [illegible]

Phase I Work Plan OU #3

Approved w/ Conditions Refer Letter

12/4/02

☐ Approv[illegible] K

COMMENT[illegible]

Michael J. Hinton

Date 12/4/02

RECEIVED
SEP 30 2002
NYSDEC - REG. 9
FOIL
_REL _UNREL

PHASE I WORK PLAN
OPERABLE UNIT 3

VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

New York State Department of Environmental Conservation

PHASE I WORK PLAN OU#3
APPROVED w/ CONDITIONS REFER
~~DATED~~ 12/4/02
LETTER
☐ Disapproved
OF ENVIRONMENTAL CONSERVATION
Michael J. Hinton
Designated Representative
Date 12/4/02

PRINTED ON
SEP 27 2002

Prepared by:
Conestóga-Rovers
& Associates

651 Colby Drive
Waterloo, Ontario
Canada N2V 1C2

Office: 519•884•0510
Fax: 519•884•0525

SEPTEMBER 2002
REF. NO. 19867 (1)
This report is printed on recycled paper.

TABLE OF CONTENTS

Page

1.0 INTRODUCTION 1
  1.1 GENERAL1
  1.2 WORK PLAN ORGANIZATION 1

2.0 BACKGROUND 3
  2.1 SITE DESCRIPTION 3
  2.2 PREVIOUS INVESTIGATIONS 3

3.0 SITE SETTING 5
  3.1 GEOLOGY 5
  3.2 SITE HYDROGEOLOGY 6

4.0 ENVIRONMENTAL CONDITIONS 8
  4.1 SURFACE SOIL 8
  4.2 SUBSURFACE SOIL 9
  4.3 SEDIMENT 10
  4.4 SURFACE WATER 11
  4.5 GROUNDWATER 12

5.0 SCOPE OF WORK 13
  5.1 TASK 1 SHALLOW MONITORING WELL INVENTORY, SURVEY, AND WATER LEVELS 13
  5.2 TASK 2 TEST PIT EXCAVATIONS 14
  5.3 TASK 3 BOREHOLES AND SUBSURFACE SOIL SAMPLING AND ANALYSIS 14
  5.4 TASK 4 MONITORING WELLS 15
  5.5 TASK 5 HYDRAULIC WATER LEVEL MEASUREMENTS 15
  5.6 TASK 6 SHALLOW GROUNDWATER SAMPLING AND ANALYSIS 15
  5.7 TASK 7 SURFACE SOIL SAMPLING AND ANALYSIS 16
  5.8 TASK 8 SURFACE WATER AND SEDIMENT SAMPLING AND ANALYSIS 16
  5.9 TASK 9 AIR MONITORING 16
  5.10 TASK 10 TOPOGRAPHIC/PROPERTY SURVEY 17

6.0 REPORTING 18
  6.1 PROGRESS REPORTS 18
  6.2 PHASE 1 REPORT 19

7.0 SCHEDULE 20

LIST OF FIGURES
(Following Text)

FIGURE 1.1 SITE LOCATION

FIGURE 1.2 SITE PLAN

FIGURE 3.1 HISTORICAL SUBSURFACE SOIL SAMPLING LOCATIONS

FIGURE 3.2 CROSS-SECTION OF SITE GEOLOGY

FIGURE 3.3 HISTORICAL GROUNDWATER SAMPLING LOCATIONS

FIGURE 3.4 SHALLOW AQUIFER GROUNDWATER CONTOURS

FIGURE 3.5 OVERBURDEN AQUIFER GROUNDWATER CONTOURS

FIGURE 3.6 BEDROCK AQUIFER GROUNDWATER CONTOURS

FIGURE 4.1 HISTORICAL SURFACE SOIL SAMPLING LOCATIONS

FIGURE 4.2 HISTORICAL SEDIMENT SAMPLING LOCATIONS

FIGURE 4.3 HISTORICAL SURFACE WATER SAMPLING LOCATIONS

FIGURE 5.1 PROPOSED TEST PIT LOCATIONS

FIGURE 5.2 PROPOSED SOIL BORING LOCATIONS

FIGURE 5.3 PROPOSED NEW GROUNDWATER MONITORING WELL LOCATIONS

FIGURE 5.4 PROPOSED SURFACE SOIL SAMPLING LOCATIONS

FIGURE 5.5 PROPOSED SURFACE WATER/SEDIMENT SAMPLING LOCATIONS

FIGURE 7.1 SCHEDULE

LIST OF TABLES
(Following Text)

TABLE 2.1	PREVIOUS INVESTIGATIONS AT OU3
TABLE 3.1	STRATIGRAPHIC SUMMARY OF SOIL BORINGS, TEST PITS, AND MONITORING WELLS
TABLE 3.2	MONITORING WELL COMPLETION DETAILS
TABLE 4.1	HISTORICAL SURFACE SOIL ANALYTICAL RESULTS
TABLE 4.2	HISTORICAL SUBSURFACE SOIL ANALYTICAL RESULTS
TABLE 4.3	SUBSURFACE SOIL SAMPLES WITH ELEVATED PARAMETER CONCENTRATIONS
TABLE 4.4	SUBSURFACE SOIL SAMPLES ANALYZED FOR PH
TABLE 4.5	HISTORICAL SEDIMENT ANALYTICAL RESULTS
TABLE 4.6	HISTORICAL SURFACE WATER ANALYTICAL RESULTS
TABLE 4.7	HISTORICAL pH RESULTS FOR SURFACE WATER
TABLE 4.8	HISTORICAL SHALLOW GROUNDWATER ANALYTICAL RESULTS
TABLE 4.9	HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
TABLE 4.10	HISTORICAL BEDROCK GROUNDWATER ANALYTICAL RESULTS

LIST OF APPENDICES

APPENDIX A	FIELD SAMPLING PLAN
APPENDIX B	QUALITY ASSURANCE PROJECT PLAN
APPENDIX C	HEALTH AND SAFETY PLAN
APPENDIX D	COMMUNITY AIR MONITORING PLAN
APPENDIX E	CITIZEN PARTICIPATION PLAN

1.0 INTRODUCTION

1.1 GENERAL

The Vanadium Corporation of America Site (Site) is located in Niagara Falls, Niagara County, New York. The Site location is presented on Figure 1.1 and a Site Plan is presented on Figure 1.2. The Site currently includes property parcels owned by Airco Properties, Inc., SKW Metals and Alloys, Inc., and the Power Authority of New York and Niagara Mohawk Power Corporation. The New York State Department of Environmental Conservation (NYSDEC) has designated the Site as a Class 2 inactive hazardous waste disposal site. NYSDEC has designated the SKW Metals and Alloys, Inc. parcel as Operable Unit 1 (OU1); the Airco Properties, Inc. parcel as Operable Unit 2 (OU2); and the New York Power Authority and Niagara Mohawk Power Corporation parcel as Operable Unit 3 (OU3).

An Order on Consent (Index No. B9-0470-94-12) was executed by NYSDEC and New York Power Authority, Niagara Mohawk Power Corporation, and Cyprus Amax Minerals Company (Respondents) for OU3. The Order on Consent outlines the scope of work for conducting a Remedial Investigation/Feasibility Study (RI/FS) for OU3. As presented in the Order on Consent, the work to be performed will be done in a phased manner, as summarized below:

Phase 1 - Additional Data Collection;
Phase 2 - Evaluation of Human Health Impacts;
Phase 3 - Remedial Investigation Report; and
Phase 4 - Remedial Alternatives Analysis/Feasibility Study.

This document entitled "Phase 1 Work Plan" was prepared to meet the requirements of Phase 1 - Additional Data Collection. The Work Plan organization is presented in Section 1.2.

1.2 WORK PLAN ORGANIZATION

The Phase 1 Work Plan is organized as follows:

Section 1.0	presents the introduction;
Section 2.0	presents Site background information;
Section 3.0	presents the Site setting;

Section 4.0	presents a summary of chemical distribution as derived from previous investigations;
Section 5.0	presents the scope of work to supplement existing data;
Section 6.0	presents the reporting requirements;
Section 7.0	presents the schedule for the scope of work as outlined in the Order On Consent;
Appendix A	presents the Field Sampling Plan;
Appendix B	presents the Quality Assurance Project Plan;
Appendix C	presents the Health and Safety Plan;
Appendix D	presents the Community Air Monitoring Plan; and
Appendix E	presents the Citizen Participation Plan.

2.0 BACKGROUND

2.1 SITE DESCRIPTION

The Vanadium Corporation of America (Vanadium) site (Site) is located in Niagara Falls, Niagara County, New York. The property is bounded on the north by an automobile depot and vacant property, to the west by Witmer Road (Route 31), on the east by Interstate 190, and on the south by vacant land and industrial facilities. The nearest water bodies are the Lower Niagara River located approximately 1.4 miles west of the property and the New York Power Authority (NYPA) reservoir, located approximately 0.8 miles north of the property. Water transfer conduits (tunnels) are located beneath the NYPA property. These conduits transfer water from the Upper Niagara River, located to the south, to the NYPA reservoir. Numerous high voltage electrical transmission lines cross the Site.

The Site consists of a 25-acre parcel owned by Airco Properties Inc. (Airco), a 37-acre parcel owned by SKW Alloys, Inc. (SKW), and right-of-way comprising approximately 88 acres owned by the Niagara Mohawk Power Corporation (NiMo) and the NYPA. The Airco parcel has been designated by NYSDEC as Operable Unit 1 (OU1), the SKW parcel has been designated as Operable Unit 2 (OU2), and the NYPA and NiMo parcel has been designated as Operable Unit 3 (OU3).

2.2 PREVIOUS INVESTIGATIONS

Several previous investigations have been performed at the Site. The majority of the previous investigations focussed on OU1 and OU2. In 1996, NYSDEC performed an investigation under the Immediate Investigative Work Assignment (IIWA) program to evaluate OU3. The investigation by NYSDEC included installing eight monitoring wells for groundwater sampling, 12 soil borings for soil sampling, two test pit samples to investigate the waste piles, and the collection of surface water and sediment samples from the existing pond. Table 2.1 presents the number of samples taken for each media and the sampling parameters. Each sample was analyzed for TCL Volatile Organic Compounds (VOCs), TCL Semi-volatile Organic Compounds (SVOCs), and Total Analyte List (TAL) metals and hexavalent chromium.

In 2001, Golder Associates performed supplemental investigations at the Site that included the collection and analyses of groundwater samples and water level measurements from the existing Site monitoring wells. Seven water samples were collected and analyzed for TAL metals and hexavalent chromium. Table 2.1 presents a summary of samples collected and sampling parameters.

3.0 SITE SETTING

This section summarizes existing geologic and hydrogeologic information for the Site. The information is based upon previous investigations at the Site and at immediately adjacent properties.

3.1 GEOLOGY

The geologic structure beneath the Site consists of four units and includes, in descending order: fill material, glaciolacustrine deposits, glacial till, and bedrock. These geologic units are briefly discussed in the following sections. A summary of borehole stratigraphy is presented in Table 3.1, and borehole locations are presented on Figure 3.1. Figure 3.2 shows a cross-section of the Site geology.

Fill Material

Fill material overlies much of the Site. The predominant fill material consists of whitish gray slag; cinders; and whitish gray, fine-grained, lime-like material. Over the majority of the Site, particularly the eastern side, the slag is covered with a layer of topsoil of varying thickness. Figure 3.1 presents the areas of the Site with exposed slag material at the ground surface. It should be noted that there are small areas on the eastern side of OU3 where the slag has been exposed. The fill thickness generally ranges from 1 to 21 feet.

Glaciolacustrine Deposits

Glaciolacustrine deposits directly underlie the fill unit, or are exposed at the surface in some areas. These deposits consist of laminated reddish brown to brown, soft to stiff, dry to moist, silty clays, clayey silts, sandy silts, and silty sands. The thickness of this unit generally ranges from 2 to 26 feet.

Glacial Till

The glacial till unit underlies the glaciolacustrine unit. The glacial till unit is relatively thin and consists of a dense, heterogeneous mixture of reddish brown to brown clay, silt, sand, gravel, and dolostone rock fragments. The till predominantly consists, however, of silt and clay. The thickness of this unit generally ranges from 1 to 7 feet.

Bedrock

Bedrock underlies the glacial till and consists of the Eramosa Dolostone of the Lockport Dolostone Group. This dolostone is characterized as dolostone/limestone, that is weathered to dense, medium to dark gray, fine to coarse crystalline, and thin to massively bedded. This formation also contains vugs that are filled with gypsum, dolomite, or calcite crystals. The depth to the top of the Eramosa Dolostone generally ranges from 7 to 32 feet below ground surface (bgs).

3.2 SITE HYDROGEOLOGY

The hydrogeologic structure beneath the Site consists of four units and includes, in descending order: a shallow hydrogeologic zone consisting of fill material and the upper portion of the glaciolacustrine deposit; an intermediate hydrogeologic zone (confining unit) consisting of the deeper portion of the glaciolacustrine deposit; a deep hydrogeologic zone consisting of the glacial till; and, the upper bedrock hydrogeologic zone. Monitoring well locations are presented on Figure 3.3 and well completion details are presented in Table 3.2.

Shallow Hydrogeologic Zone

Historical groundwater data for monitoring wells completed in the shallow hydrogeologic zone (see Figure 3.3) indicate that groundwater in this zone is mainly in the fill material, perched on top of the glaciolacustrine deposit, and within the upper portion of the glaciolacustrine deposit. The presence of this hydrogeologic zone, however, is not consistent. Figure 3.4 shows the shallow aquifer groundwater contours. Water levels in this zone fluctuate widely due to precipitation and evaporation. Water levels are generally higher during wet weather conditions, and lower during hot weather conditions. Historical water level data suggest that perched groundwater under the Site flows to the south and southwest, toward a topographic low.

Intermediate Hydrogeologic Zone

During historical investigations, ten soil borings were advanced into the glaciolacustrine deposit at the Site, from which soil samples were collected for hydraulic conductivity testing. The results for vertical hydraulic conductivity ranged from 1.00×10^{-9} cm/s to 3.50×10^{-6} cm/s, with the arithmetic mean and geometric mean being 3.67×10^{-7} cm/s and 1.52×10^{-8} cm/s, respectively. Previous investigations have therefore characterized this zone as a confining layer, restricting downward movement of groundwater from the shallow to the deep hydrogeologic zone.

Deep Hydrogeologic Zone

Historical groundwater data for monitoring wells completed in the glacial till (see Figure 3.3) indicate the presence of a groundwater divide that generally trends northwest-southeast through the center of the Site. Figure 3.5 shows the overburden aquifer groundwater contours. From the groundwater divide, groundwater in the deep hydrogeologic zone flows toward the northeast and southwest. Monitoring wells completed in the glacial till in the eastern portion of the Site are typically dry due to the dewatering effect of the NYPA conduits.

Upper Bedrock Hydrogeologic Zone

Historical groundwater data for monitoring wells completed in the upper bedrock (see Figure 3.3) indicate the presence of a groundwater divide, generally coincident with the groundwater divide in the deep hydrogeologic zone. Figure 3.6 shows the bedrock aquifer groundwater contours. From the groundwater divide, groundwater in the upper bedrock hydrogeologic zone flows toward the northeast and southwest. The NYPA conduit crosses under the eastern edge of the Site. Previous investigations have reported a steep horizontal gradient in the upper bedrock groundwater flow as it approaches the NYPA conduits.

4.0 ENVIRONMENTAL CONDITIONS

Through previous investigations at OU3, it has been determined that the primary contaminants are TAL metals, hexavalent chromium, and pH. The following sections provide brief discussions of the chemical distribution in surface soil, subsurface soil, sediment, surface water, and groundwater. It is to be noted that surface soil and subsurface soil also include slag material.

4.1 SURFACE SOIL

Surface soil samples were collected at 19 locations and analyzed for TAL metals. Surface soil sampling locations are presented on Figure 4.1. Hexavalent chromium was analyzed for at 12 of these locations, and pH at four locations. Analytical results are presented in Table 4.1. In general, elevated concentrations of cadmium, chromium (total and hexavalent), nickel, zinc, and pH were detected in surface soils.

Elevated concentrations of cadmium were detected at 13 of the 19 locations. These locations include: SB-3A, SB-9A, SS-1, SS-3, SS-4, SS-5, SS-7, SS-8, SS-9, MW101A, MW102A, MW103, and WT-107-92. Detected cadmium concentrations ranged from 0.6 mg/kg at SS-6 to 141 mg/kg at SS-3.

Elevated concentrations of chromium were detected at 14 of the 19 locations. These locations include: SB-3A, SB-9A, SB-10A, SS-1 to SS-9, MW103, and WT-107-92. Detected chromium concentrations ranged from 9 mg/kg at MW101A to 11,800 mg/kg at SB-3A.

Elevated concentrations of hexavalent chromium were detected in 11 of the 12 locations. These locations include: SB-9A, SB-10A, SS-3, SS-4, SS-8, MW102A, MW103, WT-105-92, WT-106-92, WT-107-92, and one of the stockpiles consisting of green resin-like material. The location of this stockpile is unknown. Detected hexavalent chromium concentrations ranged from 0.5 mg/kg at WT-105-92 to 51.4/66.2 mg/kg at WT-106-92.

Elevated concentrations of nickel were detected in 7 of the 19 locations. These locations include: SB-3A, SB-9A, SB-10A, MW102A, MW103, SS-3, and WT-105-92. Detected nickel concentrations ranged from 1.6 mg/kg at SS-2 to 5,160 mg/kg at SB-3A.

Elevated concentrations of zinc were detected in 15 of the 19 locations. These locations include: SB-3A, SB-9A, SB-10A, SS-1 to SS-9, MW101A, MW102A, and MW103.

Detected zinc concentrations ranged from 9.7 mg/kg at WT-105-92 to 1,400 mg/kg at S-3.

Soil pH was analyzed for at MW101A, WT-105-92, WT-106-92, and WT-107-92. The highest pH results were recorded for WT-107-92 (9.9) and WT-106-92 (10.12/10.51).

4.2 SUBSURFACE SOIL

A total of 26 subsurface samples were collected at 17 borehole locations, as presented on Figure 3.1. Soil samples were collected over various depth intervals over the depth range of 0 to 22 feet bgs. Soil samples were analyzed for TAL metals, hexavalent chromium, and pH. Analytical results are presented in Table 4.2. The TAL metals that were generally elevated are also presented in Table 4.2.

Elevated concentrations of cadmium were detected in 12 of 26 samples collected. These sample locations and depth intervals are presented in Table 4.3. Detected cadmium concentrations ranged from 0.78 mg/kg at TP-1 to 3.7 mg/kg at B-3 (2 to 4 feet bgs). The sample depth interval at TP-1 is unknown.

Elevated concentrations of chromium were detected in 20 of 26 soil samples. These sample locations and depth intervals are presented in Table 4.3. Detected chromium concentrations ranged from 6.3 mg/kg at B-3 (12 to 14 feet bgs) to 7,550 mg/kg at SB-2B (7 to 8 feet bgs). Hexavalent chromium was detected in 21 of 25 soil samples, which are also indicated in Table 4.3. Detected hexavalent chromium concentrations ranged from 0.31 mg/kg at B-3 (12 to 14 feet bgs) to 99.2 mg/kg at TP-1. The sample depth interval at TP-1 is unknown.

Elevated concentrations of nickel were detected in 7 of 26 soil samples. These sample locations and depth intervals are presented in Table 4.3. Detected nickel concentrations ranged from 5.5 mg/kg at TP-1 to 1,220 mg/kg at SB-2B (7 to 8 feet bgs). The sample depth interval at TP-1 is unknown.

Elevated concentrations of zinc were detected in 8 of 26 soil samples. These sample locations and depth intervals are presented in Table 4.3. Detected zinc concentrations ranged from 4.7 mg/kg at MW-104 (10 to 12 feet bgs) to 648 mg/kg at B-3 (12 to 14 feet bgs).

Soil pH was analyzed for 19 soil samples from 12 locations. These locations and depth intervals are presented in Table 4.2. Results for pH ranged from 9.4 at B-2 (18 to 22 feet bgs) to 12.3 at B-1A (4 to 8 feet bgs).

4.3 SEDIMENT

Sediment samples were historically taken at three locations, including SD-102-92, SD-103-92, and SD-105-92. These locations are presented on Figure 4.2. Sediment samples were analyzed for TAL metals, hexavalent chromium, and pH. Analytical results are presented in Table 4.5. Concentration exceedances of NYSDEC Sediment Criteria for metals are listed below:

Parameter	*Sample ID*	*Concentration (mg/kg)*	*NYSDEC Lowest Effect Level*	*NYSDEC Severe Effect Level*
Antimony	SD-102-92	18.7 J	2.0	25.0
Arsenic	SD-102-92	6.6 J/6.7 J	6.0	33.0
	SD-103-92	8.8 J		
Cadmium	SD-102-92	1.3 J	0.6	9.0
Chromium	SD-103-92	130 J	26.0	110.0
	SD-105-92	167 J		
Copper	SD-102-92	97.5 J/106 J	16.0	110.0
	SD-103-92	25.6		
	SD-105-92	93.4 J		
Iron	SD-103-92	28,300	20,000	40,000
	SD-105-92	20,300 J		
Lead	SD-102-92	66.2 J/66.9 J	31.0	110.0
	SD-103-92	39.7 J		
	SD-105-92	199 J		
Manganese	SD-102-92	1,270 J/1,330 J	460.0	1,100.0
	SD-103-92	736		
	SD-105-92	504 J		
Mercury	SD-103-92	0.42	0.15	1.3

Parameter	*Sample ID*	*Concentration (mg/kg)*	*NYSDEC Lowest Effect Level*	*NYSDEC Severe Effect Level*
Nickel	SD-102-92	95.6 J/102 J	16.0	50.0
	SD-103-92	36.1 J		
	SD-105-92	48.8 J		
Zinc	SD-102-92	213 J/217 J	120.0	270.0
	SD-105-92	631 J		

The pH values for the sediment samples were reported to be 9.3 at SD-102-92, 6 at SD-103-92, and 9.35 at SD-105-92.

4.4 SURFACE WATER

Surface water samples were collected at eight locations, including the outfall, SB-2B-Pond, SW-102-92, SW-103-92, SW-105-92, SW-6, SW-6A, and SW-7. These locations are shown on Figure 4.3, with the exception of the outfall and SB-2B-Pond. The location of the outfall and SB-2B-Pond are unknown. Surface water samples were analyzed for TAL metals, hexavalent chromium, and pH. Analytical results are presented in Table 4.6.

Elevated hexavalent chromium concentrations were detected at four of the eight locations. These locations include: SW-6, SW-6A, SW-7, and SW-102. Detected hexavalent chromium concentrations ranged from 0.021 mg/L at SW-6A to 1.27 mg/L at SW-7.

Elevated iron concentrations were detected at three of the eight locations. These locations include: SW-6A, SW-7, and SW-105. Detected iron concentrations ranged from 0.308 mg/L to 4.6 mg/L at SW-6A.

Surface water samples were analyzed for pH in the field at 42 locations, during various times. Sampling locations are presented on Figure 4.3. Field readings of pH are presented in Table 4.7. Surface water pH ranged from 6.16 at location 33 to 13.63 at location SW-7.

4.5 GROUNDWATER

Groundwater monitoring well locations are presented on Figure 3.3. Groundwater samples were analyzed for TAL metals, hexavalent chromium, and pH. Analytical results are presented in Tables 4.8, 4.9, and 4.10 for shallow, overburden, and bedrock wells, respectively. The groundwater data indicate that the shallow groundwater is impacted with elevated concentrations of primarily chromium, hexavalent chromium, and manganese. Much lower concentrations of these parameters were detected in the overburden and bedrock wells.

5.0 SCOPE OF WORK

This section describes the scope of work and the investigative activities to be implemented to complete the Phase 1 Investigation. The tasks to be completed are listed as follows:

Task 1 Shallow Monitoring Well Inventory, Survey, and Water Levels;
Task 2 Test Pit Excavations;
Task 3 Boreholes and Subsurface Soil Sampling and Analysis;
Task 4 Monitoring Wells;
Task 5 Hydraulic Water Level Measurements;
Task 6 Shallow Groundwater Sampling and Analysis;
Task 7 Surface Soil Sampling and Analysis;
Task 8 Surface Water and Sediment Sampling and Analysis;
Task 9 Community Air Monitoring; and
Task 10 Topographic/Property Survey.

More detailed descriptions of these tasks and protocols are presented in the following subsections, and in the Field Sampling Plan in Appendix A.

5.1 TASK 1 SHALLOW MONITORING WELL INVENTORY, SURVEY, AND WATER LEVELS

All existing shallow wells in the vicinity of the Site will be located. Existing shallow monitoring well locations are presented on Figure 3.3. Each well will be inspected to determine if it can be sampled. The condition of each well (e.g., condition of surface casing, condition of surface seal, presence of cap, bent or damaged riser pipe) will be entered onto a well inspection form. For any wells that are damaged or cannot be found, a determination will be made whether to repair, replace, or abandon the well. This determination will be based on an evaluation of the importance of the particular well in question.

Following completion of any necessary well repairs or replacements, all shallow monitoring wells to be included in the investigation will be surveyed for horizontal and vertical coordinates.

A database of the shallow monitoring well construction logs will be developed.

A complete round of water levels will be collected to verify shallow groundwater flow directions and gradients across the Site. This information will also be used to assist in locating additional monitoring wells to be installed during the Phase 1 Investigation.

5.2 TASK 2 TEST PIT EXCAVATIONS

Test pit excavations will be performed to further delineate the areal extent of buried slag at the Site, particularly in the northern portion of OU3 and east of the capped area. Excavated material will be temporarily staged next to the test pit, and used to backfill the test pit upon completion. Test pit information will be recorded on standardized test pit logs by the field engineer/geologist. Preliminary test pit locations are shown on Figure 5.1. Test pit locations may revised in the field based on accessibility and field conditions. Test pit locations will be marked and surveyed.

5.3 TASK 3 BOREHOLES AND SUBSURFACE SOIL SAMPLING AND ANALYSIS

Soil borings will be advanced using hollow-stem auger (HSA) techniques to obtain stratigraphic information, and to allow collection of subsurface soil samples.

It is proposed that 15 soil borings will be advanced at the approximate locations shown on Figure 5.2. These boreholes are identified as BH1 to BH15. Fourteen of the soil borings will be completed as shallow monitoring wells, as described in Task 4. Information obtained from the soil borings will be used to:

- determine distribution and thickness of slag material at the Site;
- determine thickness of existing cap material, where present;
- determine topography of subsurface silt layer; and
- determine where the slag material is saturated.

Soil samples will be collected from the slag material and from the underlying native silt unit. The samples will be analyzed for pH, Target Compound List (TAL) inorganics, and hexavalent chromium.

Selected soil samples from the cap overlying the slag material will be submitted for grain size distribution analyses, and potentially for laboratory permeability testing, depending upon its composition.

5.4 TASK 4 MONITORING WELLS

Specific objectives of the groundwater investigation at the Site are as follows:

- determine the interrelationship between shallow groundwater, surface water, and seeps; and
- further define the shallow groundwater flow characteristics and contaminant distribution in the groundwater at the Site.

Additional monitoring wells will be installed to supplement the existing groundwater monitoring network. It is proposed that 14 shallow groundwater monitoring wells will be installed at the approximate locations presented on Figure 5.3. These monitoring wells will be installed in the soil borings discussed in Task 3. The proposed monitoring wells are identified as MW15 to MW28. The actual number of shallow wells and their locations will be dependent upon the distribution of saturated slag, as determined in Task 3. All monitoring wells will be surveyed for horizontal and vertical control.

5.5 TASK 5 HYDRAULIC WATER LEVEL MEASUREMENTS

Water level measurements will be collected on a bi-monthly basis (over an 8-month period) to evaluate the interrelationship between the groundwater, surface water, and seeps, and the potential seasonal impact on the surface water/groundwater flow conditions. To the extent possible, the water level measurement rounds will be scheduled to monitor conditions ranging from extended dry periods to wet periods. Water level measurements will be obtained from all on-Site monitoring wells and selected off-Site wells. During each water level measurement round, the perimeter of the capped area in OU3 will be inspected to identify any seeps. Seep areas will be marked and surveyed. Surface water elevation measurements will be collected at selected locations during each monitoring event to evaluate the interrelationship between shallow groundwater, surface water, and seeps.

5.6 TASK 6 SHALLOW GROUNDWATER SAMPLING AND ANALYSIS

Two rounds of groundwater samples will be collected from all new monitoring wells and selected existing off-Site shallow monitoring wells. Groundwater sampling will be conducted using low flow purging and sampling protocols. Groundwater samples will be analyzed for pH, TAL inorganics, and hexavalent chromium.

During the first round of groundwater monitoring, samples will be collected from all new monitoring wells and all off-Site shallow wells (Airco and SKW properties). During the second groundwater monitoring round, samples will be collected from all new monitoring wells and selected off-Site wells, depending upon the first round results.

5.7 TASK 7 SURFACE SOIL SAMPLING AND ANALYSIS

A total of 30 surface soil samples will be collected and analyzed for TAL inorganics and hexavalent chromium. Approximate surface soil sampling locations are presented on Figure 5.4. Surface soil sampling locations are identified as SS10 to SS39. The sampling locations will include 12 samples from areas with slag material exposed at the ground surface and 18 samples from other areas of the Site. The surface soil samples will be collected from 0 to 2 inches bgs. The surface soil sample results will be used to conduct a baseline risk assessment. It is anticipated that the databases for areas with exposed slag will be evaluated separately from areas where the slag is not exposed, for the baseline risk assessment.

5.8 TASK 8 SURFACE WATER AND SEDIMENT SAMPLING AND ANALYSIS

Surface water and sediment samples will be collected from 17 locations coincident with the first round of groundwater sampling, as described in Task 6. The proposed surface water and sediment sampling locations are presented on Figure 5.5. Surface water/ sediment sampling locations are identified as SW8 to SW24. Surface water and sediment samples will be analyzed for pH, TAL inorganics, and hexavalent chromium. During the bi-monthly hydraulic water level measurements, as described in Task 5, surface water samples will be collected from the proposed monitoring locations and analyzed for pH, TAL inorganics, and hexavalent chromium. These data will be used to evaluate seasonal fluctuations in the surface water quality.

5.9 TASK 9 AIR MONITORING

A community air monitoring plan in accordance with New York State Department of Health protocols will be implemented at the Site, and is presented in Appendix D.

5.10 TASK 10 TOPOGRAPHIC/PROPERTY SURVEY

A detailed topographic and property survey for OU3 will be completed. The survey information will be used for establishing surface water drainage flow patterns and for evaluating potential remedial measures for the Feasibility Study.

6.0 REPORTING

6.1 PROGRESS REPORTS

During the course of the Phase 1 activities, the Respondents will submit quarterly progress reports after approval of the Phase 1 Work Plan. The progress reports will include:

i) a description of the actions which have been taken toward achieving compliance with the Order On Consent during the previous quarter;

ii) all results of sampling and tests and all other data received or generated by the Respondents or the Respondents' contractors or agents in the previous quarter, including quality assurance/quality control information, whether conducted pursuant to the Order On Consent or conducted independently by the Respondents;

iii) identification of all work plans, reports, and other deliverables required by the Order On Consent that were completed and submitted during the previous quarter;

iv) a description of all actions, including but not limited to data collection and implementation of work plans, that are scheduled for the next quarter and provide other information relating to the progress at OU3;

v) information regarding percentage of completion, unresolved delays encountered or anticipated that may affect the future schedule for implementation of the Respondents' obligations under the Order On Consent, and efforts made to mitigate those delays or anticipated delays;

vi) any modifications to any work plans that the Respondents have proposed to NYSDEC or that NYSDEC has approved; and

vii) a description of all activities undertaken in support of the Citizen Participation Plan during the previous month and those to be undertaken in the next quarter.

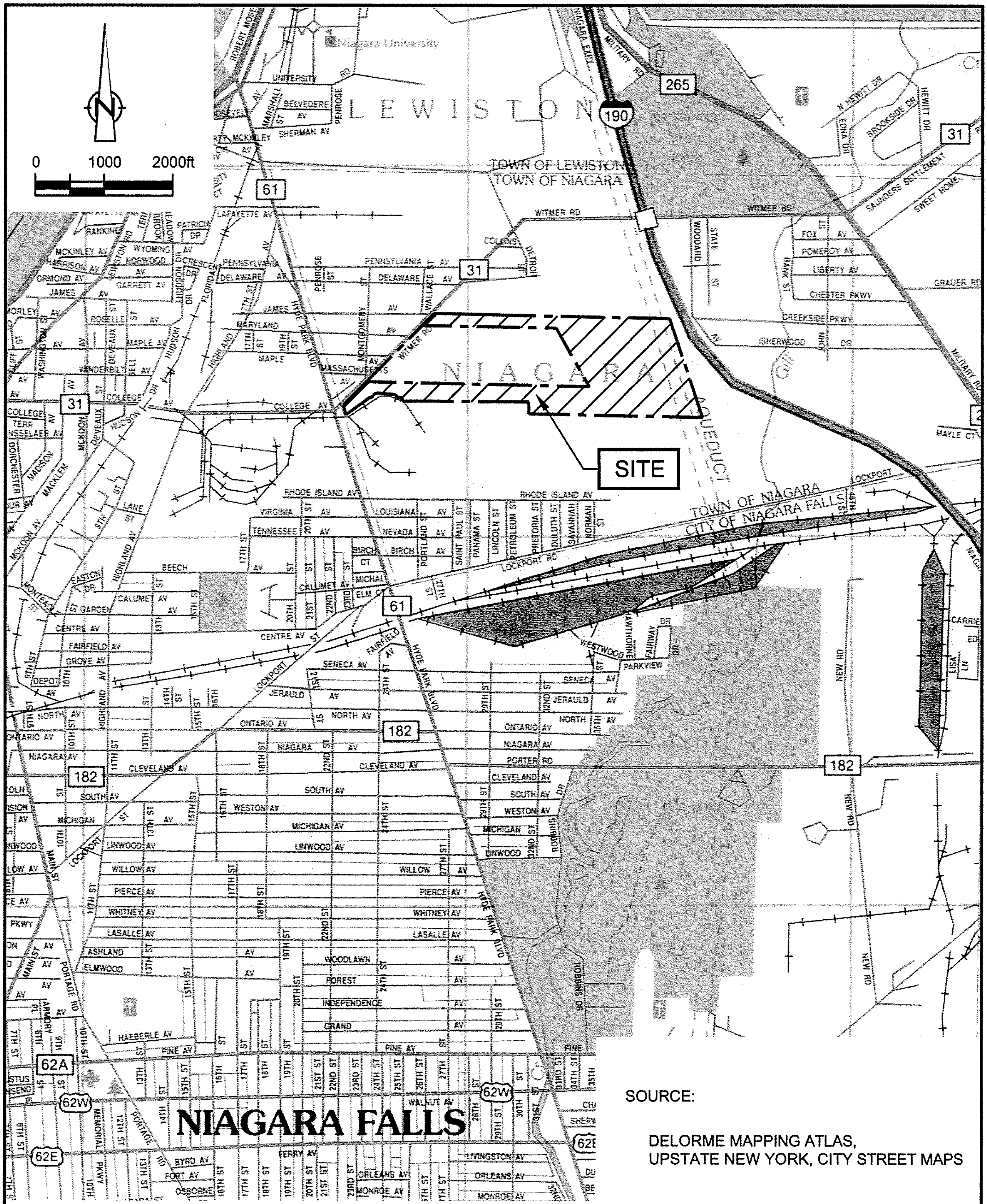
The Respondents will submit the progress reports to NYSDEC by the tenth day of every reporting period following the effective date of the Order On Consent.

6.2 PHASE 1 REPORT

The Phase 1 Report will be a letter report, and will present all data generated during the Phase 1 Investigation, and will include: analytical data, data validation report, topographic survey, well construction logs, and borehole and test pit logs. The Phase 1 Report will present an analysis of the data that were gathered.

7.0 SCHEDULE

The schedule for conducting the Phase 1 Investigation and preparing the Phase 1 Report is presented on Figure 7.1.



SOURCE:

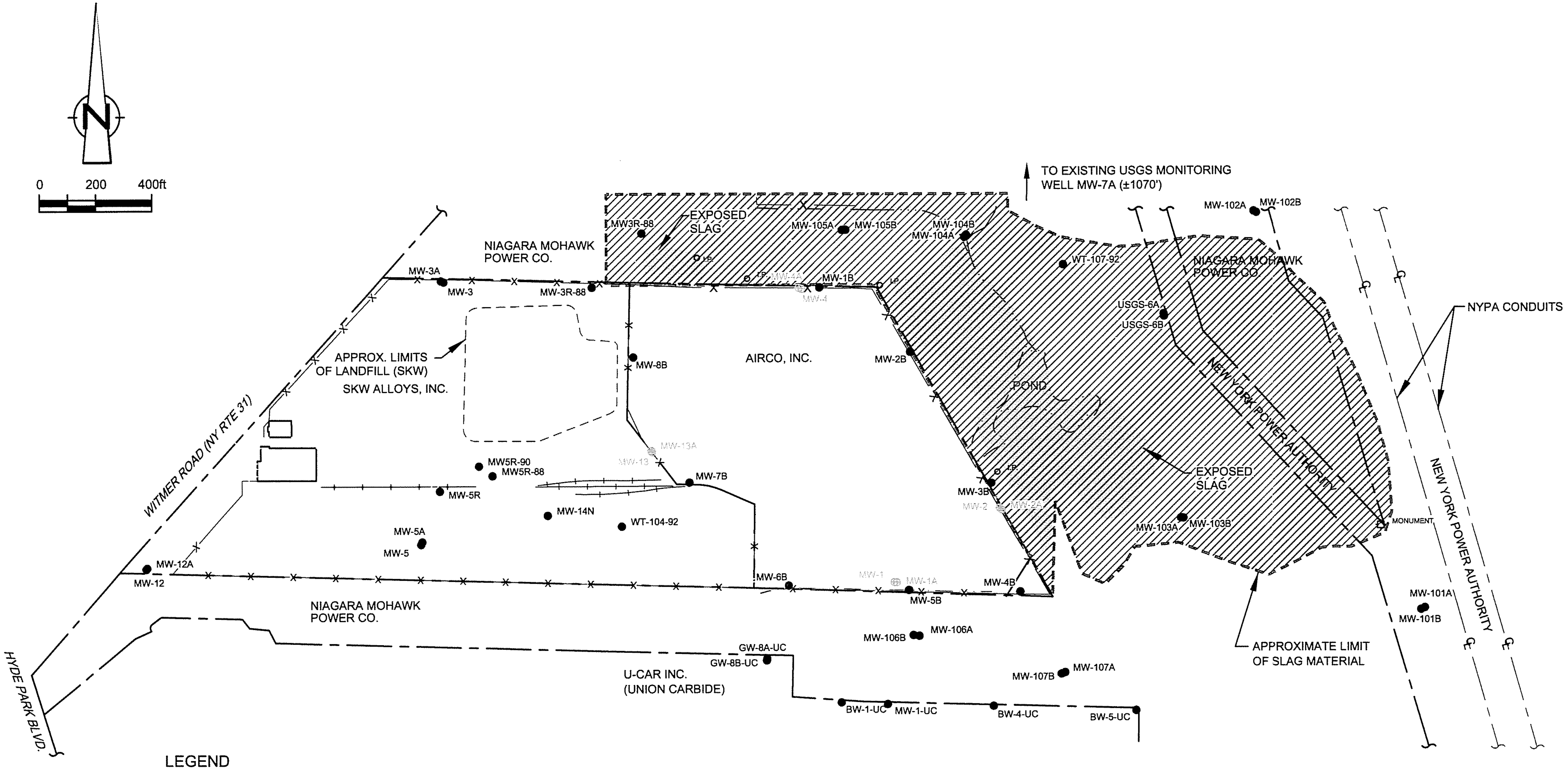
DELORME MAPPING ATLAS,
UPSTATE NEW YORK, CITY STREET MAPS

figure 1.1

SITE LOCATION
VANADIUM CORPORATION OF AMERICA SITE
Niagara Falls, NY

CRA

19867-00(001)GN-WA008 AUG 13/2002



LEGEND

── ─ ──	PROPERTY LINE
──x──	FENCE
─┼──┼─	RAILROAD
NYPA	NEW YORK POWER AUTHORITY
● MW-5	EXISTING MONITORING WELL LOCATION
⊕ MW-1	MONITORING WELL NO LONGER EXISTS IN FIELD

NOTES:

1. BASE MAP DIGITIZED FROM 'VANADIUM SITE NO. 932001' PROVIDED BY LU ENGINEERS, 2230 PENFIELD RD., PENFIELD, NY, (716) 377-1450. MAP DATA DIGITIZED FROM 'SITE PLAN AND SAMPLING LOCATION' PREPARED BY ABB ENVIRONMENTAL.
2. SITE FEATURES AND SAMPLE LOCATIONS ARE APPROXIMATE.

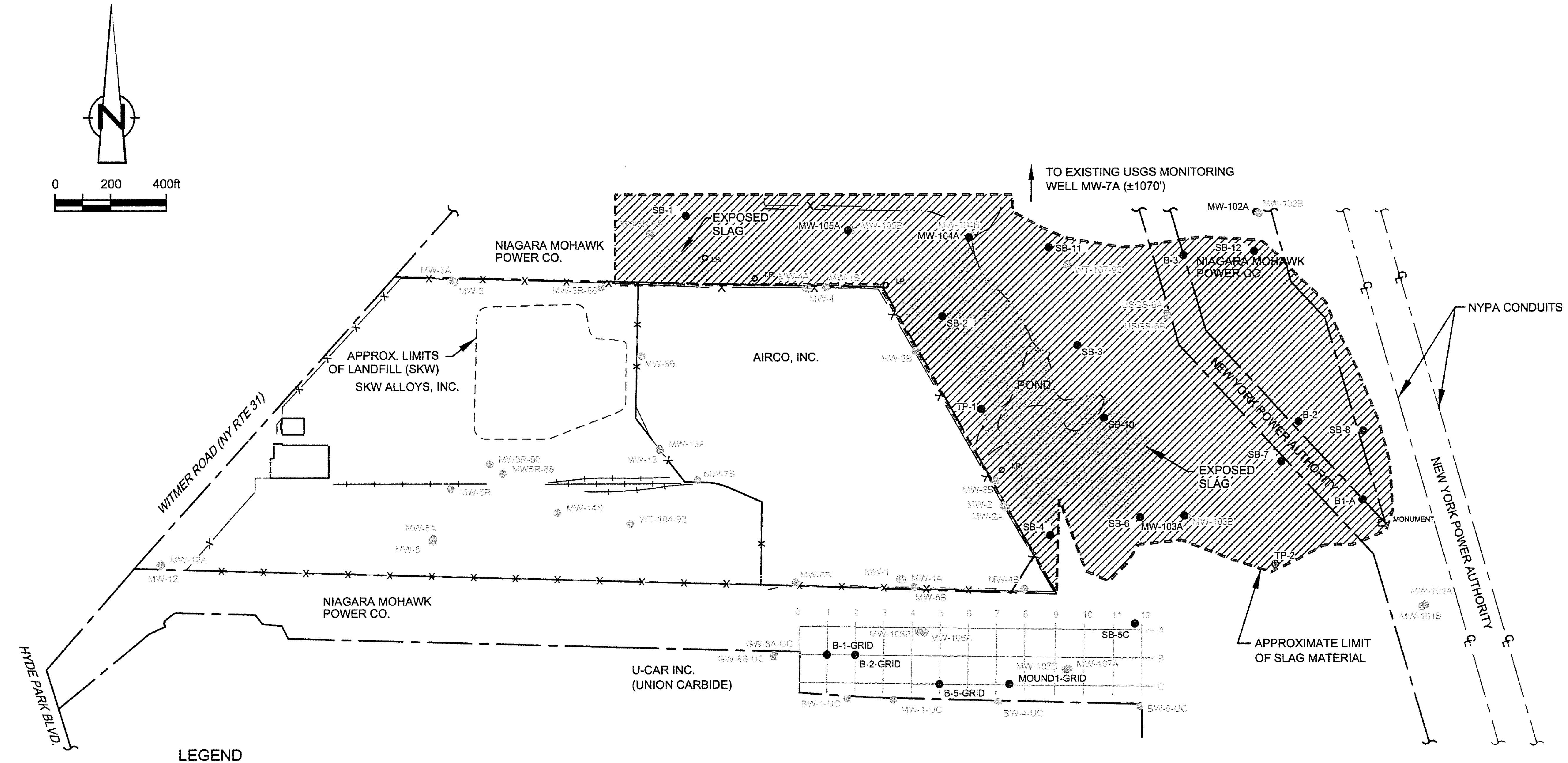
SOURCE:

NIAGARA MOHAWK POWER CORPORATION, VANADIUM CORPORATION OF AMERICA SITE, NIAGRAFALLS, NY. FIGURES 1, 2 AND 3, BBL ENGINEERS & SCIENTISTS. 12/8/2000

figure 1.2

SITE PLAN
VANADIUM CORPORATION OF AMERICA SITE
Niagara Falls, NY

19867-00(HINT002)GN-WA001 JAN 24/2003



LEGEND

- — · — PROPERTY LINE
- —x— FENCE
- —+— RAILROAD
- NYPA NEW YORK POWER AUTHORITY
- ● EXISTING MONITORING WELL LOCATION
- ● OU3 HISTORICAL SUBSURFACE SAMPLE LOCATION
- ⊕ MW-1 MONITORING WELL NO LONGER EXISTS IN FIELD

NOTES:

1. BASE MAP DIGITIZED FROM 'VANADIUM SITE NO. 932001' PROVIDED BY LU ENGINEERS, 2230 PENFIELD RD., PENFIELD, NY, (716) 377-1450. MAP DATA DIGITIZED FROM 'SITE PLAN AND SAMPLING LOCATION' PREPARED BY ABB ENVIRONMENTAL.

2. SITE FEATURES AND SAMPLE LOCATIONS ARE APPROXIMATE.

SOURCE:

NIAGARA MOHAWK POWER CORPORATION, VANADIUM CORPORATION OF AMERICA SITE, NIAGRAFALLS, NY. FIGURES 1, 2 AND 3, BBL ENGINEERS & SCIENTISTS. 12/8/2000

figure 3.1

HISTORICAL SUBSURFACE SAMPLING LOCATIONS
VANADIUM CORPORATION OF AMERICA SITE
Niagara Falls, NY

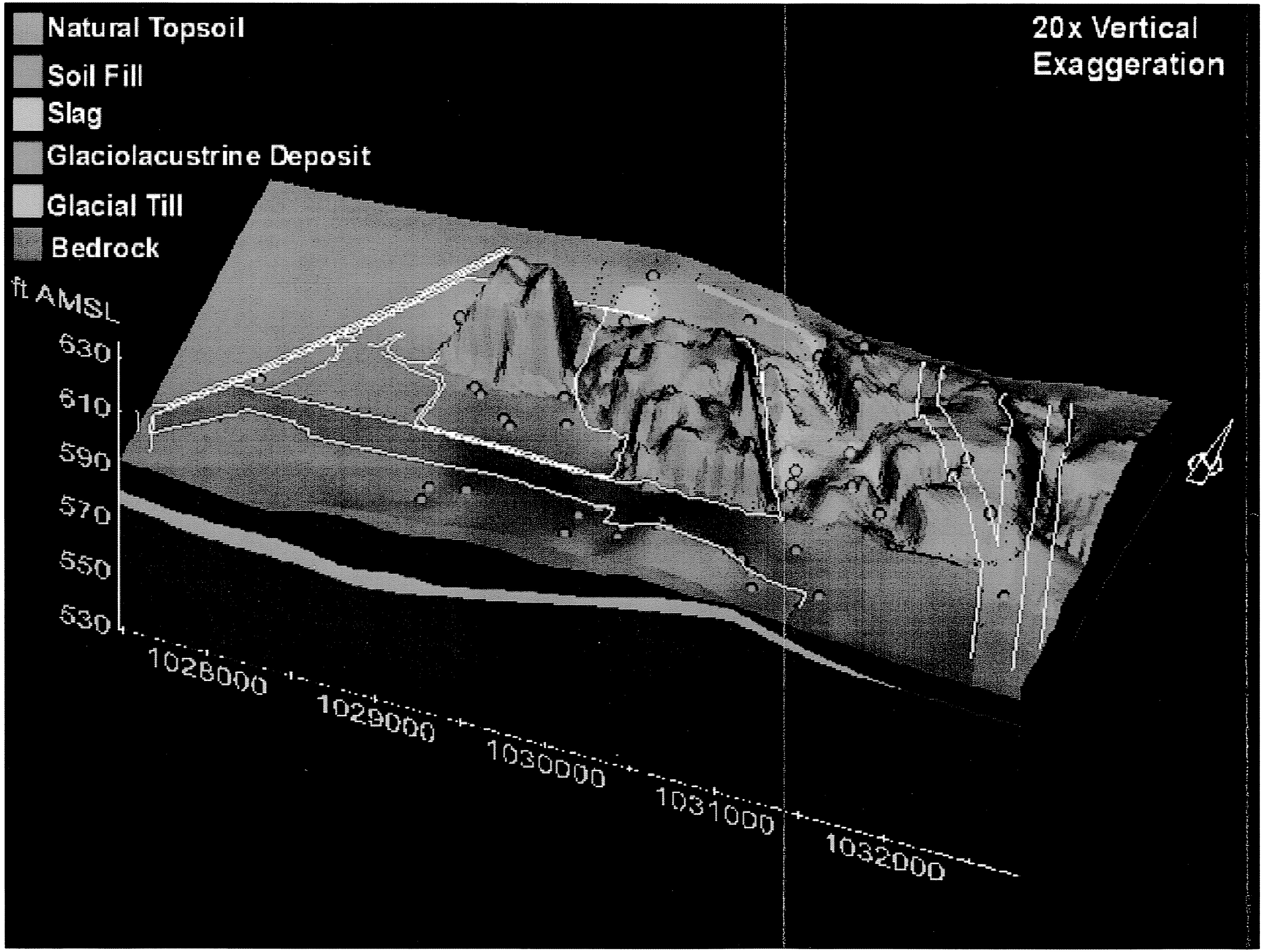
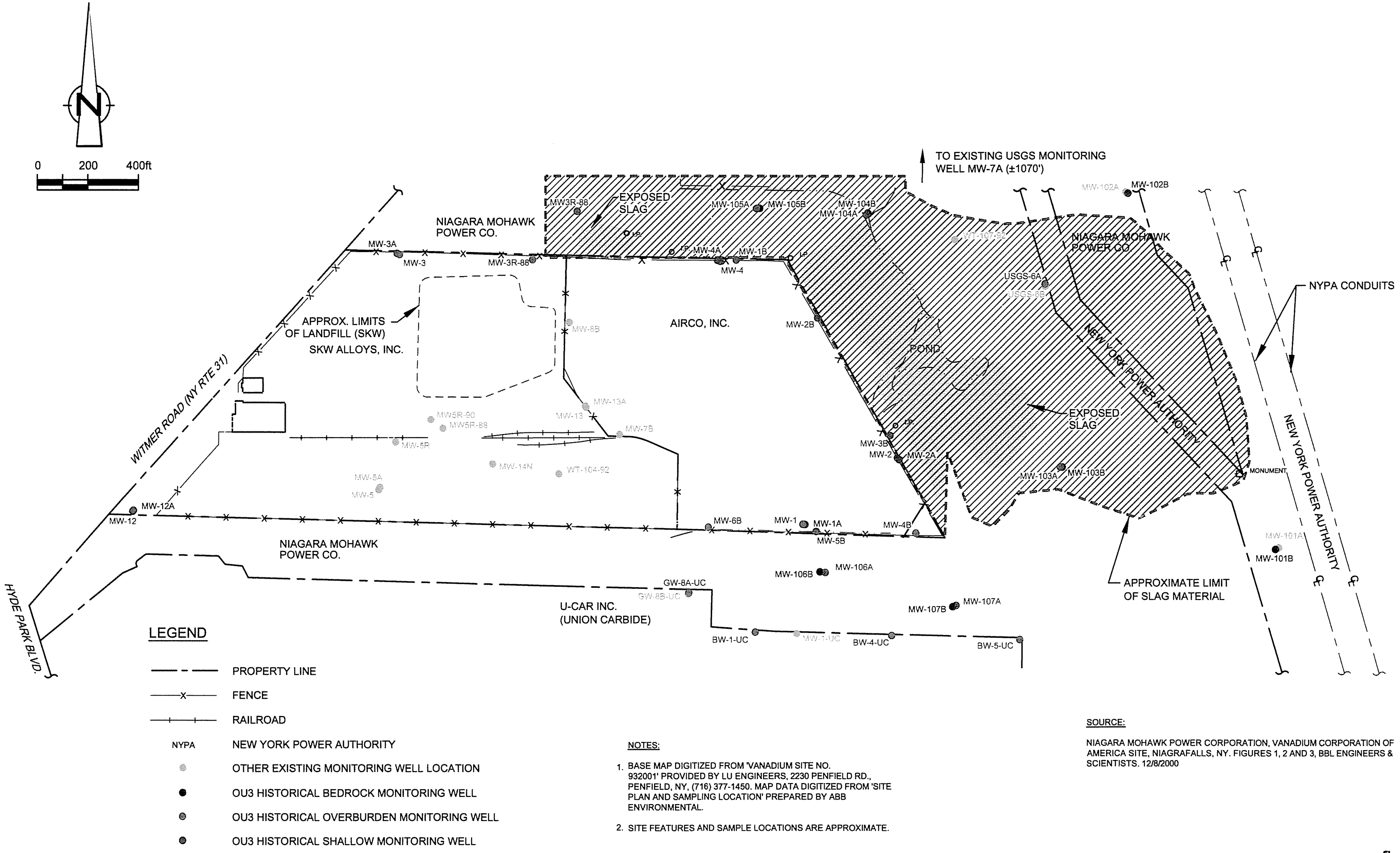


figure 3.2
CROSS - SECTION SITE GEOLOGY
VANADIUM CORPORATION OF AMERICA SITE
Niagara Falls, NY



NOTES:

1. BASE MAP DIGITIZED FROM 'VANADIUM SITE NO. 932001' PROVIDED BY LU ENGINEERS, 2230 PENFIELD RD., PENFIELD, NY, (716) 377-1450. MAP DATA DIGITIZED FROM 'SITE PLAN AND SAMPLING LOCATION' PREPARED BY ABB ENVIRONMENTAL.
2. SITE FEATURES AND SAMPLE LOCATIONS ARE APPROXIMATE.

SOURCE:

NIAGARA MOHAWK POWER CORPORATION, VANADIUM CORPORATION OF AMERICA SITE, NIAGRAFALLS, NY. FIGURES 1, 2 AND 3, BBL ENGINEERS & SCIENTISTS. 12/8/2000

figure 3.3

HISTORICAL GROUNDWATER SAMPLING LOCATIONS
VANADIUM CORPORATION OF AMERICA SITE
Niagara Falls, NY

CRA

19867-00(HINT002)GN-WA002 JAN 27/2003

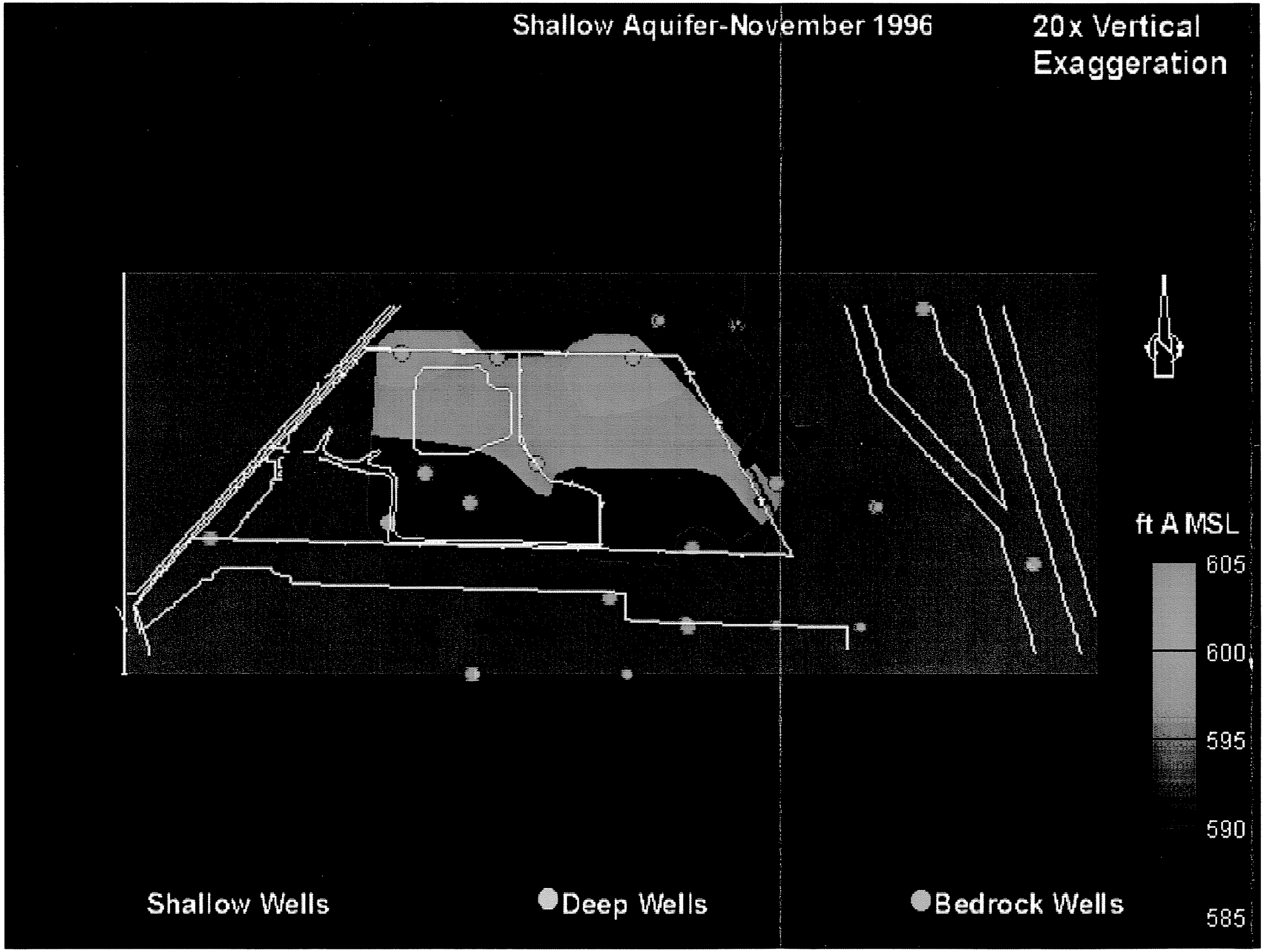


figure 3.4
SHALLOW AQUIFER GROUNDWATER CONTOURS - NOVEMBER 1996
VANADIUM CORPORATION OF AMERICA SITE
Niagara Falls, NY

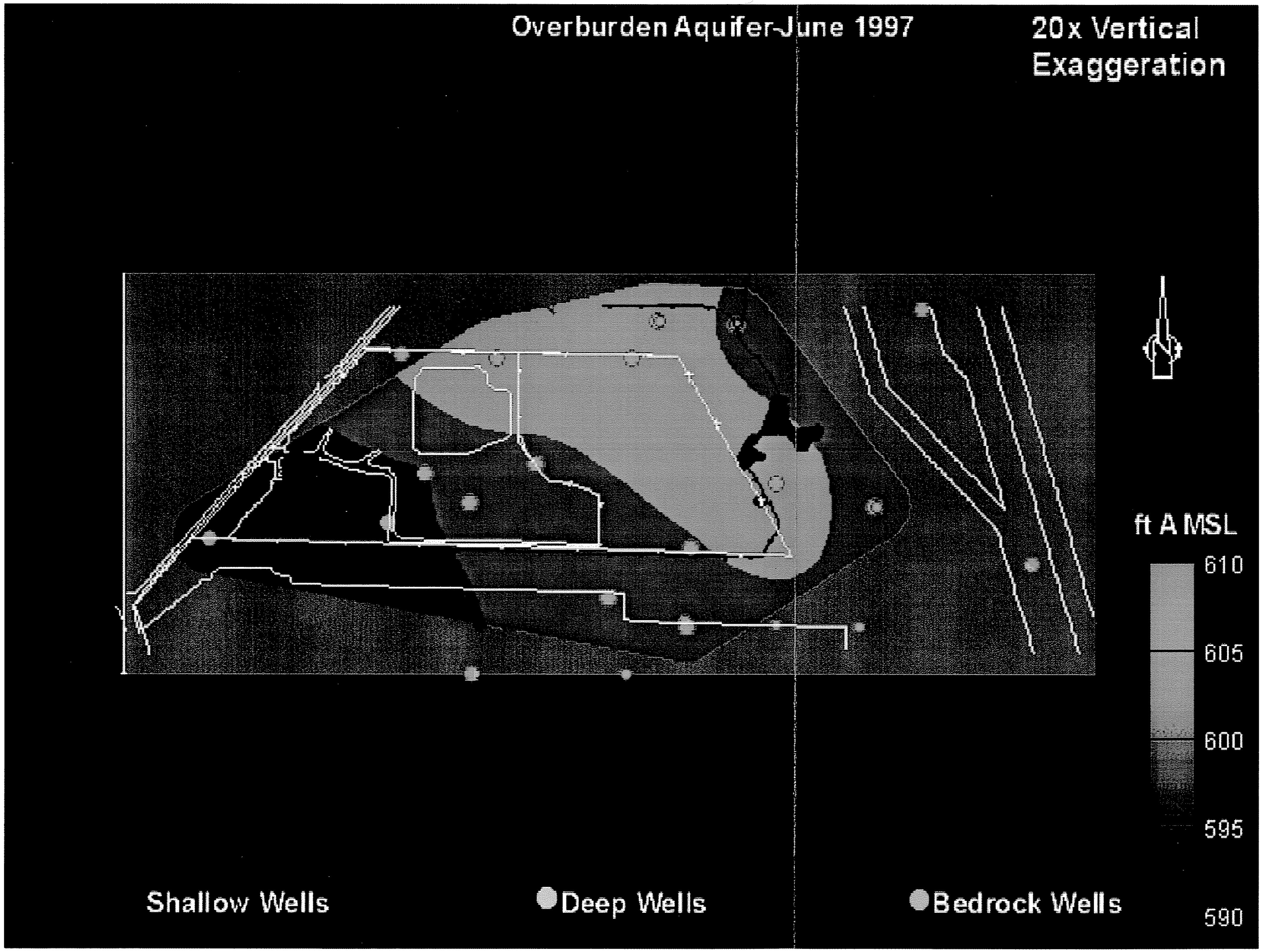


figure 3.5
OVERBURDEN GROUNDWATER CONTOURS - JUNE 1997
VANADIUM CORPORATION OF AMERICA SITE
Niagara Falls, NY

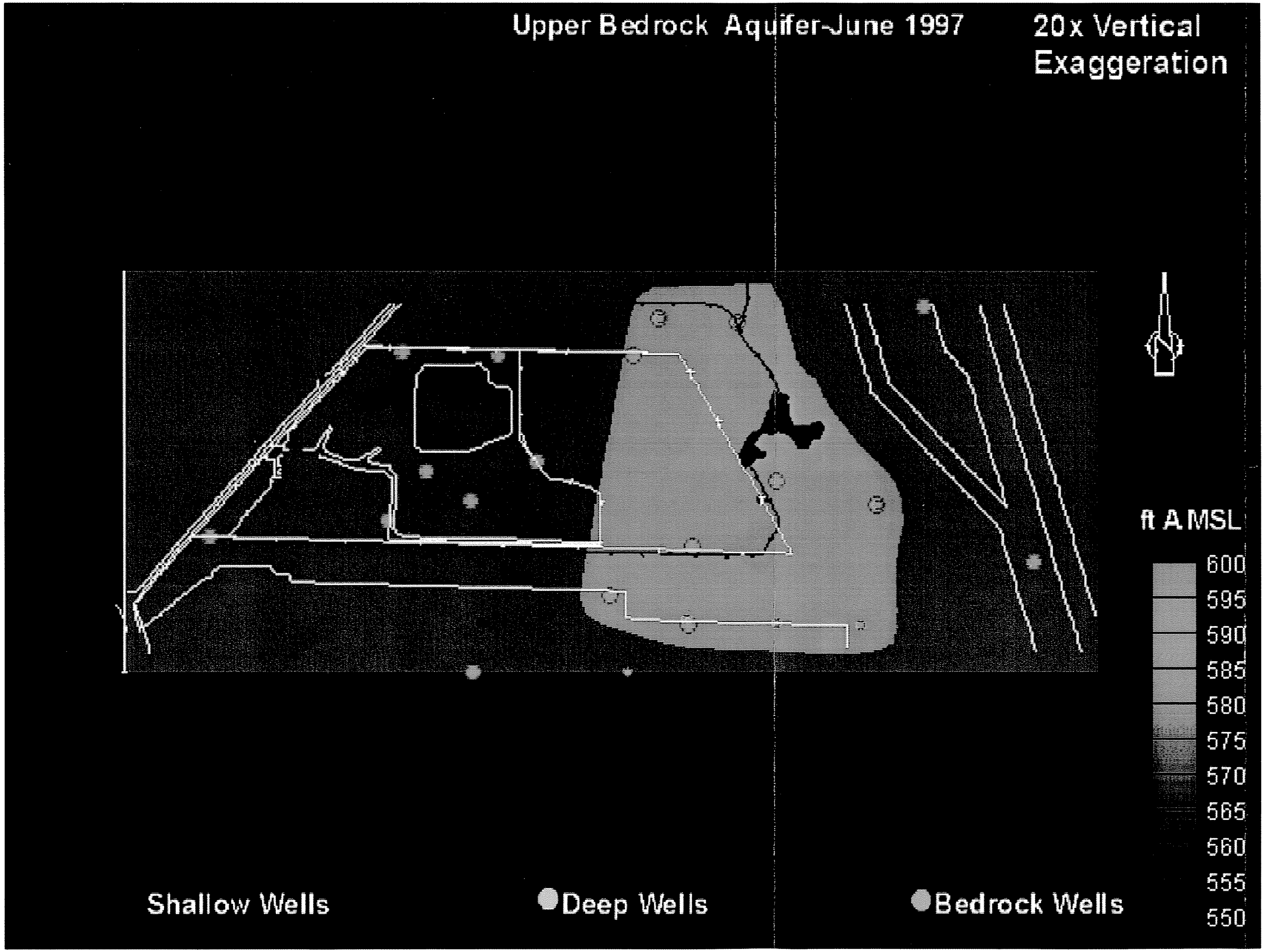
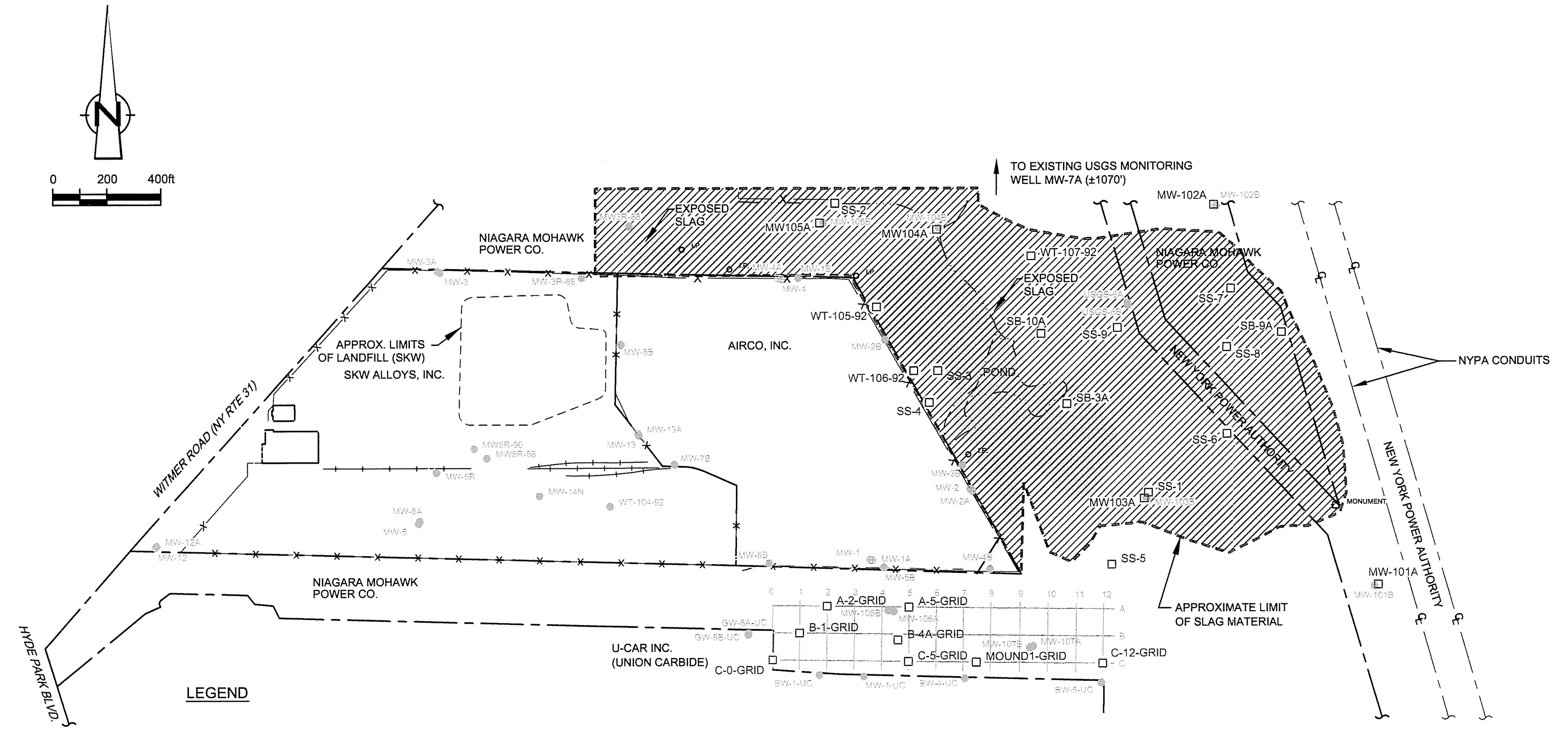


figure 3.6
BEDROCK AQUIFER GROUNDWATER CONTOURS- June 1997
VANADIUM CORPORATION OF AMERICA SITE
Niagara Falls, NY



LEGEND

— - —	PROPERTY LINE
	DITCH
——x——	FENCE
——+——	RAILROAD
NYPA	NEW YORK POWER AUTHORITY
●	MONITORING WELL LOCATION
☐	OU3 HISTORICAL SURFACE SOIL SAMPLE LOCATION
⊕ MW-1	MONITORING WELL NO LONGER EXISTS IN FIELD

NOTES:

1. BASE MAP DIGITIZED FROM 'VANADIUM SITE NO. 932001' PROVIDED BY LU ENGINEERS, 2230 PENFIELD RD., PENFIELD, NY, (716) 377-1450. MAP DATA DIGITIZED FROM 'SITE PLAN AND SAMPLING LOCATION' PREPARED BY ABB ENVIRONMENTAL.
2. SITE FEATURES AND SAMPLE LOCATIONS ARE APPROXIMATE.

SOURCE:

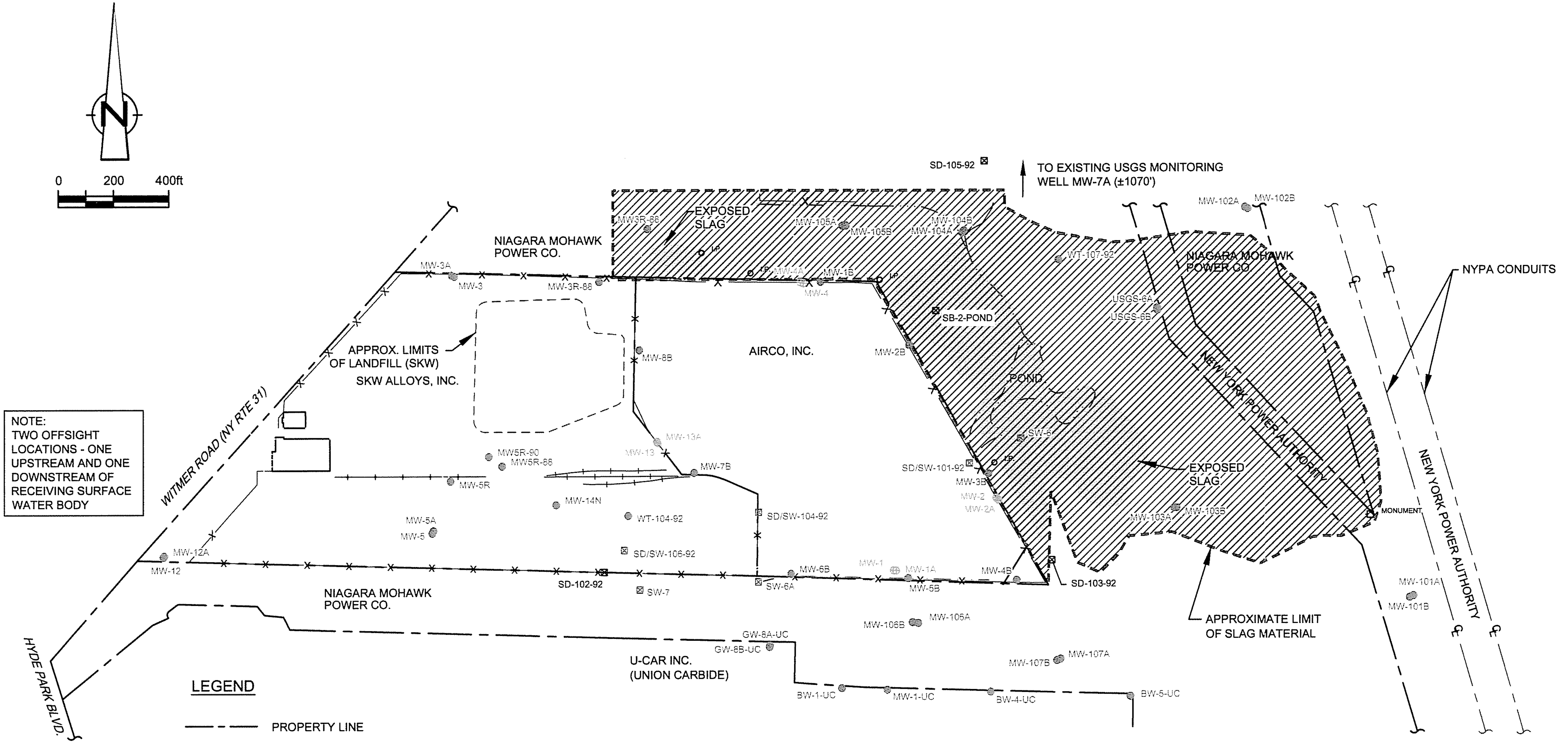
NIAGARA MOHAWK POWER CORPORATION, VANADIUM CORPORATION OF AMERICA SITE, NIAGRAFALLS, NY. FIGURES 1, 2 AND 3, BBL ENGINEERS & SCIENTISTS. 12/8/2000

figure 4.1

HISTORICAL SURFACE SOIL SAMPLING LOCATIONS
VANADIUM CORPORATION OF AMERICA SITE
Niagara Falls, NY

CRA

19867-00(HINT002)GN-WA004 JAN 28/2003



NOTE:
TWO OFFSIGHT LOCATIONS - ONE UPSTREAM AND ONE DOWNSTREAM OF RECEIVING SURFACE WATER BODY

LEGEND

— — —	PROPERTY LINE
—x—	FENCE
—+—	RAILROAD
NYPA	NEW YORK POWER AUTHORITY
●	EXISTING MONOTORING WELL LOCATION
⊠	OTHER SURFACE WATER SAMPLE LOCATION FROM PREVIOUS INVESTIGATIONS
⊠ SD-103-92	OU3 HISTORICAL SEDIMENT SAMPLE LOCATION
⊕ MW-1	MONITORING WELL NO LONGER EXISTS IN FIELD

NOTES:

1. BASE MAP DIGITIZED FROM 'VANADIUM SITE NO. 932001' PROVIDED BY LU ENGINEERS, 2230 PENFIELD RD., PENFIELD, NY, (716) 377-1450. MAP DATA DIGITIZED FROM 'SITE PLAN AND SAMPLING LOCATION' PREPARED BY ABB ENVIRONMENTAL.
2. SITE FEATURES AND SAMPLE LOCATIONS ARE APPROXIMATE.

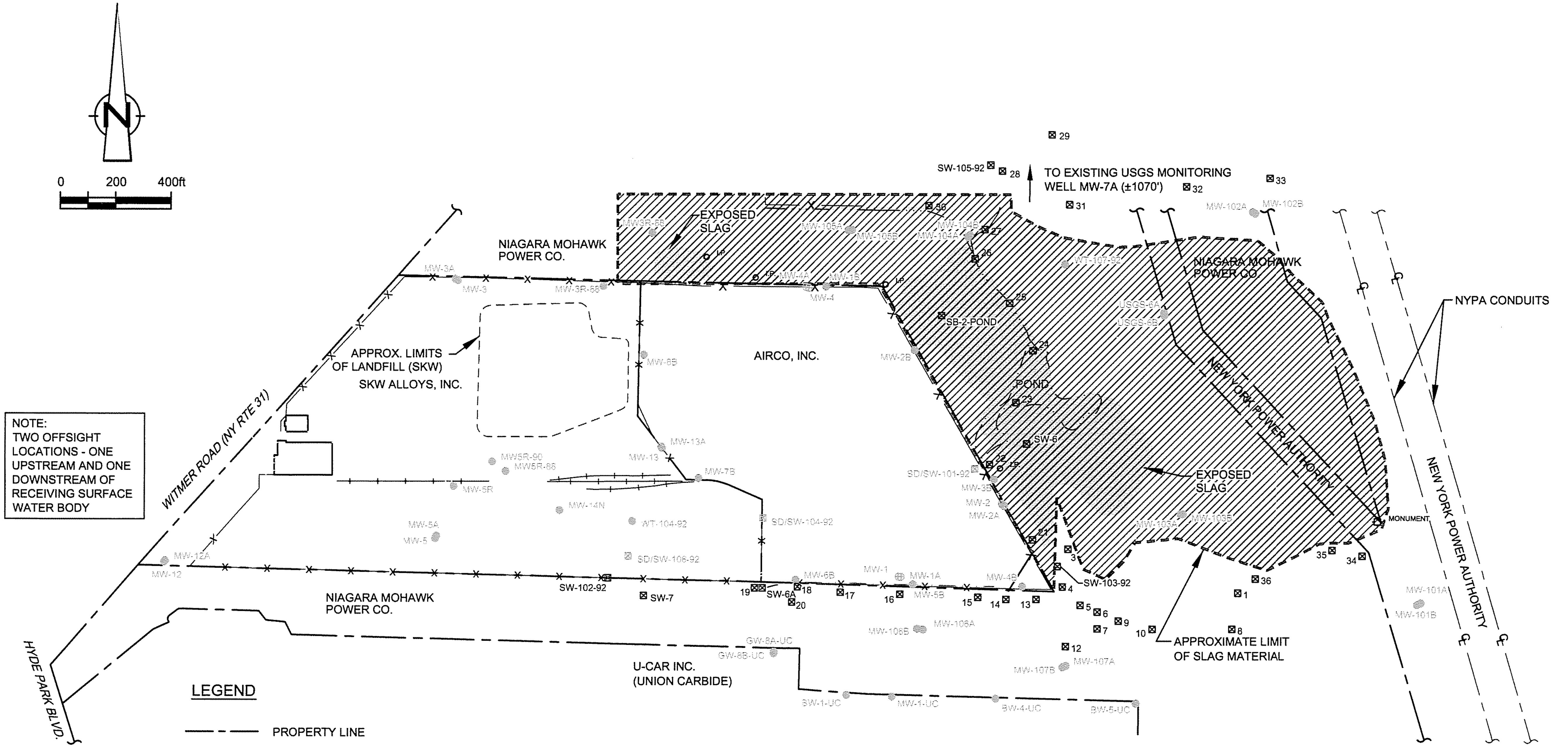
SOURCE:

NIAGARA MOHAWK POWER CORPORATION, VANADIUM CORPORATION OF AMERICA SITE, NIAGRAFALLS, NY. FIGURES 1, 2 AND 3, BBL ENGINEERS & SCIENTISTS. 12/8/2000

figure 4.2

HISTORICAL SEDIMENT SAMPLE LOCATIONS
VANADIUM CORPORATION OF AMERICA SITE
Niagara Falls, NY

19867-00(HINT002)GN-WA005 JAN 28/2003



LEGEND

PROPERTY LINE

FENCE

RAILROAD

NYPA NEW YORK POWER AUTHORITY

EXISTING MONOTORING WELL LOCATION

⊠ OTHER SURFACE WATER SAMPLE LOCATION FROM PREVIOUS INVESTIGATIONS

⊠ OU3 HISTORICAL SURFACE WATER SAMPLE LOCATION SAMPLED FOR TAL METALS, HEXAVALENT CHROMIUM AND pH

⊠ SURFACE WATER SAMPLING FOR pH ONLY

MW-1 MONITORING WELL NO LONGER EXISTS IN FIELD

NOTES:

1. BASE MAP DIGITIZED FROM 'VANADIUM SITE NO. 932001' PROVIDED BY LU ENGINEERS, 2230 PENFIELD RD., PENFIELD, NY, (716) 377-1450. MAP DATA DIGITIZED FROM 'SITE PLAN AND SAMPLING LOCATION' PREPARED BY ABB ENVIRONMENTAL.
2. SITE FEATURES AND SAMPLE LOCATIONS ARE APPROXIMATE.

SOURCE:

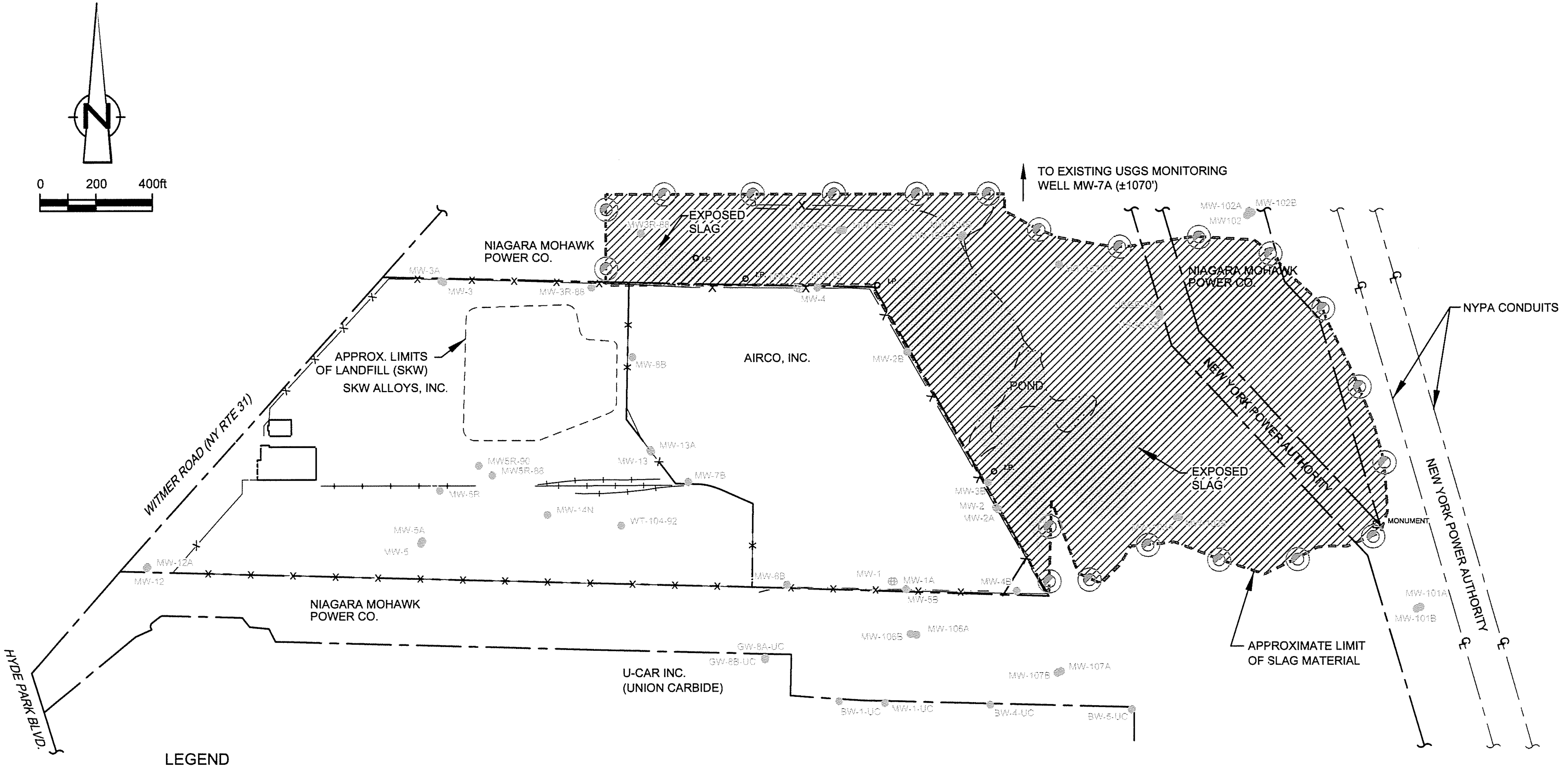
NIAGARA MOHAWK POWER CORPORATION, VANADIUM CORPORATION OF AMERICA SITE, NIAGRAFALLS, NY. FIGURES 1, 2 AND 3, BBL ENGINEERS & SCIENTISTS. 12/8/2000

figure 4.3

HISTORICAL SURFACE WATER SAMPLING LOCATIONS
VANADIUM CORPORATION OF AMERICA SITE
Niagara Falls, NY

CRA

19867-00(HINT002)GN-WA006 JAN 28/2003



LEGEND

— - — PROPERTY LINE

—x— FENCE

—+—+— RAILROAD

NYPA NEW YORK POWER AUTHORITY

● EXISTING MONITORING WELL LOCATION

⊕ MW-1 MONITORING WELL NO LONGER EXISTS IN FIELD

◎ PROPOSED TEST PIT APPROXIMATE LOCATION

NOTES:

1. BASE MAP DIGITIZED FROM 'VANADIUM SITE NO. 932001' PROVIDED BY LU ENGINEERS, 2230 PENFIELD RD., PENFIELD, NY, (716) 377-1450. MAP DATA DIGITIZED FROM 'SITE PLAN AND SAMPLING LOCATION' PREPARED BY ABB ENVIRONMENTAL.
2. SITE FEATURES AND SAMPLE LOCATIONS ARE APPROXIMATE.

SOURCE:

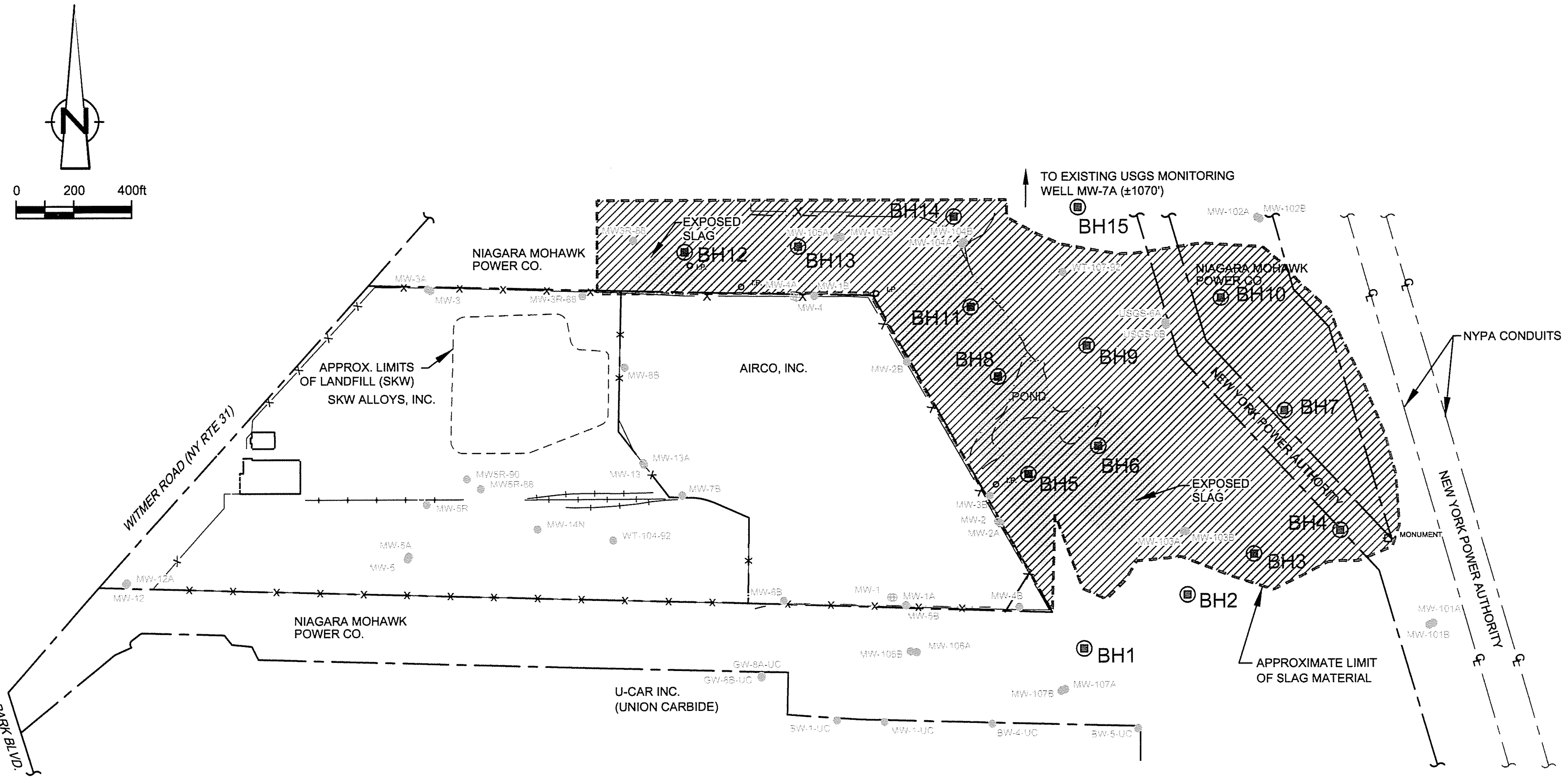
NIAGARA MOHAWK POWER CORPORATION, VANADIUM CORPORATION OF AMERICA SITE, NIAGRAFALLS, NY. FIGURES 1, 2 AND 3, BBL ENGINEERS & SCIENTISTS. 12/8/2000

figure 5.1

PROPOSED TEST PIT LOCATIONS
VANADIUM CORPORATION OF AMERICA SITE
Niagara Falls, NY

CRA

19867-00(HINT002)GN-WA007 FEB 05/2003



LEGEND

— - —	PROPERTY LINE
—x—	FENCE
—+—+—	RAILROAD
NYPA	NEW YORK POWER AUTHORITY
●	EXISTING MONITORING WELL LOCATION
⊕ MW-1	MONITORING WELL NO LONGER EXISTS IN FIELD
◙	PROPOSED SOIL BORING LOCATION

NOTES:

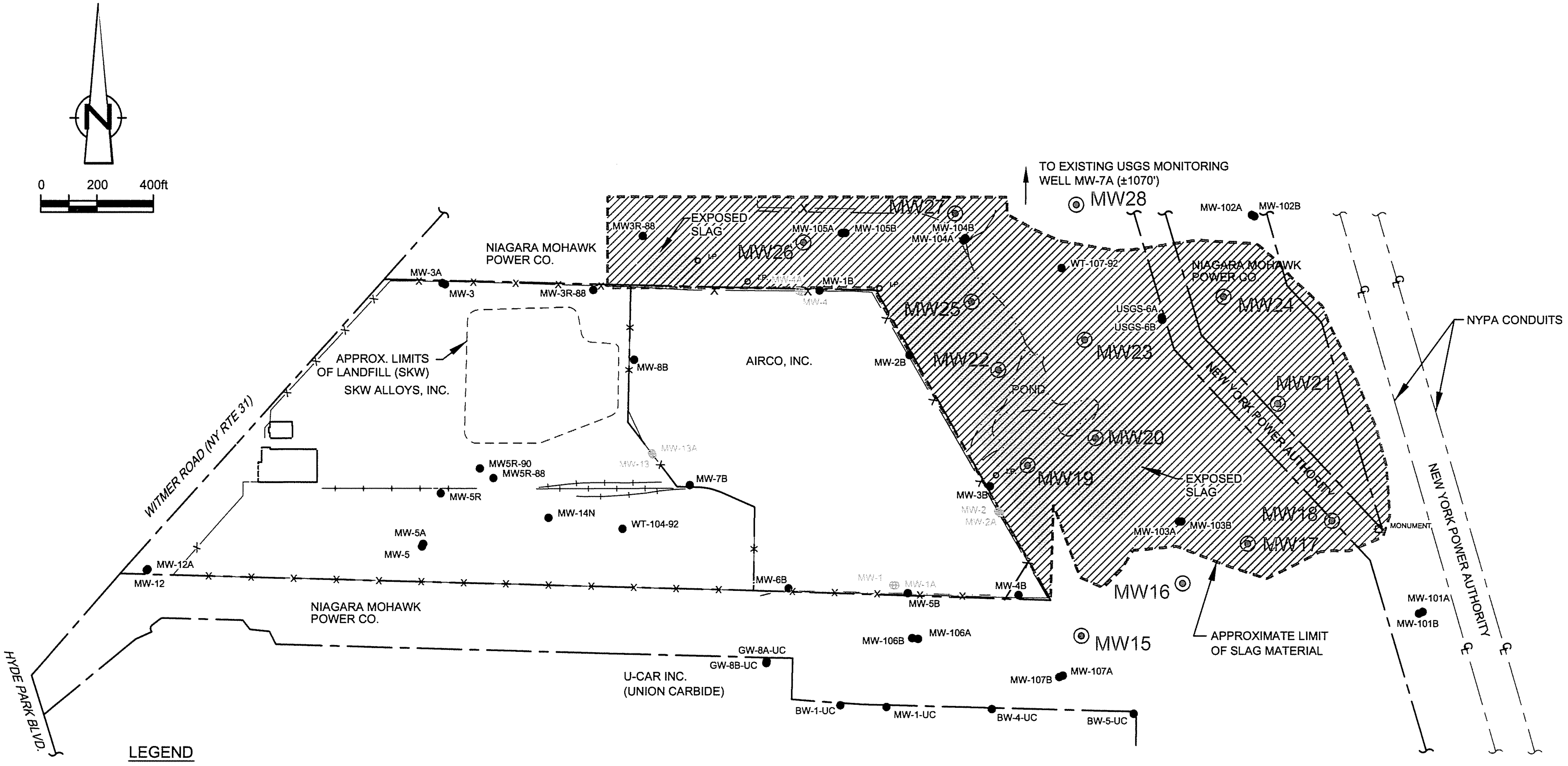
1. BASE MAP DIGITIZED FROM 'VANADIUM SITE NO. 932001' PROVIDED BY LU ENGINEERS, 2230 PENFIELD RD., PENFIELD, NY, (716) 377-1450. MAP DATA DIGITIZED FROM 'SITE PLAN AND SAMPLING LOCATION' PREPARED BY ABB ENVIRONMENTAL.
2. SITE FEATURES AND SAMPLE LOCATIONS ARE APPROXIMATE.

SOURCE:

NIAGARA MOHAWK POWER CORPORATION, VANADIUM CORPORATION OF AMERICA SITE, NIAGRAFALLS, NY. FIGURES 1, 2 AND 3, BBL ENGINEERS & SCIENTISTS. 12/8/2000

figure 5.2

PROPOSED SOIL BORING LOCATIONS
VANADIUM CORPORATION OF AMERICA SITE
Niagara Falls, NY



LEGEND

——— – ——— PROPERTY LINE

——x—— FENCE

—+—+— RAILROAD

NYPA NEW YORK POWER AUTHORITY

● EXISTING MONITORING WELL LOCATION

⊕ MW-1 MONITORING WELL NO LONGER EXISTS IN FIELD

◎ PROPOSED SHALLOW GROUNDWATER MONITORING WELL LOCATION

NOTES:

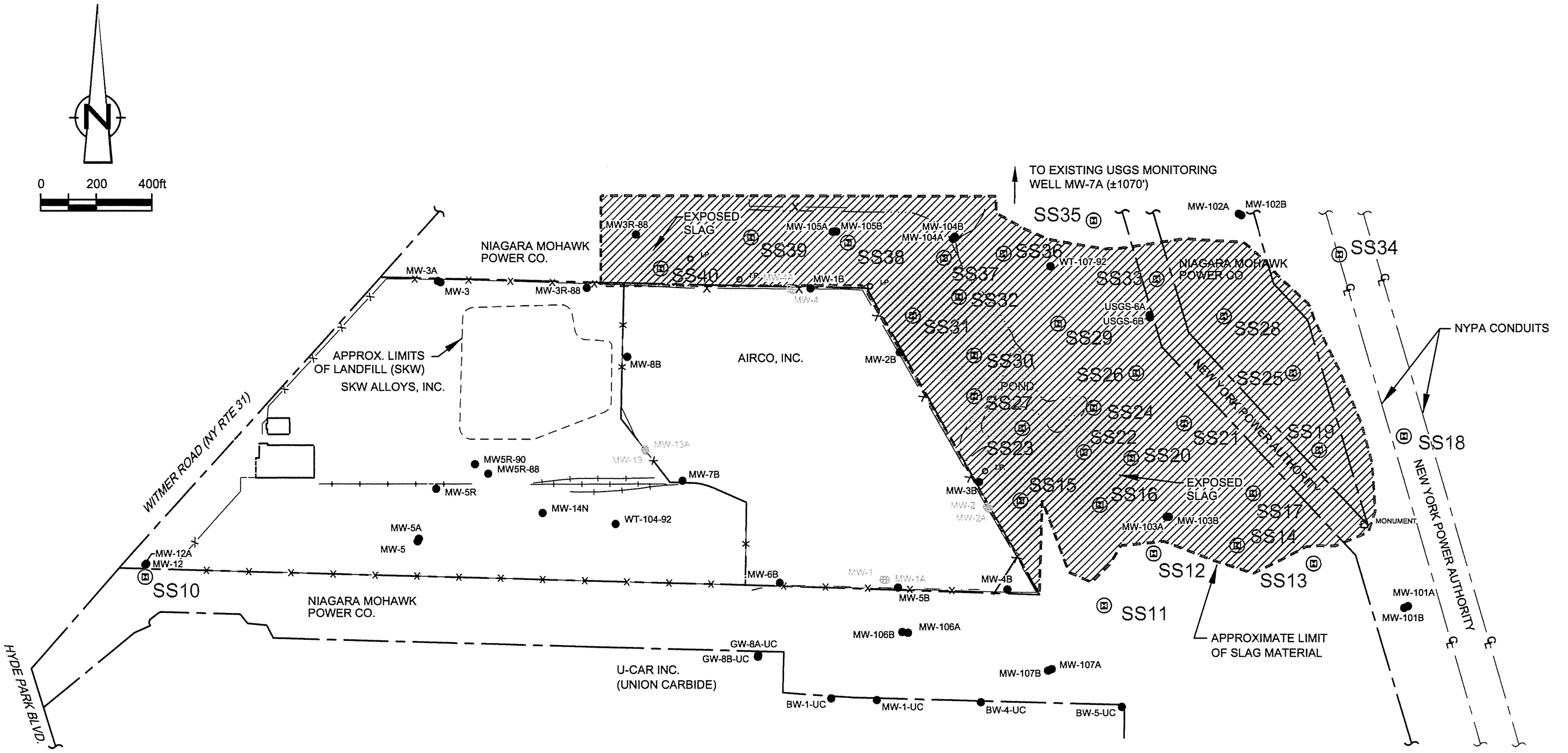
1. BASE MAP DIGITIZED FROM 'VANADIUM SITE NO. 932001' PROVIDED BY LU ENGINEERS, 2230 PENFIELD RD., PENFIELD, NY, (716) 377-1450. MAP DATA DIGITIZED FROM 'SITE PLAN AND SAMPLING LOCATION' PREPARED BY ABB ENVIRONMENTAL.
2. SITE FEATURES AND SAMPLE LOCATIONS ARE APPROXIMATE.

SOURCE:

NIAGARA MOHAWK POWER CORPORATION, VANADIUM CORPORATION OF AMERICA SITE, NIAGRAFALLS, NY. FIGURES 1, 2 AND 3, BBL ENGINEERS & SCIENTISTS. 12/8/2000

figure 5.3

PROPOSED NEW GROUNDWATER MONITORING WELL LOCATIONS
VANADIUM CORPORATION OF AMERICA SITE
Niagara Falls, NY



LEGEND

— - —	PROPERTY LINE
—x—	FENCE
—+—+—	RAILROAD
NYPA	NEW YORK POWER AUTHORITY
●	EXISTING MONITORING WELL LOCATION
⊕ MW-1	MONITORING WELL NO LONGER EXISTS IN FIELD
⊡	PROPOSED SURFACE SOIL SAMPLING LOCATION

NOTES:

1. BASE MAP DIGITIZED FROM 'VANADIUM SITE NO. 932001' PROVIDED BY LU ENGINEERS, 2230 PENFIELD RD., PENFIELD, NY, (716) 377-1450. MAP DATA DIGITIZED FROM 'SITE PLAN AND SAMPLING LOCATION' PREPARED BY ABB ENVIRONMENTAL.
2. SITE FEATURES AND SAMPLE LOCATIONS ARE APPROXIMATE.

SOURCE:

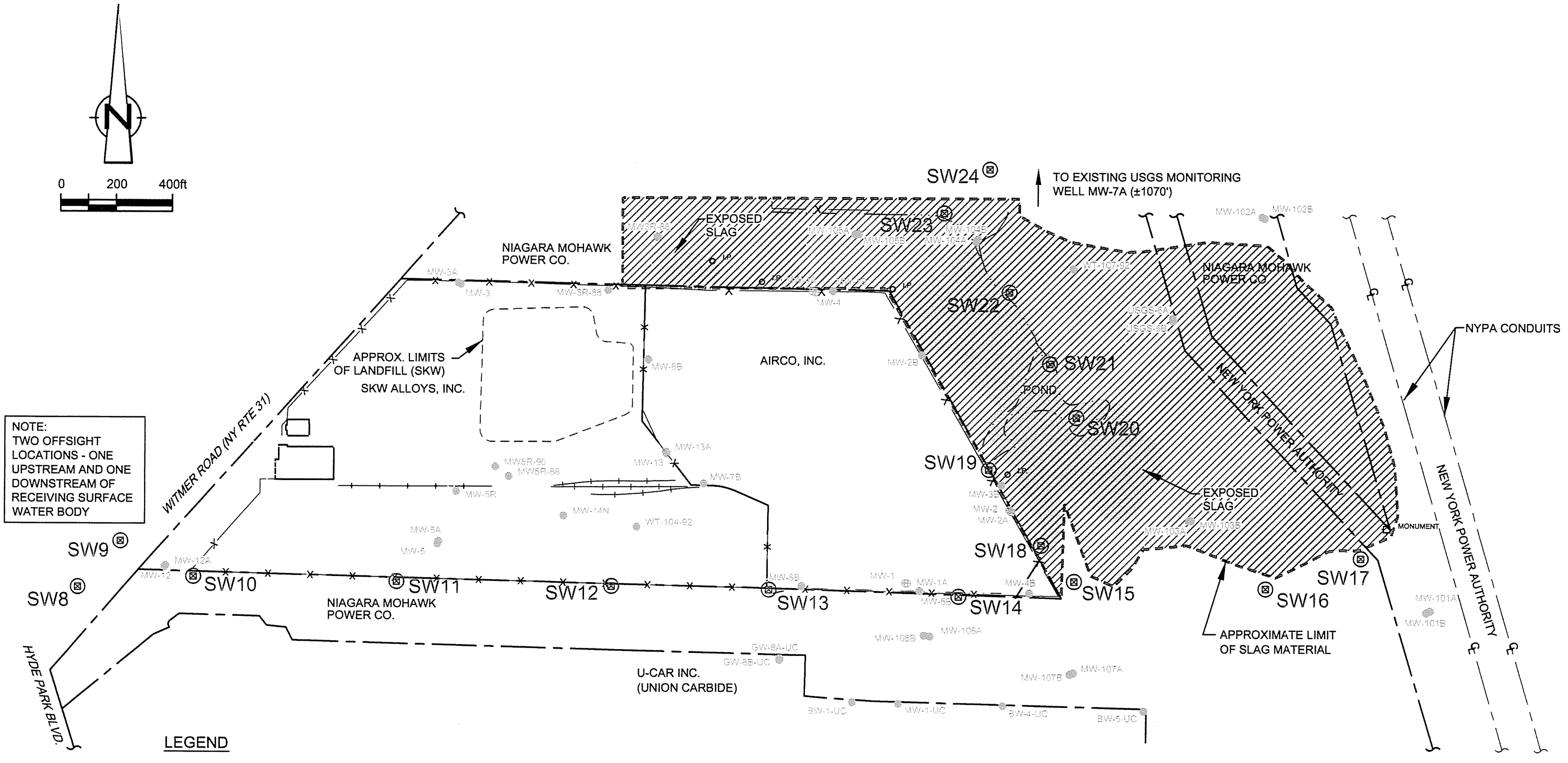
NIAGARA MOHAWK POWER CORPORATION, VANADIUM CORPORATION OF AMERICA SITE, NIAGRAFALLS, NY. FIGURES 1, 2 AND 3, BBL ENGINEERS & SCIENTISTS. 12/8/2000

figure 5.4

PROPOSED SURFACE SOIL SAMPLING LOCATIONS
VANADIUM CORPORATION OF AMERICA SITE
Niagara Falls, NY

CRA

19867-00(HINT002)GN-WA010 FEB 05/2003



NOTE:
TWO OFFSIGHT LOCATIONS - ONE UPSTREAM AND ONE DOWNSTREAM OF RECEIVING SURFACE WATER BODY

LEGEND

— - —	PROPERTY LINE
—x—	FENCE
—+—	RAILROAD
NYPA	NEW YORK POWER AUTHORITY
●	EXISTING MONITORING WELL LOCATION
⊠	PROPOSED SURFACE WATER / SEDIMENT SAMPLING LOCATION
⊖ MW-1	MONITORING WELL NO LONGER EXISTS IN FIELD

NOTES:

1. BASE MAP DIGITIZED FROM 'VANADIUM SITE NO. 932001' PROVIDED BY LU ENGINEERS, 2230 PENFIELD RD., PENFIELD, NY, (716) 377-1450. MAP DATA DIGITIZED FROM 'SITE PLAN AND SAMPLING LOCATION' PREPARED BY ABB ENVIRONMENTAL.
2. SITE FEATURES AND SAMPLE LOCATIONS ARE APPROXIMATE.

SOURCE:

NIAGARA MOHAWK POWER CORPORATION, VANADIUM CORPORATION OF AMERICA SITE, NIAGRAFALLS, NY. FIGURES 1, 2 AND 3, BBL ENGINEERS & SCIENTISTS. 12/8/2000

figure 5.5

PROPOSED SURFACE WATER / SEDIMENT SAMPLING LOCATIONS
VANADIUM CORPORATION OF AMERICA SITE
Niagara Falls, NY

19867-00(HINT002)GN-WA011 FEB 05/2003

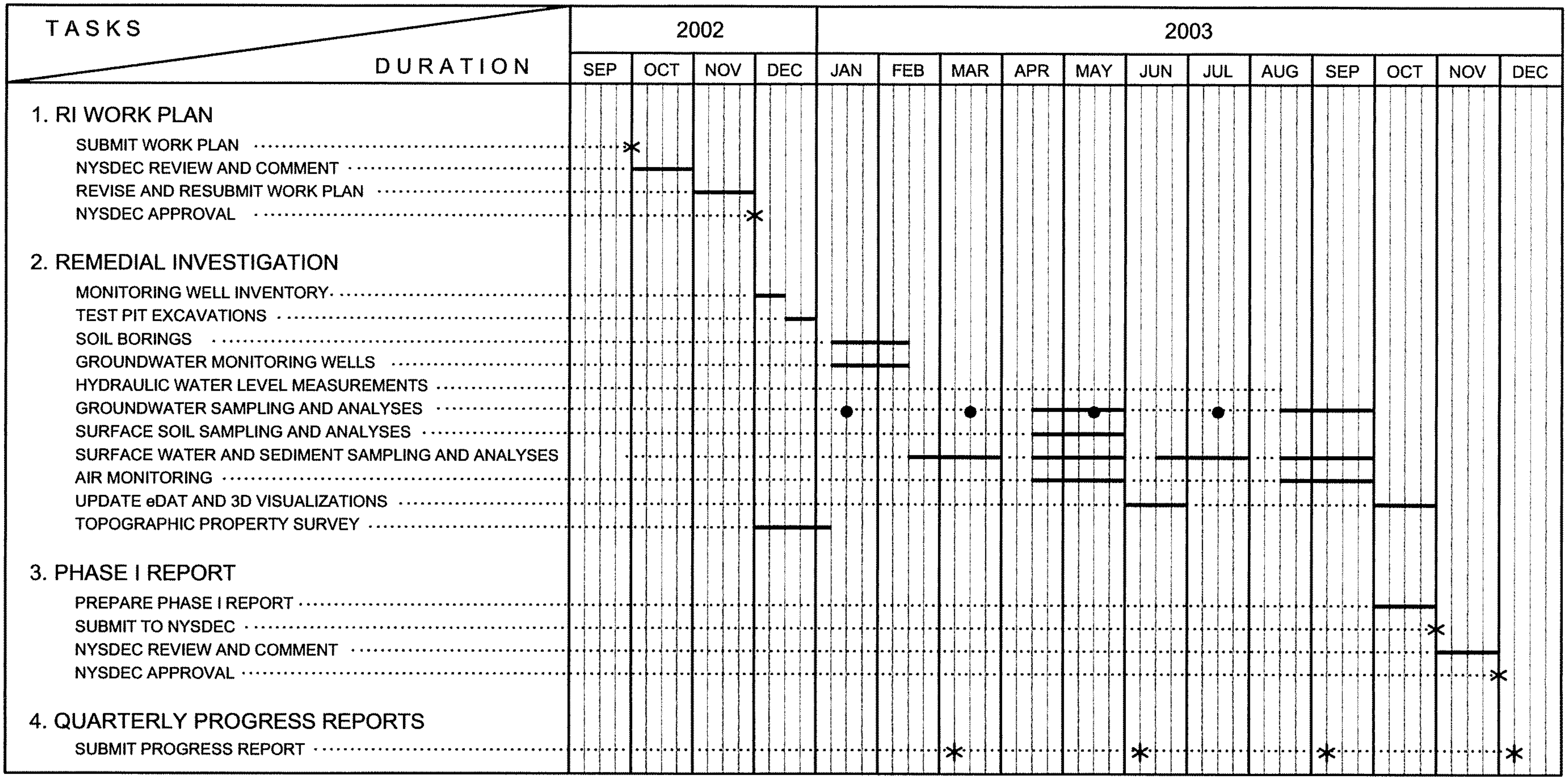


figure 7.1

SCHEDULE
VANADIUM CORPORATION OF AMERICA SITE
Niagara Falls, NY

TABLE 2.1

PREVIOUS INVESTIGATIONS AT OU3
PHASE 1 WORK PLAN
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Year	*Consultant*	*Previous Investigation*
2001	Golder Associates Inc.	**Groundwater Well Sampling and Analyses** - 8 existing monitoring wells sampled for static water levels - 7 groundwater samples taken and sampled for TAL metals and hexavalent chromium
2001	New York State Department of Environmental Conservation Division of Hazardous Waste Remediation	**Soil Borings** - 43 soil borings were drilled - 16 selected locations were sampled **Surface Soil Samples** - 8 samples were collected - All 8 analyzed for SVOCs and hexavalent chromium - 3 analyzed for metals **Waste Samples** - 4 samples were collected - Analyzed for VOCs, SVOCs, metals, hexavalent chromium, TCLP, ignitability, corrosivity, and reactivity **Sub-soil Samples** - 4 samples were collected - Analyzed for VOCs, SVOCs, metals, and hexavalent chromium **Monitoring Wells** - 2 pairs of groundwater monitoring wells installed, each pair containing one deep overburden and one upper bedrock well - Groundwater levels and samples were collected from these wells, along with 3 other existing groundwater monitoring wells - Analyzed for VOCs, SVOCs, metals, and hexavalent chromium

TABLE 2.1

PREVIOUS INVESTIGATIONS AT OU3
PHASE 1 WORK PLAN
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Year	*Consultant*	*Previous Investigation*
1996	New York State Department of Environmental Conservation Division of Environmental Remediation	**Monitoring Wells** - 4 pairs of groundwater monitoring wells installed, each well pair containing one overburden and one bedrock groundwater monitoring well - 9 groundwater samples taken - General water quality parameter testing - Analyzed for TCL VOCs, TCL SVOCs, TAL metals, and hexavalent chromium **Surface Water and Sediment** - 1 surface water sample and 1 sediment sample - Both samples analyzed for TCL VOCs, TCL SVOCs, TAL metals, and hexavalent chromium **Soil Borings** - 12 soil borings were drilled and sampled **Surface Soil Samples** - 17 surface soil and exposed surface waste samples - 5 analyzed for TCL volatiles - 17 analyzed for TCL semi-volatiles - 5 analyzed for TAL metals - 11 analyzed for hexavalent chromium **Waste Samples** - 18 samples collected - Analyzed for TCL VOCs, TCL SVOCs, TAL metals, and hexavalent chromium

TABLE 2.1

PREVIOUS INVESTIGATIONS AT OU3
PHASE 1 WORK PLAN
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Year	*Consultant*	*Previous Investigation*
		Sub-soil Samples - 16 subsurface soil samples from the native soils beneath the waste - Analyzed for TCL VOCs, TCL SVOCs, TAL metals, and hexavalent chromium **Waste Pile Examination** - 2 test pits: 1 sample from the waste material, 1 sample from the fill material - Both samples analyzed for TCL VOCs, TCL SVOCs, TAL metals, and hexavalent chromium **Air Monitoring** - Air monitoring conducted during soil borings, well drilling and test pit excavation - Monitored organic vapor concentrations and airborne dust concentrations

TABLE 3.1

STRATIGRAPHIC SUMMARY OF SOIL BORINGS, TEST PITS, AND MONITORING WELLS
PHASE 1 WORK PLAN
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

	Stratigraphic Unit Thicknesses (feet)			
Soil Boring/Monitoring Well ID	*Fill*	*Glaciolacustrine Deposits*	*Glacial Till*	*Depth To Top of Bedrock (feet bgs)*
B-1	14.8	- -	- -	- -
B-2	18.3	- -	- -	- -
B-3	16.8	- -	- -	- -
B-6	8.5	12.0	2.5	23.0
B-7	9.0	5.5	3.5	18.0
B-8	2.5	18.5	0.6	21.6
B-9	4.5	12.0	4.2	20.7
B-10	1.3	11.7	13.0	16.1
B-11	2.8	6.2	3.8	12.8
B-14	1.9	12.1	4.8	18.8
B-15	2.8	9.5	5.2	17.5
B-16	1.0	14.5	1.0	16.5
B-17	2.0	14.0	3.3	19.3
B-18	5.0	12.5	1.3	18.8
B-19	2.8	13.7	0.6	17.1
BW1-86	14.5	3.5	1.5	19.5
BW4-86	- -	- -	1.9	11.4
BW5-86	0.0	9.2	0.7	9.9
MW-1B	6.0	13.5	4.5	24.0
MW-2B	2.0	12.0	12.5	26.5
MW-3B	4.5	12.0	14.5	31.0
MW-4B	4.0	12.0	7.5	23.5
MW-5B	3.0	7.0	14.3	24.3
MW-101A	6.0	9.0	0.7	15.7
MW-102B	0.0	9.0	2.0	11.0
MW-103B	1.0	14.0	2.5	17.5
MW-104B	8.0	10.0	2.2	20.2
MW-105B	6.0	4.0	5.2	15.2
MW-106A	- -	11.0	- -	- -
MW-106B	- -	11.1	- -	14.0
MW-107A	- -	9.3	- -	- -
MW-107B	- -	9.3	- -	12.0
MW3R-88	2.0	4.0	3.7	9.7
SB-10A	21.2	- -	- -	- -
SB-11B	18.0	- -	- -	- -
SB-12B	18.0	- -	- -	- -
SB-1B	6.0	2.0	2.7	10.7
SB-2B	5.2	- -	- -	- -
SB-3A	9.8	- -	- -	- -
SB-4B	7.3	- -	- -	- -

TABLE 3.1

STRATIGRAPHIC SUMMARY OF SOIL BORINGS, TEST PITS, AND MONITORING WELLS
PHASE 1 WORK PLAN
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

	Stratigraphic Unit Thicknesses (feet)			
Soil Boring/Monitoring Well ID	*Fill*	*Glaciolacustrine Deposits*	*Glacial Till*	*Depth To Top of Bedrock (feet bgs)*
SB-5C	--	--	--	11.0
SB-6B	8.1	--	--	--
SB-7B	15.4	--	--	--
SB-8B	17.2	--	--	--
SB-9A	17.8	--	--	--

TABLE 3.2

MONITORING WELL COMPLETION DETAILS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Well ID	*Total Boring Depth (ft bgs)*	*Screened Interval (ft bgs)*	*Screened Unit*
MW1A	- -	2.5 -- 4.5	reddish brown silty clay
MW2A	- -	5.5 -- 7.5	brownish gray silty clay
MW3A	- -	8 -- 10	reddish brown sand
MW4A	- -	8 -- 10	reddish brown silty clay
MW12A	5	2.5 -- 4.5	reddish brown slity clay
MW1-UC	20.5	16.3 -- 18.3	glacial till
MW1	11.1	9.1 -- 11.1	glacial till
MW2	14.5	12 -- 14	glacial till
MW3	15.2	12 -- 14	reddish brown sand; glacial till
MW4	16.7	14 -- 16	glacial till
MW12	18	15.5 -- 17.5	reddish brown sandy silt; glacial till
MW3R-88	9.7	4.7 -- 9.7	reddish brown silty sand; glacial till
MW103A	17	12 -- 17	gray clay; reddish brown silty clay; glacial till
MW104A	19	14 -- 19	reddish brown silty clay; glacial till
MW105A	14	9 -- 14	reddish brown silty clay; glacial till
MW-106A	11	6 -- 11	reddish brown silty clay
MW-107A	9.5	4.5 -- 9.5	reddish brown clayey silt
GW-8A-UC	17.5	12.4 -- 17.4	reddish brown silty clay; glacial till
MW101B	64	54 -- 64	Lockport Dolomite Group
MW102B	52.8	42.8 -- 52.8	Lockport Dolomite Group
MW103B	33	23 -- 33	Lockport Dolomite Group
MW104B	36	26 -- 36	Lockport Dolomite Group
MW105B	30	20 -- 30	Lockport Dolomite Group
MW-106B	23	15 -- 23	Lockport Dolomite Group
MW-107B	22.5	14.5 -- 22.5	Lockport Dolomite Group
BW1-86-UC	34.5	19.5 -- 34.5	Lockport Dolomite Group
BW4-86-UC	25	11.4 -- 25	Lockport Dolomite Group
BW5-86-UC	24.9	10 -- 24.9	Lockport Dolomite Group

TA 4.1

HISTORICAL SURFACE SOIL ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:* *Sample Matrix Code:*		*Eastern USA Background Concentration (mg/kg)*	*TAGM $^{(a)}$ Values (mg/kg)*	*A-2-GRID* *A-2* *3/1/2000* *NiMO/NMPA* *SUSO*	*A-5-GRID* *A-5* *3/1/2000* *NiMO/NMPA* *SUSO*	*B-1-GRID* *B-1* *3/1/2000* *NiMO/NMPA* *SUSO*	*B-4A-GRID* *B-4A* *3/1/2000* *NiMO/NMPA* *SUSO*	*C-0-GRID* *C-0* *3/1/2000* *NiMO/NMPA* *SUSO*
Parameters	***Units***							
Metals								
Aluminum	mg/Kg	33,000	SB	--	--	5030 *	--	9200 *
Antimony	mg/Kg	NS	SB	--	--	1.7 N	--	ND (1.5) N
Arsenic	mg/Kg	3 - 12	7.5 or SB	--	--	4.6	--	6.7
Barium	mg/Kg	15 - 600	300 or SB	--	--	138 E	--	96.0 E
Beryllium	mg/Kg	0 - 1.75	0.16 or SB	--	--	ND (0.28)	--	0.44 B
Cadmium	mg/Kg	0.1 -1.0	1 or SB	--	--	0.61 B	--	ND (0.17)
Calcium	mg/Kg	130 - 35,000	SB	--	--	21100	--	31600 *
Chromium	mg/Kg	1.5 - 40	10 or SB	--	--	48 E*	--	38.7 E*
Chromium, Hexavalent	mg/Kg	NS	NS	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)
Cobalt	mg/Kg	2.5 or 60	30 or SB	--	--	4.7 B	--	6.9 B
Copper	mg/Kg	1.0 - 50	25 or SB	--	--	104	--	58.7
Iron	mg/Kg	2,000 - 550,000	2,000 or SB	--	--	17300 E*	--	16700 E*
Lead	mg/Kg	NS	SB	--	--	167	--	57.9
Magnesium	mg/Kg	100 - 5,000	SB	--	--	11000 *	--	13200 *
Manganese	mg/Kg	50 - 5,000	SB	--	--	336 EN	--	433 EN
Mercury	mg/Kg	0.001 - 0.2	0.1	--	--	11.8	--	ND (0.12)
Nickel	mg/Kg	0.5 - 25	13 or SB	--	--	40.9 *	--	31.7 *
Potassium	mg/Kg	8,500 - 43,000	SB	--	--	798 BE	--	2280 E
Selenium	mg/Kg	0.1 - 3.9	2 or SB	--	--	ND (1.4)	--	ND (1.2)
Silver	mg/Kg	NS	SB	--	--	0.66 B	--	ND (0.37)
Sodium	mg/Kg	6,000 - 8,000	SB	--	--	1090 B	--	818 B
Thallium	mg/Kg	NS	SB	--	--	ND (2.3)	--	ND (2.0)
Vanadium	mg/Kg	1.0 - 300	150 or SB	--	--	17.6	--	25.3
Zinc	mg/Kg	9.0 - 50.0	20 or SB	--	--	323 E	--	133 E
General Chemistry								
pH Corrosivity	s.u.	NS	NS	--	--	--	--	--

TA 4.1

HISTORICAL SURFACE SOIL ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:* *Sample Matrix Code:*		*Eastern USA Background Concentration (mg/kg)*	*TAGM$^{(a)}$ Values (mg/kg)*	*C-5-GRID* *C-5* *3/1/2000* *NiMO/NMPA* *SUSO*	*C-12-GRID* *C-12* *3/1/2000* *NiMO/NMPA* *SUSO*	*Green Surface Waste* *GREEN SURFACE WASTE* *11/7/1996* *NiMO/NMPA* *SUSO*	*MOUND1-GRID* *MOUND1* *3/1/2000* *NiMO/NMPA* *SUSO*
Parameters	***Units***						
Metals							
Aluminum	mg/Kg	33,000	SB	15600 *	--	49600	21800 *
Antimony	mg/Kg	NS	SB	ND (1.7) N	--	ND (1.2)	ND (1.6) N
Arsenic	mg/Kg	3 - 12	7.5 or SB	18.0	--	8.4 *	6.0
Barium	mg/Kg	15 - 600	300 or SB	904 E	--	1410 *	108 E
Beryllium	mg/Kg	0 - 1.75	0.16 or SB	0.79 B	--	3.5	0.80 B
Cadmium	mg/Kg	0.1 -1.0	1 or SB	0.65 B	--	ND (0.51)	ND (0.19)
Calcium	mg/Kg	130 - 35,000	SB	7670 *	--	--	2450 *
Chromium	mg/Kg	1.5 - 40	10 or SB	63.8 E*	--	11.4	65.4 E*
Chromium, Hexavalent	mg/Kg	NS	NS	ND (1.0)	ND (1.0)	0.18 N	ND (1.0)
Cobalt	mg/Kg	2.5 or 60	30 or SB	88.9	--	ND (0.83)	8.8 B
Copper	mg/Kg	1.0 - 50	25 or SB	100	--	3.7 B	27.0
Iron	mg/Kg	2,000 - 550,000	2,000 or SB	48200 E*	--	1890	24100 E*
Lead	mg/Kg	NS	SB	166	--	18.0 *	44.2
Magnesium	mg/Kg	100 - 5,000	SB	3740 *	--	31700	4140 *
Manganese	mg/Kg	50 - 5,000	SB	8950 EN	--	24400 E*	566 EN
Mercury	mg/Kg	0.001 - 0.2	0.1	ND (0.12)	--	ND (0.05)	ND (0.14)
Nickel	mg/Kg	0.5 - 25	13 or SB	54.1 *	--	ND (1.2)	31.9 *
Potassium	mg/Kg	8,500 - 43,000	SB	2220 E	--	8240	2950 E
Selenium	mg/Kg	0.1 - 3.9	2 or SB	ND (1.4)	--	15.9	ND (1.4)
Silver	mg/Kg	NS	SB	1.7 B	--	7.6 N	0.50 B
Sodium	mg/Kg	6,000 - 8,000	SB	900 B	--	850 B	577 B
Thallium	mg/Kg	NS	SB	ND (2.3)	--	18.8	ND (2.2)
Vanadium	mg/Kg	1.0 - 300	150 or SB	25.3	--	3.9 B	38.9
Zinc	mg/Kg	9.0 - 50.0	20 or SB	633 E	--	12.7	85.7 E
General Chemistry							
pH Corrosivity	s.u.	NS	NS	--	--	--	--

TA 4.1

HISTORICAL SURFACE SOIL ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:* *Sample Matrix Code:*		*Eastern USA Background Concentration (mg/kg)*	*TAGM $^{(a)}$ Values (mg/kg)*	*MW-101A* *MW-101* *11/7/1996* *NYPA* *STW*	*MW-102A* *MW-102* *11/7/1996* *NiMO/NMPA* *SUSO*	*MW-103* *MW-103* *11/7/1996* *NiMO/NMPA* *SUSO*	*MW-104A* *MW-104* *11/7/1996* *NiMO/NMPA* *SUSO*	*MW-105A* *MW-105* *11/7/1996* *NiMO/NMPA* *SUSO*
Parameters	***Units***							
Metals								
Aluminum	mg/Kg	33,000	SB	7470	11200	12400	25600	8830
Antimony	mg/Kg	NS	SB	ND (2.7) N	1.7 BJ	24.6	15.1 B	5.9 B
Arsenic	mg/Kg	3 - 12	7.5 or SB	2.5 B	4.8	6.2	5.8	6.3
Barium	mg/Kg	15 - 600	300 or SB	41.6 B	121 E	129 E	112 E	118 E
Beryllium	mg/Kg	0 - 1.75	0.16 or SB	0.29 B	0.64 BJ	0.24 B	0.37 B	0.43 B
Cadmium	mg/Kg	0.1 -1.0	1 or SB	1.5	2.5	1.5	2.7	3.1
Calcium	mg/Kg	130 - 35,000	SB	--	--	--	--	--
Chromium	mg/Kg	1.5 - 40	10 or SB	9.0 E	37.9 N*	685 N*	436 N*	168 N*
Chromium, Hexavalent	mg/Kg	NS	NS	--	0.53 E*	0.68 E*	0.77 E*	9.1 E*
Cobalt	mg/Kg	2.5 or 60	30 or SB	6.8 B	11.5 B	8.7 B	7.4 B	7.2 B
Copper	mg/Kg	1.0 - 50	25 or SB	16.3	23.1 E	38.1 E	33.7 E	36.0 E
Iron	mg/Kg	2,000 - 550,000	2,000 or SB	12300	21200	8780	13600	25600
Lead	mg/Kg	NS	SB	6.5 N*	27 *	40.9 *	41.4 *	187 *
Magnesium	mg/Kg	100 - 5,000	SB	25000	5400	33700	36900	35900
Manganese	mg/Kg	50 - 5,000	SB	628	726 *	654 *	544 *	744 *
Mercury	mg/Kg	0.001 - 0.2	0.1	ND (0.13)	ND (0.07)	ND (0.05)	ND (0.07)	0.57
Nickel	mg/Kg	0.5 - 25	13 or SB	14.2	27.4	46.7	19.7	24.3
Potassium	mg/Kg	8,500 - 43,000	SB	840 B	1450 BE	ND (44.6) E	558 BE	792 BE
Selenium	mg/Kg	0.1 - 3.9	2 or SB	ND (1.1)	2.4	ND (1.3)	2.1	ND (1.0)
Silver	mg/Kg	NS	SB	ND (0.27) N	ND (0.34) N	ND (0.31) N	ND (0.34) N	ND (0.25) N
Sodium	mg/Kg	6,000 - 8,000	SB	ND (134)	ND (39.5)	ND (36.0)	ND (39.9)	ND (28.8)
Thallium	mg/Kg	NS	SB	ND (0.27) NW	ND (0.95)	ND (0.86)	ND (0.96)	ND (0.69)
Vanadium	mg/Kg	1.0 - 300	150 or SB	13.7	26.2 E	34.2 E	30.2 E	21.3 E
Zinc	mg/Kg	9.0 - 50.0	20 or SB	184	96.6	116	197	338
General Chemistry								
pH Corrosivity	s.u.	NS	NS	8.0	--	--	--	--

TA[illegible] 4.1

HISTORICAL SURFACE SOIL ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*Eastern USA Background Concentration (mg/kg)*	*TAGM$^{(a)}$ Values (mg/kg)*	*SB-3A*	*SB-9A*	*SB-10A*	*SS-1*	*SS-2*
Sample ID:				*SB-3A*	*SB-9A*	*SB-10A*	*SS-1*	*SS-2*
Sample Date:				*11/7/1996*	*11/7/1996*	*11/7/1996*	*11/7/1996*	*11/7/1996*
Location Description:				*NiMO/NMPA*	*NiMO/NMPA*	*NYPA*	*NiMO/NMPA*	*NiMO/NMPA*
Sample Matrix Code:				*SUSO*	*SUSO*	*SUSO*	*SUSO*	*SUSO*
Parameters	***Units***							
Metals								
Aluminum	mg/Kg	33,000	SB	16600	23200	34000	13900	13100
Antimony	mg/Kg	NS	SB	339	ND (5.5)	ND (1.4)	33.0	46.1
Arsenic	mg/Kg	3 - 12	7.5 or SB	ND (0.47)	8.2	21.9 *	2.4 B	ND (0.57)
Barium	mg/Kg	15 - 600	300 or SB	163	157	100 *	313 E	35.3 B
Beryllium	mg/Kg	0 - 1.75	0.16 or SB	ND (0.05)	0.82 B	0.68 B	0.24 B	ND (0.05)
Cadmium	mg/Kg	0.1 -1.0	1 or SB	6.2	3.8	ND (0.62)	0.93 B	ND (0.57)
Calcium	mg/Kg	130 - 35,000	SB	--	--	--	--	--
Chromium	mg/Kg	1.5 - 40	10 or SB	11800	59.7	42.0	1000 N*	1640
Chromium, Hexavalent	mg/Kg	NS	NS	--	0.19	0.15 BN	--	24.6
Cobalt	mg/Kg	2.5 or 60	30 or SB	72.3	21.5	13.0 B	5.1 B	3.4 B
Copper	mg/Kg	1.0 - 50	25 or SB	175 E	25.6 E	39.9	28.1 E	8.8 E
Iron	mg/Kg	2,000 - 550,000	2,000 or SB	51300	31500	24500	5620	2670
Lead	mg/Kg	NS	SB	52.2	30.0	23.0 *	26.9 *	7.5
Magnesium	mg/Kg	100 - 5,000	SB	19400	5980	11100	57900	70900
Manganese	mg/Kg	50 - 5,000	SB	4240 *	1190 *	627 E	431 *	375 *
Mercury	mg/Kg	0.001 - 0.2	0.1	ND (0.05) N	ND (0.06) N	ND (0.07)	ND (0.05)	ND (0.06) N
Nickel	mg/Kg	0.5 - 25	13 or SB	5160	30.5	29.9	24.6	1.6 B
Potassium	mg/Kg	8,500 - 43,000	SB	ND (36.1) E	4090 E	2580	ND (44.7) E	ND (43.3) E
Selenium	mg/Kg	0.1 - 3.9	2 or SB	8.8	2.0	3.3	1.3 B	ND (1.2)
Silver	mg/Kg	NS	SB	ND (0.23) N	ND (0.24) N	ND (0.30) N	ND (0.31) N	ND (0.27) N
Sodium	mg/Kg	6,000 - 8,000	SB	ND (29.1)	190 B	298 B	ND (36.1)	ND (34.9)
Thallium	mg/Kg	NS	SB	0.82 B	ND (0.73)	ND (0.89)	ND (0.87)	ND (0.81)
Vanadium	mg/Kg	1.0 - 300	150 or SB	151	51.4	32.1	67.7 E	38.1
Zinc	mg/Kg	9.0 - 50.0	20 or SB	323	150	119	73.1	76.7
General Chemistry								
pH Corrosivity	s.u.	NS	NS	--	--	--	--	--

TA 4.1

HISTORICAL SURFACE SOIL ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:* *Sample Matrix Code:*		*Eastern USA Background Concentration (mg/kg)*	*TAGM ^(a)^ Values (mg/kg)*	SS-3 SS-3 11/7/1996 NiMO/NMPA SUSO	SS-4 SS-4 11/7/1996 NiMO/NMPA SUSO	SS-5 SS-5 11/7/1996 NiMO/NMPA SUSO	SS-6 SS-6 11/7/1996 NiMO/NMPA SUSO	SS-7 SS-7 11/7/1996 NiMO/NMPA SUSO
Parameters	***Units***							
Metals								
Aluminum	mg/Kg	33,000	SB	113000	14800	22500	18000	21300
Antimony	mg/Kg	NS	SB	86.4	64.9	ND (7.2)	37.5	12.9 B
Arsenic	mg/Kg	3 - 12	7.5 or SB	5.0	ND (0.58)	12.6	ND (0.59)	3.3
Barium	mg/Kg	15 - 600	300 or SB	264	51.4 B	207	56.6	111
Beryllium	mg/Kg	0 - 1.75	0.16 or SB	0.35 B	ND (0.06)	0.76 B	0.09 B	0.62 B
Cadmium	mg/Kg	0.1 -1.0	1 or SB	141	0.74 B	4.0	0.60 B	2.8
Calcium	mg/Kg	130 - 35,000	SB	--	--	--	--	--
Chromium	mg/Kg	1.5 - 40	10 or SB	1300	2260	119	1330	459
Chromium, Hexavalent	mg/Kg	NS	NS	ND (0.003)	1.4	--	--	--
Cobalt	mg/Kg	2.5 or 60	30 or SB	20.2	536 B	13.5 B	4.3 B	15.3
Copper	mg/Kg	1.0 - 50	25 or SB	5420 E	19.0 E	55.8 E	10.5 E	16.0 E
Iron	mg/Kg	2,000 - 550,000	2,000 or SB	27600	4190	25100	3990	22600
Lead	mg/Kg	NS	SB	1760	29.1	67.1	8.1	15.1
Magnesium	mg/Kg	100 - 5,000	SB	20700	67300	5270	73100	21300
Manganese	mg/Kg	50 - 5,000	SB	1470 *	456 *	1220 *	358 *	1200 *
Mercury	mg/Kg	0.001 - 0.2	0.1	ND (0.05) N	ND (0.06) N	0.30 N	ND (0.06) N	ND (0.06) N
Nickel	mg/Kg	0.5 - 25	13 or SB	454	12.5	51.0	6.6 B	15.8
Potassium	mg/Kg	8,500 - 43,000	SB	799 BE	ND (44.1) E	2950 E	ND (45.0) E	2270 E
Selenium	mg/Kg	0.1 - 3.9	2 or SB	5.8	1.3 B	4.0	ND (1.3)	2.1
Silver	mg/Kg	NS	SB	4.2 N	ND (0.28) N	ND (0.31) N	ND (0.28) N	ND (0.24) N
Sodium	mg/Kg	6,000 - 8,000	SB	129 B	ND (35.6)	ND (40.6)	ND (36.2)	ND (30.7)
Thallium	mg/Kg	NS	SB	ND (0.64)	ND (0.83)	ND (0.94)	ND (0.84)	ND (0.71)
Vanadium	mg/Kg	1.0 - 300	150 or SB	26.9	71.2	49.3	42.9	46.9
Zinc	mg/Kg	9.0 - 50.0	20 or SB	1400	77.5	162	66.2	91.6
General Chemistry								
pH Corrosivity	s.u.	NS	NS	--	--	--	--	--

TA 4.1

HISTORICAL SURFACE SOIL ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

		Eastern USA Background Concentration (mg/kg)	*TAGM $^{(a)}$ Values (mg/kg)*					
Sample Location:				*SS-8*	*SS-9*	*WT-105-92*	*WT-106-92*	*WT-106-92*
Sample ID:				*SS-8*	*SS-9*	*WT-105*	*WT-106*	*WT-106*
Sample Date:				*11/7/1996*	*11/7/1996*	*1/1/1989*	*1/1/1989*	*1/1/1989*
Location Description:				*NiMO/NMPA*	*NiMO/NMPA*	*NYPA/PASNY*	*NYPA/PASNY*	*NYPA/PASNY*
Sample Matrix Code:				*SUSO*	*SUSO*	*ST*	*ST*	*ST* *Duplicate*
Parameters	***Units***							
Metals								
Aluminum	mg/Kg	33,000	SB	17200	19200	5960	11900	16700
Antimony	mg/Kg	NS	SB	29.0	12.9 B	22.3	38.1	60.6
Arsenic	mg/Kg	3 - 12	7.5 or SB	ND (0.51)	0.67 B	24.2	ND (2)	ND (2)
Barium	mg/Kg	15 - 600	300 or SB	80.8	88.7	207	31.4	27.8
Beryllium	mg/Kg	0 - 1.75	0.16 or SB	0.36 B	0.44 B	1.1	0.44	0.86
Cadmium	mg/Kg	0.1 -1.0	1 or SB	1.9	2.1	ND (1)	ND (1)	ND (1)
Calcium	mg/Kg	130 - 35,000	SB	--	--	5370	162000	203000
Chromium	mg/Kg	1.5 - 40	10 or SB	1040	489	R	R	R
Chromium, Hexavalent	mg/Kg	NS	NS	1.6	--	0.50	51.4	66.2
Cobalt	mg/Kg	2.5 or 60	30 or SB	7.6 B	8.1 B	13.0 J	3.7 J	5.0 J
Copper	mg/Kg	1.0 - 50	25 or SB	14.0 E	14.4 E	1640	7.7	9.6
Iron	mg/Kg	2,000 - 550,000	2,000 or SB	12400	14200	30200	2390	3360
Lead	mg/Kg	NS	SB	10.8	11.7	4.2 J	3.9 J	6.8 J
Magnesium	mg/Kg	100 - 5,000	SB	40100	32900	354	56600	76900
Manganese	mg/Kg	50 - 5,000	SB	566 *	612 *	7190	334	354
Mercury	mg/Kg	0.001 - 0.2	0.1	ND (0.05) N	ND (0.06) N	ND (0.04)	ND (0.04)	ND (0.04)
Nickel	mg/Kg	0.5 - 25	13 or SB	10.5	10.7	199	18.0	23.5
Potassium	mg/Kg	8,500 - 43,000	SB	1560 E	1930 E	ND (1000)	ND (1000)	ND (1000)
Selenium	mg/Kg	0.1 - 3.9	2 or SB	ND (1.1)	2.3	ND (1)	ND (1)	ND (1)
Silver	mg/Kg	NS	SB	ND (0.24) N	ND (0.25) N	R	ND (2)	ND (2)
Sodium	mg/Kg	6,000 - 8,000	SB	ND (31.1)	ND (32.5)	836	215	213
Thallium	mg/Kg	NS	SB	ND (0.72)	ND (0.76)	--	--	--
Vanadium	mg/Kg	1.0 - 300	150 or SB	39.9	38.3	5.4	42.7	69.0
Zinc	mg/Kg	9.0 - 50.0	20 or SB	57.1	77.9	19.2 J	9.7 J	12.1 J
General Chemistry								
pH Corrosivity	s.u.	NS	NS	--	--	6.35	10.12	10.51

TA 4.1

HISTORICAL SURFACE SOIL ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*Eastern USA Background Concentration (mg/kg)*	*TAGM [a] Values (mg/kg)*	*WT-107-92*
Sample ID:				*WT-107*
Sample Date:				*1/1/1989*
Location Description:				*NYPA/PASNY*
Sample Matrix Code:				*ST*
Parameters	***Units***			
Metals				
Aluminum	mg/Kg	33,000	SB	15000
Antimony	mg/Kg	NS	SB	23.5 J
Arsenic	mg/Kg	3 - 12	7.5 or SB	ND (2)
Barium	mg/Kg	15 - 600	300 or SB	36.2 J
Beryllium	mg/Kg	0 - 1.75	0.16 or SB	0.77
Cadmium	mg/Kg	0.1 -1.0	1 or SB	2.0 J
Calcium	mg/Kg	130 - 35,000	SB	189000
Chromium	mg/Kg	1.5 - 40	10 or SB	1030 J
Chromium, Hexavalent	mg/Kg	NS	NS	4.11
Cobalt	mg/Kg	2.5 or 60	30 or SB	3.2
Copper	mg/Kg	1.0 - 50	25 or SB	7.7
Iron	mg/Kg	2,000 - 550,000	2,000 or SB	2850
Lead	mg/Kg	NS	SB	6.0 J
Magnesium	mg/Kg	100 - 5,000	SB	71200
Manganese	mg/Kg	50 - 5,000	SB	288
Mercury	mg/Kg	0.001 - 0.2	0.1	ND (0.04)
Nickel	mg/Kg	0.5 - 25	13 or SB	11.4 J
Potassium	mg/Kg	8,500 - 43,000	SB	386
Selenium	mg/Kg	0.1 - 3.9	2 or SB	R
Silver	mg/Kg	NS	SB	ND (2)
Sodium	mg/Kg	6,000 - 8,000	SB	ND (1000)
Thallium	mg/Kg	NS	SB	--
Vanadium	mg/Kg	1.0 - 300	150 or SB	39.8
Zinc	mg/Kg	9.0 - 50.0	20 or SB	R
General Chemistry				
pH Corrosivity	s.u.	NS	NS	9.90

HISTORICAL SURFACE SOIL ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Notes:
* - Duplicate Analysis not within control limits.
B - Indicates a value greater than or equal to the instrument detection limit, but less than the contract required detection limit.
D - Analysis at a secondary dilution factor.
E - Indicates a value estimated or not reported due to the presence of interference.
J - The associated numerical value is an estimated quantity or Compound detected below sample quantitation limit.
N - Indicates spike sample recovery was not within the control limits.
ND() - Non detect at associated value.
NW - Value Estimated
NS - Indicates no standard.
R - Rejected
-- Not applicable

TABLE 4.2

HISTORICAL SUBSURFACE SOIL ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*Eastern USA*		*B-1A*	*B-1A*	*B-1A*	*B-1A*	*B-1-GRID*	*B-2*
Sample ID:		*Background*	*TAGM (a)*	*B-1*	*B-1*	*B-1A*	*B-1A*	*B-1*	*B-2*
Sample Date:		*Concentration*	*Values*	*11/7/1996*	*11/7/1996*	*11/7/1996*	*11/7/1996*	*3/1/2000*	*11/7/1996*
Sample Depth:		*(mg/kg)*	*(mg/kg)*	*0-4 ft*	*4-8 ft*	*10-14 ft*	*14-18 ft*		*1-18 ft*
Location Description:				*NYPA*	*NYPA*	*NYPA*	*NYPA*	*NiMO/NMPA*	*NYPA*
Sample Matrix Code:				*STW*	*STW*	*STW*	*STW*	*SUBSO*	*STW*
Parameters	***Units***								
Metals									
Aluminum	mg/Kg	33,000	SB	15600	12400	17400	12000	23800 *	15900
Antimony	mg/Kg	NS	SB	3.0 BN	ND (2.4) N	2.9 BN	ND (2.3) N	ND (1.5) N	16.6 N
Arsenic	mg/Kg	3 - 12	7.5 or SB	1.3 B	0.34 B	2.5 B	4.1	5.8	1.1 B
Barium	mg/Kg	15 - 600	300 or SB	20.3 B	16.0 B	19.9 B	102	154 E	26.8 B
Beryllium	mg/Kg	0 - 1.75	0.16 or SB	ND (0.28)	ND (0.24)	ND (0.28)	0.38 B	1.2 B	ND (0.27)
Cadmium	mg/Kg	0.1 -1.0	1 or SB	1.3 B	ND (0.24)	1.2 B	2.4	ND (0.17)	ND (0.27)
Calcium	mg/Kg	130 - 35,000	SB	--	--	--	--	2460 *	--
Chromium	mg/Kg	1.5 - 40	10 or SB	542 E	482 E	498 E	17.6 E	30.6 E*	2430 E
Chromium, Hexavalent	mg/Kg	NS	NS	14	6.4	11	ND (1.1)	ND (1.0)	28
Cobalt	mg/Kg	2.5 or 60	30 or SB	ND (2.8)	ND (2.4)	ND (2.8)	7.4 B	16.6	3.3 B
Copper	mg/Kg	1.0 - 50	25 or SB	10.6	5.6 B	8.2	17.6	36.8	11.1
Iron	mg/Kg	2,000 - 550,000	2,000 or SB	1520 E	1030 E	1920 E	15200	33000 E*	2680 E
Lead	mg/Kg	NS	SB	80.2 N*	4.5 N*	2.9 N*	7.6 N*	86.9	6.1 N*
Magnesium	mg/Kg	100 - 5,000	SB	58700 E	48100 E	52400 E	8690	6850 *	63900 E
Manganese	mg/Kg	50 - 5,000	SB	198	139	131	335	870 EN	246
Mercury	mg/Kg	0.001 - 0.2	0.1	ND (0.14)	ND (0.12)	ND (0.14)	ND (0.12)	ND (0.12)	ND (0.13)
Nickel	mg/Kg	0.5 - 25	13 or SB	ND (5.6)	ND (4.8)	ND (5.6)	16.7	31.7 *	16.9
Potassium	mg/Kg	8,500 - 43,000	SB	ND (28.1)	ND (24.1)	ND (28.1)	1600	3790 E	ND (27.4)
Selenium	mg/Kg	0.1 - 3.9	2 or SB	ND (1.1)	ND (0.96)	ND (1.1)	ND (0.93)	ND (1.2)	ND (1.1)
Silver	mg/Kg	NS	SB	ND (0.28) N	ND (0.24) N	ND (0.28) N	ND (0.24) N	ND (0.37)	ND (0.27) N
Sodium	mg/Kg	6,000 - 8,000	SB	ND (141)	429 B	ND (140)	ND (116)	834 B	ND (137)
Thallium	mg/Kg	NS	SB	ND (0.28) N	ND (0.24) NW	ND (0.28) NW	ND (0.24) N	ND (2.0)	ND (0.27) N
Vanadium	mg/Kg	1.0 - 300	150 or SB	25.8	32.3	27.5	18.7	42.1	42.4
Zinc	mg/Kg	9.0 - 50.0	20 or SB	139 N*	16.8 N	20.5 N	47.1	84.2	29.8 N
General Chemistry									
pH Corrosivity	s.u.	NS	NS	11.7	12.3	12.1	9.8	--	12.2

TABLE 4.2

HISTORICAL SUBSURFACE SOIL ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*Eastern USA Background Concentration (mg/kg)*	*TAGM $^{(a)}$ Values (mg/kg)*	*B-2*	*B-2-GRID*	*B-3*	*B-3*	*B-3*	*C-5-GRID*
Sample ID:				*B-2*	*B-2*	*B-3*	*B-3*	*B-3*	*C-5*
Sample Date:				*11/7/1996*	*3/1/2000*	*11/7/1996*	*11/7/1996*	*11/7/1996*	*3/1/2000*
Sample Depth:				*18-22 ft*		*1-12 ft*	*12-16 ft*	*17-20 ft*	
Location Description:				*NYPA*	*NiMO/NMPA*	*NYPA*	*NYPA*	*NYPA*	*NiMO/NMPA*
Sample Matrix Code:				*STW*	*SUBSO*	*STW*	*STW*	*STW*	*SUBSO*
<u>*Parameters*</u>	<u>*Units*</u>								
<u>*Metals*</u>									
Aluminum	mg/Kg	33,000	SB	12500	26700 *	15400	13900	15900	14600 *
Antimony	mg/Kg	NS	SB	ND (2.4) N	ND (1.5) N	6.6 BN	10.9 BN	ND (2.5) N	ND (1.4) N
Arsenic	mg/Kg	3 - 12	7.5 or SB	3.2	4.1	0.83 B	0.78 B	3.4	4.2
Barium	mg/Kg	15 - 600	300 or SB	87.1	138 E	72.8	169	115	108 E
Beryllium	mg/Kg	0 - 1.75	0.16 or SB	0.41 B	1.2 B	ND (0.33)	ND (0.32)	0.58 B	1.0 B
Cadmium	mg/Kg	0.1 -1.0	1 or SB	2.8	ND (0.18)	ND (0.33)	ND (0.32)	2.9	0.22 B
Calcium	mg/Kg	130 - 35,000	SB	--	6320 *	--	--	--	60100 *
Chromium	mg/Kg	1.5 - 40	10 or SB	17.2 E	35.9 E*	1070 E	1720 E	22.7 E	20.1 E*
Chromium, Hexavalent	mg/Kg	NS	NS	ND (1.1)	ND (1.0)	39	ND (1.5)	ND (1.2)	ND (1.0)
Cobalt	mg/Kg	2.5 or 60	30 or SB	7.5 B	11.3 B	ND (3.3)	4.2 B	9.9 B	10.3 B
Copper	mg/Kg	1.0 - 50	25 or SB	17.8	26.6	7.8 B	9.5	20.6	20.9
Iron	mg/Kg	2,000 - 550,000	2,000 or SB	16300 E	34000 E*	1710 E	2700 E	18200 E	20600 E*
Lead	mg/Kg	NS	SB	6.8 N*	9.3	4.8 N*	4.6 N*	7.3 N*	15.4
Magnesium	mg/Kg	100 - 5,000	SB	8980 E	10100	48000 E	57800 E	8320 E	12500 *
Manganese	mg/Kg	50 - 5,000	SB	359	467 EN	326	545	528	608 EN
Mercury	mg/Kg	0.001 - 0.2	0.1	ND (0.12)	ND (0.12)	ND (0.16)	ND (0.16)	ND (0.12)	ND (0.11)
Nickel	mg/Kg	0.5 - 25	13 or SB	17.5	31.8 *	8.7 B	21.2	21.2	21.2 *
Potassium	mg/Kg	8,500 - 43,000	SB	1280	4250 E	ND (33.3)	ND (31.7)	1490	3820 E
Selenium	mg/Kg	0.1 - 3.9	2 or SB	ND (0.95)	ND (1.3)	ND (1.3)	ND (1.3)	1.9	ND (1.1)
Silver	mg/Kg	NS	SB	ND (0.24) N	ND (0.38)	ND (0.33) N	ND (0.32) N	ND (0.25) N	ND (0.34)
Sodium	mg/Kg	6,000 - 8,000	SB	ND (119)	806 B	ND (166)	ND (159)	ND (126)	758 B
Thallium	mg/Kg	NS	SB	ND (0.24) N	ND (2.0)	ND (0.33) N	ND (0.33) N	ND (0.25) N	ND (1.8)
Vanadium	mg/Kg	1.0 - 300	150 or SB	20.0	45.0	32.0	40.3	22.4	28.3
Zinc	mg/Kg	9.0 - 50.0	20 or SB	46.9 N	74.4 E	29.7 N	27.7	55.4 N	96.1 E
<u>*General Chemistry*</u>									
pH Corrosivity	s.u.	NS	NS	9.4	--	12.1	12.0	9.8	--

TABLE 4.2

HISTORICAL SUBSURFACE SOIL ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*Eastern USA*		*MOUND1-GRID*	*MW-102*	*MW-103*	*MW-104*	*MW-104*
Sample ID:		*Background*	*TAGM (a)*	*MOUND1*	*MW-102*	*MW-103*	*MW-104*	*MW-104*
Sample Date:		*Concentration*	*Values*	*3/1/2000*	*11/7/1996*	*11/7/1996*	*11/7/1996*	*11/7/1996*
Sample Depth:		*(mg/kg)*	*(mg/kg)*		*6-8 ft*	*12-14 ft*	*16-18 ft*	*8-10 ft*
Location Description:				*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*
Sample Matrix Code:				*SUBSO*	*SO*	*SO*	*SO*	*SO*
Parameters	***Units***							
Metals								
Aluminum	mg/Kg	33,000	SB	21400 *	10100	15800	14400	23300
Antimony	mg/Kg	NS	SB	ND (1.4) N	ND (1.2)	ND (1.2)	3.6 B	3.3 B
Arsenic	mg/Kg	3 - 12	7.5 or SB	2.7	5.0	2.7	5.2	7.9
Barium	mg/Kg	15 - 600	300 or SB	76.6 E	86.9 E	134 E	121 E	219 E
Beryllium	mg/Kg	0 - 1.75	0.16 or SB	0.67 B	0.38 B	0.72 B	0.57 B	1.2 B
Cadmium	mg/Kg	0.1 -1.0	1 or SB	ND (0.17)	2.4	2.7	2.7	5.0
Calcium	mg/Kg	130 - 35,000	SB	2100 *	--	--	--	--
Chromium	mg/Kg	1.5 - 40	10 or SB	26.3 E*	16.2 N*	23.4 N*	72.4 N*	54.3 N*
Chromium, Hexavalent	mg/Kg	NS	NS	ND (1.0)	0.48 E*	0.37 E*	1.6 E*	0.42 E*
Cobalt	mg/Kg	2.5 or 60	30 or SB	7.6 B	9.5 B	16.7	13.4	13.6 B
Copper	mg/Kg	1.0 - 50	25 or SB	7.6	21.7 E	22.9 E	22.5 E	30.6 E
Iron	mg/Kg	2,000 - 550,000	2,000 or SB	26700 E*	21200	30400	25700	31200
Lead	mg/Kg	NS	SB	7.5	5.6 *	8.1 *	6.4 *	25.2 *
Magnesium	mg/Kg	100 - 5,000	SB	5570 *	10900	13200	12900	8150
Manganese	mg/Kg	50 - 5,000	SB	355 EN	689 *	496 *	874 *	409 *
Mercury	mg/Kg	0.001 - 0.2	0.1	0.14	ND (0.05)	ND (0.05)	ND (0.06)	ND (0.06)
Nickel	mg/Kg	0.5 - 25	13 or SB	18.6 *	23.6	35.8	26.0	34.0
Potassium	mg/Kg	8,500 - 43,000	SB	3720 E	978 BE	2300 E	2110 E	2580 E
Selenium	mg/Kg	0.1 - 3.9	2 or SB	ND (1.2)	1.2	2.6	ND (1.2)	2.3
Silver	mg/Kg	NS	SB	ND (0.36)	ND (0.26) N	ND (0.27) N	ND (0.28) N	ND (0.32) N
Sodium	mg/Kg	6,000 - 8,000	SB	918 B	ND (30.6)	ND (31.1)	ND (33.4)	262 B
Thallium	mg/Kg	NS	SB	ND (1.9)	ND (0.73)	ND (0.75)	ND (0.80)	ND (0.89)
Vanadium	mg/Kg	1.0 - 300	150 or SB	33.9	22.4 E	32.6 E	30.2 E	41.1 E
Zinc	mg/Kg	9.0 - 50.0	20 or SB	63.9 E	54.3	76.2	68.9	750
General Chemistry								
pH Corrosivity	s.u.	NS	NS	--	--	--	--	--

TABLE 4.2

HISTORICAL SUBSURFACE SOIL ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*Eastern USA Background Concentration (mg/kg)*	*TAGM $^{(a)}$ Values (mg/kg)*	*MW-104*	*MW-105*	*SB-1B*	*SB-2B*	*SB-2C*
Sample ID:				*MW-104*	*MW-105*	*SB-1B*	*SB-2B*	*SB-2C*
Sample Date:				*11/7/1996*	*11/7/1996*	*11/7/1996*	*11/7/1996*	*11/7/1996*
Sample Depth:				*6-8 ft*	*12-14 ft*	*4-6 ft*	*4-6 ft*	*6-8 ft*
Location Description:				*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*
Sample Matrix Code:				*SO*	*SO*	*STW*	*STW*	*SO*
Parameters	***Units***							
Metals								
Aluminum	mg/Kg	33,000	SB	17400	4480	19300	13300	14400
Antimony	mg/Kg	NS	SB	45.1	ND (1.1)	ND (1.3)	59.8	ND (1.2)
Arsenic	mg/Kg	3 - 12	7.5 or SB	ND (1.4)	ND (1.1)	7.8 *	ND (0.60) *	3.4 *
Barium	mg/Kg	15 - 600	300 or SB	25 BE	59.0 E	75.0 *	48.9 B	81.7 *
Beryllium	mg/Kg	0 - 1.75	0.16 or SB	ND (0.06)	0.20 B	1.4	0.06 B	0.75 B
Cadmium	mg/Kg	0.1 -1.0	1 or SB	ND (0.65)	1.9	ND (0.55)	ND (0.60)	ND (0.51)
Calcium	mg/Kg	130 - 35,000	SB	2.7 E*	--	--	--	--
Chromium	mg/Kg	1.5 - 40	10 or SB	4.8 B	6.3 N*	40.8	2630	31.6
Chromium, Hexavalent	mg/Kg	NS	NS	1350 N*	0.31 E*	0.47 N	13.5 N	0.28 N
Cobalt	mg/Kg	2.5 or 60	30 or SB	6 BE	5.3 B	4.7 B	5.7 B	13.3
Copper	mg/Kg	1.0 - 50	25 or SB	1480	9.1 E	57.7	18.2	21.6
Iron	mg/Kg	2,000 - 550,000	2,000 or SB	ND (0.75) *	7800	14900	7540	25500
Lead	mg/Kg	NS	SB	90200	21.1 *	21.6 *	3.6 *	5.9 *
Magnesium	mg/Kg	100 - 5,000	SB	342 *	79300	27700	55300	13200
Manganese	mg/Kg	50 - 5,000	SB	ND (0.07)	1040 *	826 E*	347 E*	581 E*
Mercury	mg/Kg	0.001 - 0.2	0.1	10.4 B	ND (0.05)	ND (0.07)	ND (0.05)	ND (0.05)
Nickel	mg/Kg	0.5 - 25	13 or SB	ND (49.9) E	6.7 B	25.2	17.6	22.4
Potassium	mg/Kg	8,500 - 43,000	SB	ND (1.4)	101 BE	597 B	74.9 B	1670
Selenium	mg/Kg	0.1 - 3.9	2 or SB	ND (0.34) N	ND (1.1)	2.2	ND (1.3)	ND (1.1)
Silver	mg/Kg	NS	SB	ND (40.2)	ND (0.25) N	ND (0.26) N	ND (0.28) N	ND (0.24) N
Sodium	mg/Kg	6,000 - 8,000	SB	ND (0.97)	ND (29.8)	484 B	ND (36.3)	166 B
Thallium	mg/Kg	NS	SB	48.6 E*	ND (0.72)	ND (0.78)	1.1 B	ND (0.73)
Vanadium	mg/Kg	1.0 - 300	150 or SB	16.7	6.8 BE	21.4	36.7	36.3
Zinc	mg/Kg	9.0 - 50.0	20 or SB		648	132	19.2	57.0
General Chemistry				-				
pH Corrosivity	s.u.	NS	NS		--	11	--	--

TABLE 4.2

HISTORICAL SUBSURFACE SOIL ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*Eastern USA*		*SB-3B*	*SB-3C*	*SB-4B*	*SB-4C*	*SB-5C*
Sample ID:		*Background*	*TAGM* $^{(a)}$	*SB-3B*	*SB-3C*	*SB-4B*	*SB-4C*	*SB-5C*
Sample Date:		*Concentration*	*Values*	*11/7/1996*	*11/7/1996*	*11/7/1996*	*11/7/1996*	*11/7/1996*
Sample Depth:		*(mg/kg)*	*(mg/kg)*	*6-8 ft*	*10-12 ft*	*2-4 ft*	*7-9 ft*	*2-4 ft*
Location Description:				*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*
Sample Matrix Code:				*STW*	*SO*	*STW*	*SO*	*SO*
Parameters	***Units***							
Metals								
Aluminum	mg/Kg	33,000	SB	11000	13300	18200	18300	14100
Antimony	mg/Kg	NS	SB	72.4	1.6 B	98.7	ND (1.2)	ND (1.1)
Arsenic	mg/Kg	3 - 12	7.5 or SB	ND (0.67) *	5.7 *	17.6 *	6.7 *	3.9 *
Barium	mg/Kg	15 - 600	300 or SB	302 *	125 *	157 *	129 *	124 *
Beryllium	mg/Kg	0 - 1.75	0.16 or SB	0.26 B	0.73 B	0.51 B	0.90 B	0.77 B
Cadmium	mg/Kg	0.1 -1.0	1 or SB	1.4 B	2.2	3.6	4.1	3.7
Calcium	mg/Kg	130 - 35,000	SB	--	--	--	--	--
Chromium	mg/Kg	1.5 - 40	10 or SB	2980	46.4	4140	26.5	33.4
Chromium, Hexavalent	mg/Kg	NS	NS	1.0 N	--	11.8 N	--	--
Cobalt	mg/Kg	2.5 or 60	30 or SB	10.2 B	16.2	132	18.5	14.9
Copper	mg/Kg	1.0 - 50	25 or SB	44.0	31.4	196	30.9	24.7
Iron	mg/Kg	2,000 - 550,000	2,000 or SB	7390	27200	29600	33300	24500
Lead	mg/Kg	NS	SB	110 *	12.6 *	21.6 *	11.9 *	7.1 *
Magnesium	mg/Kg	100 - 5,000	SB	49100	12900	29900	16000	16600
Manganese	mg/Kg	50 - 5,000	SB	2060 E*	807 E*	78300 E*	1270 E*	848 E*
Mercury	mg/Kg	0.001 - 0.2	0.1	0.14	0.13	0.08 B	0.06 B	0.09 B
Nickel	mg/Kg	0.5 - 25	13 or SB	45.6	25.9	597	38.7	26.2
Potassium	mg/Kg	8,500 - 43,000	SB	ND (51.0)	2620	ND (39.6)	2040	1260
Selenium	mg/Kg	0.1 - 3.9	2 or SB	2.2	ND (1.1)	40.4	2.6	1.2
Silver	mg/Kg	NS	SB	ND (0.32) N	ND (0.25) N	11.9 N	ND (0.25) N	ND (0.23) N
Sodium	mg/Kg	6,000 - 8,000	SB	ND (41.1)	ND (32.1)	ND (31.9)	105 B	ND (30.1)
Thallium	mg/Kg	NS	SB	1.7 B	ND (0.75)	31.7	ND (0.74)	ND (0.70)
Vanadium	mg/Kg	1.0 - 300	150 or SB	37.4	32.4	168	34.4	32.4
Zinc	mg/Kg	9.0 - 50.0	20 or SB	229	74.4	42.1	78.9	64.0
General Chemistry								
pH Corrosivity	s.u.	NS	NS	12	--	12	--	--

TABLE 4.2

HISTORICAL SUBSURFACE SOIL ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*Eastern USA Background Concentration (mg/kg)*	*TAGM $^{(a)}$ Values (mg/kg)*	*SB-6B*	*SB-6C*	*SB-7B*	*SB-7C*	*SB-8B*
Sample ID:				*SB-6B*	*SB-6C*	*SB-7B*	*SB-7C*	*SB-8B*
Sample Date:				*11/7/1996*	*11/7/1996*	*11/7/1996*	*11/7/1996*	*11/7/1996*
Sample Depth:				*7-8 ft*	*8-9 ft*	*14-16 ft*	*16-18 ft*	*15-17 ft*
Location Description:				*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NYPA*
Sample Matrix Code:				*STW*	*SO*	*STW*	*SO*	*STW*
Parameters	***Units***							
Metals								
Aluminum	mg/Kg	33,000	SB	24900	24500	14500	26000	13800
Antimony	mg/Kg	NS	SB	185	2.4 B	22.2	ND (6.0)	19.3 B
Arsenic	mg/Kg	3 - 12	7.5 or SB	ND (0.64) *	7.8 *	ND (0.66)	6.8	ND (0.84)
Barium	mg/Kg	15 - 600	300 or SB	234 *	193 *	18.9 B	193	34.5 B
Beryllium	mg/Kg	0 - 1.75	0.16 or SB	ND (0.06)	1.4	ND (0.06)	1.0 B	ND (0.08)
Cadmium	mg/Kg	0.1 -1.0	1 or SB	2.8	5.4	ND (0.66)	4.0	ND (0.84)
Calcium	mg/Kg	130 - 35,000	SB	--	--	--	--	--
Chromium	mg/Kg	1.5 - 40	10 or SB	7550	52.7	858	34.8	748
Chromium, Hexavalent	mg/Kg	NS	NS	19.8 N	--	2.9	0.24	4.7
Cobalt	mg/Kg	2.5 or 60	30 or SB	41.5	19.1	1.1 B	14.2	2.5 B
Copper	mg/Kg	1.0 - 50	25 or SB	77.3	39.2	4.2 BE	29.6 E	5.4 BE
Iron	mg/Kg	2,000 - 550,000	2,000 or SB	19900	39500	798	35300	791
Lead	mg/Kg	NS	SB	ND (0.73) *	23.5 *	ND (0.76)	7.2	ND (0.96)
Magnesium	mg/Kg	100 - 5,000	SB	27100	8780	69900	10500	47700
Manganese	mg/Kg	50 - 5,000	SB	4260 E*	697 E*	186 *	773 *	169 *
Mercury	mg/Kg	0.001 - 0.2	0.1	0.10 B	0.11 B	ND (0.07) N	ND (0.05) N	ND (0.07) N
Nickel	mg/Kg	0.5 - 25	13 or SB	1220	48.6	ND (0.32)	32.7	ND (0.40)
Potassium	mg/Kg	8,500 - 43,000	SB	ND (48.8)	3570	ND (50.6) E	4040 E	ND (63.8) E
Selenium	mg/Kg	0.1 - 3.9	2 or SB	16.9	2.6	2.0	3.5	ND (1.8)
Silver	mg/Kg	NS	SB	5.5 N	ND (0.25) N	ND (0.32) N	ND (0.26) N	ND (0.40) N
Sodium	mg/Kg	6,000 - 8,000	SB	ND (39.3)	925 B	ND (40.8)	476 B	ND (51.4)
Thallium	mg/Kg	NS	SB	ND (0.91)	ND (0.76)	ND (0.95)	ND (0.78)	ND (1.2)
Vanadium	mg/Kg	1.0 - 300	150 or SB	278	47.7	36.6	47.1	56.3
Zinc	mg/Kg	9.0 - 50.0	20 or SB	18.4	91.7	6.5	81.8	10.5
General Chemistry								
pH Corrosivity	s.u.	NS	NS	12	--	12	--	12

TABLE 4.2

HISTORICAL SUBSURFACE SOIL ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*Eastern USA*		*SB-8C*	*SB-9B*	*SB-9B*	*SB-9C*	*SB-10B*	*SB-10C*
Sample ID:		*Background*	*TAGM* [(a)]	*SB-8C*	*SB-9B*	*SB-9B*	*SB-9C*	*SB-10B*	*SB-10C*
Sample Date:		*Concentration*	*Values*	*11/7/1996*	*11/7/1996*	*11/7/1996*	*11/7/1996*	*11/7/1996*	*11/7/1996*
Sample Depth:		*(mg/kg)*	*(mg/kg)*	*17-19 ft*	*10-12 ft*	*10-12 ft*	*17-19 ft*	*18-20 ft*	*20-22 ft*
Location Description:				*NiMO/NMPA*	*NYPA*	*NYPA*	*NiMO/NMPA*	*NYPA*	*NYPA*
Sample Matrix Code:				*SO*	*STW*	*STW*	*SO*	*STW*	*SO*
						Duplicate			
Parameters	***Units***								
Metals									
Aluminum	mg/Kg	33,000	SB	33700	18600	15900	27700	14600	20700
Antimony	mg/Kg	NS	SB	ND (6.0)	94.7	90.8	ND (5.4)	45.9	ND (1.2)
Arsenic	mg/Kg	3 - 12	7.5 or SB	6.6	ND (0.57)	ND (0.59)	9.4	ND (0.63) *	8.9 *
Barium	mg/Kg	15 - 600	300 or SB	202	53.2 B	34.4 B	184	20.3 B*	139 *
Beryllium	mg/Kg	0 - 1.75	0.16 or SB	1.2 B	0.13 B	ND (0.06)	1.0 B	ND (0.06)	1.1 B
Cadmium	mg/Kg	0.1 -1.0	1 or SB	4.3	0.80 B	ND (0.59)	4.2	ND (0.63)	ND (0.53)
Calcium	mg/Kg	130 - 35,000	SB	--	--	--	--	--	--
Chromium	mg/Kg	1.5 - 40	10 or SB	71.2	3270	2970	34.8	1230	38.8
Chromium, Hexavalent	mg/Kg	NS	NS	--	68.7	--	--	1.0 N	--
Cobalt	mg/Kg	2.5 or 60	30 or SB	17.2	6.0 B	4.9 B	18.7	3.6 B	18.7
Copper	mg/Kg	1.0 - 50	25 or SB	34.3 E	9.5 E	7.5 E	34.3 E	6.2 B	30.9
Iron	mg/Kg	2,000 - 550,000	2,000 or SB	37200	3070	2840	35200	1210	35900
Lead	mg/Kg	NS	SB	8.3	ND (0.65)	ND (0.68)	8.8	ND (0.72) *	10.8 *
Magnesium	mg/Kg	100 - 5,000	SB	15600	78800	84900	9910	72200	12000
Manganese	mg/Kg	50 - 5,000	SB	793 *	260 *	301 *	1230 *	230 E*	853 E*
Mercury	mg/Kg	0.001 - 0.2	0.1	0.09 BN	ND (0.06) N	ND (0.06) N	0.10 BN	ND (0.06)	ND (0.06)
Nickel	mg/Kg	0.5 - 25	13 or SB	36.7	6.7 B	3.2 B	41	ND (1.4)	36.1
Potassium	mg/Kg	8,500 - 43,000	SB	6970 E	ND (43.4) E	ND (45.3) E	5530 E	ND (47.7)	2560
Selenium	mg/Kg	0.1 - 3.9	2 or SB	2.4	ND (1.2)	1.7	3.5	3.1	2.6
Silver	mg/Kg	NS	SB	ND (0.26) N	ND (0.27) N	ND (0.28) N	ND (0.24) N	ND (0.30) N	ND (0.25) N
Sodium	mg/Kg	6,000 - 8,000	SB	329 B	ND (35.0)	ND (36.5)	577 B	ND (38.5)	689 B
Thallium	mg/Kg	NS	SB	ND (0.79)	ND (0.81)	ND (0.85)	ND (0.71)	ND (0.89)	ND (0.76)
Vanadium	mg/Kg	1.0 - 300	150 or SB	60.0	45.0	47.1	52.5	54.6	39.8
Zinc	mg/Kg	9.0 - 50.0	20 or SB	86.5	23.8	17.5	72.5	5.7 B	75.9
General Chemistry									
pH Corrosivity	s.u.	NS	NS	--	12	12	--	12	--

TABLE 4.2

HISTORICAL SUBSURFACE SOIL ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*Eastern USA*		*SB-11B*	*SB-11C*	*SB-12B*	*SB-12C*	*SB-12D*	*SB-12E*
Sample ID:		*Background*	*TAGM* [(a)]	*SB-11B*	*SB-11C*	*SB-12B*	*SB-12C*	*SB-12D*	*SB-12E*
Sample Date:		*Concentration*	*Values*	*11/7/1996*	*11/7/1996*	*11/7/1996*	*11/7/1996*	*11/7/1996*	*11/7/1996*
Sample Depth:		*(mg/kg)*	*(mg/kg)*	*10-12 ft*	*18-20 ft*	*16-18 ft*	*18-20 ft*	*18-20 ft*	*4-6 ft*
Location Description:				*NYPA*	*NYPA*	*NYPA*	*NYPA*	*NYPA*	*NYPA*
Sample Matrix Code:				*STW*	*SO*	*STW*	*SO*	*STW*	*STW*
Parameters	*Units*								
Metals									
Aluminum	mg/Kg	33,000	SB	18000	19800	14800	16300	11700	20000
Antimony	mg/Kg	NS	SB	26.6	ND (1.2)	40.0	ND (1.3)	2.7 B	182
Arsenic	mg/Kg	3 - 12	7.5 or SB	ND (0.86) *	6.1 *	ND (0.97) *	7.0 *	5.2 *	ND (0.55) *
Barium	mg/Kg	15 - 600	300 or SB	22.5 B*	141 *	147 *	122 *	283 *	348 *
Beryllium	mg/Kg	0 - 1.75	0.16 or SB	ND (0.08)	0.94 B	0.15 B	0.81 B	0.53 B	0.14 B
Cadmium	mg/Kg	0.1 -1.0	1 or SB	ND (0.86)	ND (0.51)	ND (0.97)	ND (0.55)	ND (0.55)	ND (0.55)
Calcium	mg/Kg	130 - 35,000	SB	--	--	--	--	--	--
Chromium	mg/Kg	1.5 - 40	10 or SB	760	33.6	1080	29.7	83.3	4690
Chromium, Hexavalent	mg/Kg	NS	NS	13.5 N	--	55.5 N	--	0.08 BN	124 N
Cobalt	mg/Kg	2.5 or 60	30 or SB	3.4 B*	16.1	4.3 B	14.4	10.2 B	8.3 B
Copper	mg/Kg	1.0 - 50	25 or SB	1.8 B*	24.8	7.3 B	29.2	17.2	15.6
Iron	mg/Kg	2,000 - 550,000	2,000 or SB	668	31300	2660	29900	20300	6130
Lead	mg/Kg	NS	SB	ND (0.98) *	5.1 *	1.7 *	5.7 *	4.2 *	ND (0.63) *
Magnesium	mg/Kg	100 - 5,000	SB	56700	9360	55700	11200	12600	57600
Manganese	mg/Kg	50 - 5,000	SB	269 E*	630 E*	963 E*	671 E*	622 E*	1440 E*
Mercury	mg/Kg	0.001 - 0.2	0.1	ND (0.07)	ND (0.06)	ND (0.10)	ND (0.06)	ND (0.05)	ND (0.05)
Nickel	mg/Kg	0.5 - 25	13 or SB	ND (2.0)	32.6	ND (2.2)	21.8	13.7	23.5
Potassium	mg/Kg	8,500 - 43,000	SB	ND (65.4)	2250	ND (73.9)	3150	1790	42.0
Selenium	mg/Kg	0.1 - 3.9	2 or SB	2.5	2.7	2.1	2.3	1.7	1.6
Silver	mg/Kg	NS	SB	ND (0.41) N	ND (0.24) N	ND (0.46) N	ND (0.26) N	ND (0.26) N	ND (0.26) N
Sodium	mg/Kg	6,000 - 8,000	SB	ND (52.7)	888 B	ND (59.6)	579 B	ND (34.1)	ND (33.8)
Thallium	mg/Kg	NS	SB	ND (1.2)	ND (0.73)	ND (1.4)	ND (0.79)	ND (0.79)	ND (0.79)
Vanadium	mg/Kg	1.0 - 300	150 or SB	28.2	34.6	33.4	33.0	23.9	62.2
Zinc	mg/Kg	9.0 - 50.0	20 or SB	4.7 B	73.9	15.8	64.6	40.8	14.5
General Chemistry									
pH Corrosivity	s.u.	NS	NS	12	--	12	--	--	12

TABLE 4.2

HISTORICAL SUBSURFACE SOIL ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Notes:
* - Duplicate Analysis not within control limits.
B - Indicates a value greater than or equal to the instrument detection limit, but less than the contract required detection limit.
D - Analysis at a secondary dilution factor.
E - Indicates a value estimated or not reported due to the presence of interference.
J - The associated numerical value is an estimated quantity or Compound detected below sample quantitation limit.
N - Indicates spike sample recovery was not within the control limits.
ND() - Non detect at associated value.
NW - Value Estimated
NS - Indicates no standard.
R - Rejected
-- Not applicable
SB - Site Background
NS - No Standard
(a) - Division Technical and Administrative Guidance Memorandum: Determination of Soil Cleanup Objectives and Cleanup Levels (TAGM 4046), January 24, 1994.

TABLE 4.3

SUBSURFACE SOIL SAMPLES
WITH ELEVATED PARAMETER CONCENTRATIONS
PHASE 1 WORK PLAN
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Parameter	*Borehole ID*	*Sample Depth Interval (feet bgs)*
Cadmium	B-1A	0 to 4, 10 to 14
	B-2	2 to 4, 18 to 22
	B-3	2 to 4, 12 to 14, 17 to 20
	MW-102	6 to 8
	MW-104	8 to 10, 16 to 18
	SB-2B	7 to 8
	SB-8B	14 to 18
	SB-11B	12 to 14
Chromium	B-1A	0 to 4, 4 to 8, 10 to 14, 15 to 17
	B-2	2 to 4, 18 to 22
	B-3	2 to 4, 12 to 14, 17 to 20
	MW-103	12 to 16
	MW-104	8 to 10, 10 to 12, 16 to 18
	MW-105	14 to 16
	SB-1B	6 to 8
	SB-2B	7 to 8
	SB-4B	4 to 6
	SB-5C	4 to 6
	SB-6B	1 to 12
	SB-7B	1 to 18
	SB-8B	14 to 18
	SB-11B	12 to 14
	SB-12B	16 to 18
	TP-1	NA
	TP-2	NA
Hexavalent Chromium	B-1A	0 to 4, 4 to 8, 10 to 14, 15 to 17
	B-2	2 to 4
	B-3	12 to 14
	MW-102	6 to 8
	MW-103	
	MW-104	8 to 10, 10 to 12, 16 to 18
	MW-105	14 to 16
	SB-1B	6 to 8
	SB-2B	7 to 8
	SB-4B	4 to 6
	SB-5C	4 to 6
	SB-6B	1 to 12
	SB-7B	1 to 18

TABLE 4.3

SUBSURFACE SOIL SAMPLES
WITH ELEVATED PARAMETER CONCENTRATIONS
PHASE 1 WORK PLAN
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Parameter	*Borehole ID*	*Sample Depth Interval (feet bgs)*
Hexavalent Chromium	SB-11B	12 to 14
	SB-12B	16 to 18
	TP-1	NA
	TP-2	NA
Nickel	B-1-GRID	0.83
	B-2	2 to 4
	B-2-GRID	1.5
	B-3	2 to 4
	SB-2B	7 to 8
	SB-4B	4 to 6
	SB-11B	12 to 14
	MW-104	8 to 10, 16 to 18
Zinc	B-1A	0 to 4
	B-1-GRID	0.83
	B-2-GRID	1.5
	B-3	2 to 4, 12 to 14, 17 to 20
	C-5-GRID	10
	SB-4B	4 to 6
	SB-11B	12 to 14
	MOUND1-GRID	1.5 to 2.5
	MW-102	6 to 8
	MW-104	8 to 10, 16 to 18

Note:

NA - Not available

TABLE 4.4

SUBSURFACE SOIL SAMPLES ANALYZED FOR pH
PHASE 1 WORK PLAN
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Borehole ID	*Sample Depth Interval (feet bgs)*
B-1A	0 to 4, 4 to 8, 10 to 14, 14 to 18
B-2	1 to 18, 18 to 22
B-3	1 to 12, 12 to 16, 17 to 20
SB-1B	4 to 6
SB-4B	2 to 4
SB-6B	7 to 8
SB-7B	14 to 16
SB-8B	15 to 17
SB-11B	10 to 12
SB-12B	16 to 18
TP-1	NA
TP-2	NA

Note:

NA - Not available

TABLE 4.5

HISTORICAL SEDIMENT ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC (a)*	*NYSDEC (a)*	*SB-2 Pond*	*SD-102*	*SD-102*	*SD-103*	*SD-105*
Sample ID:		*Lowest Effect Level*	*Severe Effect Level*	*SB-2 POND*	*SD-102*	*SD-102*	*SD-103*	*SD-105*
Sample Date:				*11/7/1996*	*1/1/1989*	*1/1/1989*	*1/1/1989*	*1/1/1989*
Location Description:				*NiMO/NMPA*	*SKW Landfill*	*SKW Landfill Duplicate*	*NYPA/PASNY*	*NYPA/PASNY*
Parameters	***Units***							
Metals								
Aluminum	mg/Kg	NV	NV	13300	4000 J	3870 J	20000	13500 J
Antimony	mg/Kg	2.0	25.0	56.5	22.2 J	18.7 J	ND (12)	ND (12)
Arsenic	mg/Kg	6.0	33.0	ND (1.3)	6.6 J	6.7 J	8.8 J	4.2 J
Barium	mg/Kg	NV	NV	421 E	294 J	258 J	144 J	277 J
Beryllium	mg/Kg	NV	NV	0.09 B	ND (1)	ND (1)	0.62	ND (1)
Cadmium	mg/Kg	0.6	9.0	2.1	ND (1)	1.3 J	ND (1)	ND (1)
Calcium	mg/Kg	NV	NV	--	276000 J	260000 J	7890	93000 J
Chromium	mg/Kg	26.0	110.0	2380 N*	R	R	130 J	167 J
Chromium, Hexavalent	mg/Kg	NV	NV	0.45 E*	3.50	--	3.23	6.83 J
Cobalt	mg/Kg	NV	NV	10.3 B	9.1 J	6.7 J	14.7	6.2 J
Copper	mg/Kg	16.0	110.0	39.4 E	106 J	97.5 J	25.6	93.4 J
Iron	mg/Kg	20,000	40,000	7190	5700 J	5780 J	28300	20300 J
Lead	mg/Kg	31.0	110.0	23.6 *	66.9 J	66.2 J	39.7 J	199 J
Magnesium	mg/Kg	NV	NV	46100	12900 J	12700 J	5190	29500 J
Manganese	mg/Kg	460.0	1,100.0	1970 *	1330 J	1270 J	736	504 J
Mercury	mg/Kg	0.15	1.3	ND (0.07)	ND (0.04)	ND (0.04)	0.42	ND (0.04)
Nickel	mg/Kg	16.0	50.0	216	102 J	95.6 J	36.1 J	48.8 J
Potassium	mg/Kg	NV	NV	ND (45.6) E	490 J	363 J	3240	1960 J
Selenium	mg/Kg	NV	NV	2.2	ND (1)	ND (1)	R	R
Silver	mg/Kg	1.0	2.2	ND (0.31) N	--	--	--	--
Sodium	mg/Kg	NV	NV	ND (36.8)	349 J	335 J	ND (1000)	308 J
Thallium	mg/Kg	NV	NV	ND (0.88)	--	--	--	--
Vanadium	mg/Kg	NV	NV	53.6 E	18.4 J	16.6 J	40.5	33.6 J
Zinc	mg/Kg	120.0	270.0	58.9	217 J	213 J	90.0 J	631 J
General Chemistry								
pH Corrosivity	s.u.	NV	NV	--	9.3	9.35	6.00	9.35

TABLE 4.5

HISTORICAL SEDIMENT ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC [(a)]*	*NYSDEC [(a)]*	*SB-2 Pond*	*SD-102*	*SD-102*	*SD-103*	*SD-105*
Sample ID:		*Lowest Effect*	*Severe Effect*	*SB-2 POND*	*SD-102*	*SD-102*	*SD-103*	*SD-105*
Sample Date:		*Level*	*Level*	*11/7/1996*	*1/1/1989*	*1/1/1989*	*1/1/1989*	*1/1/1989*
Location Description:				*NiMO/NMPA*	*SKW Landfill*	*SKW Landfill Duplicate*	*NYPA/PASNY*	*NYPA/PASNY*
Parameters	***Units***							

Notes:

* - Duplicate Analysis not within control limits.
B -
E - Indicates a value estimated or not reported due to the presence of interference.
J - The associated numerical value is an estimated quantity or Compound detected below sample quantitation limit.
N - Indicates spike sample recovery was not within the control limits.
ND() - Non detect at associated value.
NW - Value Estimated
NV - No Value
R - Rejected
-- Not applicable
NS - No Standard
(a) - Technical Guidance for Screening Contaminated Sediments, NYSDEC, January 25, 1999.

TABLE 4.6

HISTORICAL SURFACE WATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC*	*Outfall*	*Outfall-1*	*SB-2 Pond*	*SW-6*	*SW-6*
Sample ID:		*Ambient*	*Outfall*	*Outfall 1*	*SB-2 POND*	*Location6*	*Location6*
Sample Date:		*Water*	*1/29/1999*	*2/12/1999*	*11/7/1996*	*3/7/1979*	*4/11/1979*
Location Description:		*Quality*[a]	*SKW Landfill*	*SKW Landfill*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*
Metals							
Aluminum	mg/L	NS	--	--	0.302 E	--	--
Antimony	mg/L	NS	--	--	0.0357 B	--	--
Arsenic	mg/L	0.340	--	--	ND (0.0046)	--	--
Barium	mg/L	NS	--	--	0.0398 B	0.15	0.10
Beryllium	mg/L	NS	--	--	0.00047 B	--	--
Boron	mg/L	NS	--	--	--	--	--
Cadmium	mg/L	NCV	--	--	ND (0.0021)	--	--
Calcium	mg/L	NS	--	--	--	--	--
Chromium	mg/L	NCV	0.200	ND (0.014)	0.878	0.25	0.23
Chromium, Hexavalent	mg/L	0.016	0.05	ND (0.04)	0.752	--	--
Cobalt	mg/L	0.110	--	--	ND (0.0034)	--	--
Copper	mg/L	NCV	--	--	0.0099 B	--	--
Iron	mg/L	0.300	--	--	0.132	0.07	0.06
Lead	mg/L	NCV	--	--	ND (0.0024)	--	--
Magnesium	mg/L	NS	--	--	1.47 B	--	--
Manganese	mg/L	NS	--	--	0.0202	0.03	0.01
Mercury	mg/L	0.0014	--	--	ND (0.0001)	--	--
Nickel	mg/L	NCV	--	--	ND (0.0048)	--	--
Potassium	mg/L	NS	--	--	6.66	--	--
Selenium	mg/L	NS	--	--	0.0059	--	--
Silicon	mg/L	NS	--	--	--	2.9	1.5
Silver	mg/L	NCV	--	--	ND (0.0011) N	--	--
Sodium	mg/L	NS	--	--	38.1 E	--	--
Thallium	mg/L	0.020	--	--	ND (0.0031)	--	--
Vanadium	mg/L	0.190	--	--	0.026 B	--	--
Zinc	mg/L	NCV	--	--	0.0081 B	0.02	ND (0.005)
General Chemistry							
pH (water)	s.u.	NS	6.57	7.98	--	11.75	12.05

TABLE 4.6

HISTORICAL SURFACE WATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC*	*SW-6*	*SW-6*	*SW-6*	*SW-6*	*SW-6*
Sample ID:		*Ambient*	*Location6*	*Location6*	*Location6*	*Location6*	*Location6*
Sample Date:		*Water*	*5/14/1979*	*6/11/1979*	*12/14/1979*	*1/16/1980*	*4/11/1980*
Location Description:		*Quality* [(a)]	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*
Metals							
Aluminum	mg/L	NS	--	--	--	--	--
Antimony	mg/L	NS	--	--	--	--	--
Arsenic	mg/L	0.340	--	--	--	--	--
Barium	mg/L	NS	0.10	0.10	0.15	0.1	0.1
Beryllium	mg/L	NS	--	--	--	--	--
Boron	mg/L	NS	--	--	--	--	--
Cadmium	mg/L	NCV	--	--	--	--	--
Calcium	mg/L	NS	--	--	--	--	--
Chromium	mg/L	NCV	0.30	0.13	0.07	0.19	0.25
Chromium, Hexavalent	mg/L	0.016	--	--	--	--	0.18
Cobalt	mg/L	0.110	--	--	--	--	--
Copper	mg/L	NCV	--	--	--	--	--
Iron	mg/L	0.300	0.04	0.05	0.08	0.06	0.02
Lead	mg/L	NCV	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	--	--
Manganese	mg/L	NS	0.01	ND (0.01)	ND (0.005)	0.02	0.01
Mercury	mg/L	0.0014	--	--	--	--	--
Nickel	mg/L	NCV	--	--	--	--	--
Potassium	mg/L	NS	--	--	--	--	--
Selenium	mg/L	NS	--	--	--	--	--
Silicon	mg/L	NS	1.6	4.4	--	0.5	0.8
Silver	mg/L	NCV	--	--	--	--	--
Sodium	mg/L	NS	--	--	--	--	--
Thallium	mg/L	0.020	--	--	--	--	--
Vanadium	mg/L	0.190	--	--	--	--	--
Zinc	mg/L	NCV	0.01	ND (0.01)	0.015	0.02	ND (0.01)
General Chemistry							
pH (water)	s.u.	NS	11.55	11.85	11.40	12.30	11.70

TABLE 4.6

HISTORICAL SURFACE WATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:*		*NYSDEC Ambient Water Quality* $^{(a)}$	*SW-6* *Location6* *7/8/1980* *NiMO/NMPA*	*SW-6* *Location6* *10/30/1980* *NiMO/NMPA*	*SW-6* *Location6* *4/7/1981* *NiMO/NMPA*	*SW-6* *Location6* *6/22/1981* *NiMO/NMPA*	*SW-6* *Location6* *10/29/1981* *NiMO/NMPA*
Metals							
Aluminum	mg/L	NS	--	--	--	--	--
Antimony	mg/L	NS	--	--	--	--	--
Arsenic	mg/L	0.340	--	--	--	--	--
Barium	mg/L	NS	0.3	ND (0.1)	0.29	ND (0.20)	--
Beryllium	mg/L	NS	--	--	--	--	--
Boron	mg/L	NS	--	--	--	--	--
Cadmium	mg/L	NCV	--	--	--	--	--
Calcium	mg/L	NS	--	--	--	--	--
Chromium	mg/L	NCV	0.16	0.06	0.144	0.033	--
Chromium, Hexavalent	mg/L	0.016	--	ND (0.02)	0.040	ND (0.005)	--
Cobalt	mg/L	0.110	--	--	--	--	--
Copper	mg/L	NCV	--	--	--	--	--
Iron	mg/L	0.300	0.02	0.03	ND (0.05)	ND (0.05)	--
Lead	mg/L	NCV	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	--	--
Manganese	mg/L	NS	0.02	0.02	ND (0.02)	ND (0.02)	--
Mercury	mg/L	0.0014	--	--	--	--	--
Nickel	mg/L	NCV	--	--	--	--	--
Potassium	mg/L	NS	--	--	--	--	--
Selenium	mg/L	NS	--	--	--	--	--
Silicon	mg/L	NS	0.6	0.9	0.70	3.4	--
Silver	mg/L	NCV	--	--	--	--	--
Sodium	mg/L	NS	--	--	--	--	--
Thallium	mg/L	0.020	--	--	--	--	--
Vanadium	mg/L	0.190	--	--	--	--	--
Zinc	mg/L	NCV	0.01	ND (0.01)	0.012	0.020	--
General Chemistry							
pH (water)	s.u.	NS	11.30	12.10	12.05	9.10	11.30

TABLE 4.6

HISTORICAL SURFACE WATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC*	*SW-6*	*SW-6*	*SW-6*	*SW-6*	*SW-6*
Sample ID:		*Ambient*	*Location6*	*Location6*	*Location6*	*Location6*	*Location6*
Sample Date:		*Water*	*1/6/1982*	*4/14/1982*	*3/1/1983*	*10/26/1983*	*2/24/1984*
Location Description:		*Quality* [(a)]	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*
Metals							
Aluminum	mg/L	NS	--	--	--	--	--
Antimony	mg/L	NS	--	--	--	--	--
Arsenic	mg/L	0.340	--	--	--	--	--
Barium	mg/L	NS	ND (0.2)	0.250	ND (0.2)	--	4.9
Beryllium	mg/L	NS	--	--	--	--	--
Boron	mg/L	NS	--	--	--	--	--
Cadmium	mg/L	NCV	--	--	--	--	--
Calcium	mg/L	NS	--	--	--	--	--
Chromium	mg/L	NCV	0.248	0.195	0.023	--	0.33
Chromium, Hexavalent	mg/L	0.016	0.042	0.053	0.014	--	0.17
Cobalt	mg/L	0.110	--	--	--	--	--
Copper	mg/L	NCV	--	--	--	--	--
Iron	mg/L	0.300	0.058	ND (0.050)	ND (0.05)	--	ND (0.05)
Lead	mg/L	NCV	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	--	--
Manganese	mg/L	NS	ND (0.020)	ND (0.020)	ND (0.02)	--	0.017
Mercury	mg/L	0.0014	--	--	--	--	--
Nickel	mg/L	NCV	--	--	--	--	--
Potassium	mg/L	NS	--	--	--	--	--
Selenium	mg/L	NS	--	--	--	--	--
Silicon	mg/L	NS	2.5	1.80	1.61	--	2.1
Silver	mg/L	NCV	--	--	--	--	--
Sodium	mg/L	NS	--	--	--	--	--
Thallium	mg/L	0.020	--	--	--	--	--
Vanadium	mg/L	0.190	--	--	--	--	--
Zinc	mg/L	NCV	0.050	ND (0.010)	ND (0.050)	--	ND (0.02)
General Chemistry							
pH (water)	s.u.	NS	--	11.05	11.18	11.99	12.29

TABLE 4.6

HISTORICAL SURFACE WATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:*		*NYSDEC* *Ambient* *Water* *Quality* [(a)]	*SW-6* *Location6* *4/11/1984* *NiMO/NMPA*	*SW-6* *Location6* *1/8/1985* *NiMO/NMPA*	*SW-6* *Location6* *4/3/1985* *NiMO/NMPA*	*SW-6* *Location6* *10/31/1985* *NiMO/NMPA*	*SW-6* *Location6* *1/23/1986* *NiMO/NMPA*
Metals							
Aluminum	mg/L	NS	--	--	--	--	--
Antimony	mg/L	NS	--	--	--	--	--
Arsenic	mg/L	0.340	--	--	--	--	--
Barium	mg/L	NS	0.12	0.137	--	--	--
Beryllium	mg/L	NS	--	--	--	--	--
Boron	mg/L	NS	--	--	--	--	--
Cadmium	mg/L	NCV	--	--	--	--	--
Calcium	mg/L	NS	--	--	--	--	--
Chromium	mg/L	NCV	--	0.135	--	--	--
Chromium, Hexavalent	mg/L	0.016	--	0.086	--	--	--
Cobalt	mg/L	0.110	--	--	--	--	--
Copper	mg/L	NCV	--	--	--	--	--
Iron	mg/L	0.300	--	ND (0.050)	--	--	--
Lead	mg/L	NCV	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	--	--
Manganese	mg/L	NS	--	ND (0.050)	--	--	--
Mercury	mg/L	0.0014	--	--	--	--	--
Nickel	mg/L	NCV	--	--	--	--	--
Potassium	mg/L	NS	--	--	--	--	--
Selenium	mg/L	NS	--	--	--	--	--
Silicon	mg/L	NS	--	ND (0.4)	--	--	--
Silver	mg/L	NCV	--	--	--	--	--
Sodium	mg/L	NS	--	--	--	--	--
Thallium	mg/L	0.020	--	--	--	--	--
Vanadium	mg/L	0.190	--	--	--	--	--
Zinc	mg/L	NCV	--	0.016	--	--	--
General Chemistry							
pH (water)	s.u.	NS	11.68	12.27	11.41	9.40	8.46

TABLE 4.6

HISTORICAL SURFACE WATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC*	*SW-6*	*SW-6*	*SW-6*	*SW-6*	*SW-6*
Sample ID:		*Ambient*	*Location6*	*Location6*	*Location6*	*Location6*	*SW-6*
Sample Date:		*Water*	*4/2/1986*	*8/4/1986*	*10/2/1986*	*4/15/1987*	*4/2/1989*
Location Description:		*Quality* (a)	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*
Metals							
Aluminum	mg/L	NS	--	--	--	--	--
Antimony	mg/L	NS	--	--	--	--	--
Arsenic	mg/L	0.340	--	--	--	--	--
Barium	mg/L	NS	0.113	--	--	0.085	--
Beryllium	mg/L	NS	--	--	--	--	--
Boron	mg/L	NS	--	--	--	--	--
Cadmium	mg/L	NCV	--	--	--	--	--
Calcium	mg/L	NS	--	--	--	--	--
Chromium	mg/L	NCV	0.179	--	--	0.103	--
Chromium, Hexavalent	mg/L	0.016	0.116	--	--	0.095	--
Cobalt	mg/L	0.110	--	--	--	--	--
Copper	mg/L	NCV	--	--	--	--	--
Iron	mg/L	0.300	0.063	--	--	0.051	--
Lead	mg/L	NCV	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	--	--
Manganese	mg/L	NS	ND (0.03)	--	--	ND (0.005)	--
Mercury	mg/L	0.0014	--	--	--	--	--
Nickel	mg/L	NCV	--	--	--	--	--
Potassium	mg/L	NS	--	--	--	--	--
Selenium	mg/L	NS	--	--	--	--	--
Silicon	mg/L	NS	1.59	--	--	2.27	--
Silver	mg/L	NCV	--	--	--	--	--
Sodium	mg/L	NS	--	--	--	--	--
Thallium	mg/L	0.020	--	--	--	--	--
Vanadium	mg/L	0.190	--	--	--	--	--
Zinc	mg/L	NCV	0.080	--	--	ND (0.01)	--
General Chemistry							
pH (water)	s.u.	NS	12.5	7.90	11.30	11.50	12.5

TABLE 4.6

HISTORICAL SURFACE WATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC*	*SW-6A*	*SW-6A*	*SW-6A*	*SW-6A*	*SW-6A*
Sample ID:		*Ambient*	*Location6A*	*Location6A*	*Location6A*	*Location6A*	*Location6A*
Sample Date:		*Water*	*1/16/1980*	*4/11/1980*	*7/8/1980*	*10/30/1980*	*4/7/1981*
Location Description:		*Quality* (a)	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*
Metals							
Aluminum	mg/L	NS	--	--	--	--	--
Antimony	mg/L	NS	--	--	--	--	--
Arsenic	mg/L	0.340	--	--	--	--	--
Barium	mg/L	NS	0.1	0.1	0.4	ND (0.1)	0.21
Beryllium	mg/L	NS	--	--	--	--	--
Boron	mg/L	NS	--	--	--	--	--
Cadmium	mg/L	NCV	--	--	--	--	--
Calcium	mg/L	NS	--	--	--	--	--
Chromium	mg/L	NCV	0.30	0.39	0.72	0.19	0.300
Chromium, Hexavalent	mg/L	0.016	--	--	--	ND (0.02)	0.100
Cobalt	mg/L	0.110	--	--	--	--	--
Copper	mg/L	NCV	--	--	--	--	--
Iron	mg/L	0.300	0.05	0.04	0.02	0.04	ND (0.05)
Lead	mg/L	NCV	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	--	--
Manganese	mg/L	NS	ND (0.01)	0.01	0.01	0.02	ND (0.02)
Mercury	mg/L	0.0014	--	--	--	--	--
Nickel	mg/L	NCV	--	--	--	--	--
Potassium	mg/L	NS	--	--	--	--	--
Selenium	mg/L	NS	--	--	--	--	--
Silicon	mg/L	NS	0.6	0.05	1.1	1.5	3.6
Silver	mg/L	NCV	--	--	--	--	--
Sodium	mg/L	NS	--	--	--	--	--
Thallium	mg/L	0.020	--	--	--	--	--
Vanadium	mg/L	0.190	--	--	--	--	--
Zinc	mg/L	NCV	0.01	ND (0.01)	ND (0.01)	0.01	ND (0.01)
General Chemistry							
pH (water)	s.u.	NS	12.20	11.75	11.55	11.90	11.91

TABLE 4.6

HISTORICAL SURFACE WATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC*	*SW-6A*	*SW-6A*	*SW-6A*	*SW-6A*	*SW-6A*
Sample ID:		*Ambient*	*Location6A*	*Location6A*	*Location6A*	*Location6A*	*Location6A*
Sample Date:		*Water*	*6/22/1981*	*10/29/1981*	*1/6/1982*	*4/14/1982*	*3/1/1983*
Location Description:		*Quality* (a)	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*
Metals							
Aluminum	mg/L	NS	--	--	--	--	--
Antimony	mg/L	NS	--	--	--	--	--
Arsenic	mg/L	0.340	--	--	--	--	--
Barium	mg/L	NS	0.26	ND (0.2)	ND (0.2)	--	ND (0.2)
Beryllium	mg/L	NS	--	--	--	--	--
Boron	mg/L	NS	--	--	--	--	--
Cadmium	mg/L	NCV	--	--	--	--	--
Calcium	mg/L	NS	--	--	--	--	--
Chromium	mg/L	NCV	0.158	0.658	0.461	0.469	0.599
Chromium, Hexavalent	mg/L	0.016	0.021	0.426	0.098	0.243	0.283
Cobalt	mg/L	0.110	--	--	--	--	--
Copper	mg/L	NCV	--	--	--	--	--
Iron	mg/L	0.300	ND (0.05)	ND (0.05)	0.053	ND (0.050)	ND (0.05)
Lead	mg/L	NCV	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	--	--
Manganese	mg/L	NS	ND (0.02)	0.020	ND (0.020)	ND (0.020)	ND (0.02)
Mercury	mg/L	0.0014	--	--	--	--	--
Nickel	mg/L	NCV	--	--	--	--	--
Potassium	mg/L	NS	--	--	--	--	--
Selenium	mg/L	NS	--	--	--	--	--
Silicon	mg/L	NS	6.0	0.2	3.5	2.50	1.71
Silver	mg/L	NCV	--	--	--	--	--
Sodium	mg/L	NS	--	--	--	--	--
Thallium	mg/L	0.020	--	--	--	--	--
Vanadium	mg/L	0.190	--	--	--	--	--
Zinc	mg/L	NCV	0.012	ND (0.050)	0.067	ND (0.010)	ND (0.050)
General Chemistry							
pH (water)	s.u.	NS	10.05	11.40	11.25	11.15	11.15

TABLE 4.6

HISTORICAL SURFACE WATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC*	*SW-6A*	*SW-6A*	*SW-6A*	*SW-6A*	*SW-6A*
Sample ID:		*Ambient*	*Location6A*	*Location6A*	*Location6A*	*Location6A*	*Location6A*
Sample Date:		*Water*	*10/26/1983*	*2/24/1984*	*4/11/1984*	*1/8/1985*	*4/3/1985*
Location Description:		*Quality* [(a)]	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*
Metals							
Aluminum	mg/L	NS	--	--	--	--	--
Antimony	mg/L	NS	--	--	--	--	--
Arsenic	mg/L	0.340	--	--	--	--	--
Barium	mg/L	NS	--	6.3	0.06	0.180	--
Beryllium	mg/L	NS	--	--	--	--	--
Boron	mg/L	NS	--	--	--	--	--
Cadmium	mg/L	NCV	--	--	--	--	--
Calcium	mg/L	NS	--	--	--	--	--
Chromium	mg/L	NCV	--	0.21	--	0.305	--
Chromium, Hexavalent	mg/L	0.016	--	0.10	--	0.258	--
Cobalt	mg/L	0.110	--	--	--	--	--
Copper	mg/L	NCV	--	--	--	--	--
Iron	mg/L	0.300	--	ND (0.05)	--	0.215	--
Lead	mg/L	NCV	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	--	--
Manganese	mg/L	NS	--	0.018	--	ND (0.050)	--
Mercury	mg/L	0.0014	--	--	--	--	--
Nickel	mg/L	NCV	--	--	--	--	--
Potassium	mg/L	NS	--	--	--	--	--
Selenium	mg/L	NS	--	--	--	--	--
Silicon	mg/L	NS	--	1.9	--	ND (0.4)	--
Silver	mg/L	NCV	--	--	--	--	--
Sodium	mg/L	NS	--	--	--	--	--
Thallium	mg/L	0.020	--	--	--	--	--
Vanadium	mg/L	0.190	--	--	--	--	--
Zinc	mg/L	NCV	--	ND (0.02)	--	0.016	--
General Chemistry							
pH (water)	s.u.	NS	12.06	12.4	11.67	12.48	11.48

TABLE 4.6

HISTORICAL SURFACE WATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC*	*SW-6A*	*SW-6A*	*SW-6A*	*SW-6A*	*SW-6A*
Sample ID:		*Ambient*	*Location6A*	*Location6A*	*Location6A*	*Location6A*	*Location6A*
Sample Date:		*Water*	*10/31/1985*	*4/2/1986*	*8/4/1986*	*10/2/1986*	*4/15/1987*
Location Description:		*Quality* [(a)]	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*
Metals							
Aluminum	mg/L	NS	--	--	--	--	--
Antimony	mg/L	NS	--	--	--	--	--
Arsenic	mg/L	0.340	--	--	--	--	--
Barium	mg/L	NS	--	0.275	--	--	0.226
Beryllium	mg/L	NS	--	--	--	--	--
Boron	mg/L	NS	--	--	--	--	--
Cadmium	mg/L	NCV	--	--	--	--	--
Calcium	mg/L	NS	--	--	--	--	--
Chromium	mg/L	NCV	--	0.463	--	--	0.333
Chromium, Hexavalent	mg/L	0.016	--	0.450	--	--	0.306
Cobalt	mg/L	0.110	--	--	--	--	--
Copper	mg/L	NCV	--	--	--	--	--
Iron	mg/L	0.300	--	0.159	--	--	0.308
Lead	mg/L	NCV	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	--	--
Manganese	mg/L	NS	--	ND (0.03)	--	--	0.021
Mercury	mg/L	0.0014	--	--	--	--	--
Nickel	mg/L	NCV	--	--	--	--	--
Potassium	mg/L	NS	--	--	--	--	--
Selenium	mg/L	NS	--	--	--	--	--
Silicon	mg/L	NS	--	1.38	--	--	2.22
Silver	mg/L	NCV	--	--	--	--	--
Sodium	mg/L	NS	--	--	--	--	--
Thallium	mg/L	0.020	--	--	--	--	--
Vanadium	mg/L	0.190	--	--	--	--	--
Zinc	mg/L	NCV	--	0.105	--	--	0.011
General Chemistry							
pH (water)	s.u.	NS	11.54	12.3	12.45	12.00	11.40

TABLE 4.6

HISTORICAL SURFACE WATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC*	*SW-6A*	*SW-6A*	*SW-6A*	*SW-6A*	*SW-6A*
Sample ID:		*Ambient*	*SW-6A*	*Point 6A*	*SW-6A*	*Point 6A*	*Point 6A*
Sample Date:		*Water*	*1/19/1989*	*6/1/1989*	*1/11/1990*	*12/1/1992*	*6/30/1993*
Location Description:		*Quality* [a]	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*
Metals							
Aluminum	mg/L	NS	--	--	--	--	0.2
Antimony	mg/L	NS	--	--	--	--	ND (0.05)
Arsenic	mg/L	0.340	--	--	--	--	ND (0.005)
Barium	mg/L	NS	--	--	--	--	0.4
Beryllium	mg/L	NS	--	--	--	--	ND (0.005)
Boron	mg/L	NS	--	--	--	--	--
Cadmium	mg/L	NCV	--	--	--	--	ND (0.005)
Calcium	mg/L	NS	--	--	--	--	810
Chromium	mg/L	NCV	--	0.18	--	0.16	0.92
Chromium, Hexavalent	mg/L	0.016	--	0.2	--	0.11	0.84
Cobalt	mg/L	0.110	--	--	--	--	--
Copper	mg/L	NCV	--	--	--	--	ND (0.01)
Iron	mg/L	0.300	--	--	--	--	0.31
Lead	mg/L	NCV	--	--	--	--	ND (0.005)
Magnesium	mg/L	NS	--	--	--	--	1.3
Manganese	mg/L	NS	--	--	--	--	0.03
Mercury	mg/L	0.0014	--	--	--	--	ND (0.001)
Nickel	mg/L	NCV	--	--	--	--	ND (0.02)
Potassium	mg/L	NS	--	--	--	--	64
Selenium	mg/L	NS	--	--	--	--	0.04
Silicon	mg/L	NS	--	--	--	--	--
Silver	mg/L	NCV	--	--	--	--	ND (0.005)
Sodium	mg/L	NS	--	--	--	--	77
Thallium	mg/L	0.020	--	--	--	--	ND (0.05)
Vanadium	mg/L	0.190	--	--	--	--	--
Zinc	mg/L	NCV	--	--	--	--	0.13
General Chemistry							
pH (water)	s.u.	NS	12.69	11.61	12.5	11.71	12.53

TABLE 4.6

HISTORICAL SURFACE WATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC*	*SW-6A*	*SW-6A*	*SW-6A*	*SW-6A*	*SW-6A*
Sample ID:		*Ambient*	*Point 6A*	*Point 6A*	*Point 6A*	*Point 6A*	*Point 6A*
Sample Date:		*Water*	*12/7/1993*	*3/23/1994*	*6/28/1994*	*9/20/1994*	*3/16/1995*
Location Description:		*Quality* [(a)]	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*
Metals							
Aluminum	mg/L	NS	--	--	--	--	--
Antimony	mg/L	NS	--	--	--	--	--
Arsenic	mg/L	0.340	--	--	--	--	--
Barium	mg/L	NS	--	--	--	--	--
Beryllium	mg/L	NS	--	--	--	--	--
Boron	mg/L	NS	--	--	--	--	--
Cadmium	mg/L	NCV	ND (0.001)	ND (0.0005)	ND (0.0005)	ND (0.005)	ND (0.0005)
Calcium	mg/L	NS	126	82	330	588	127
Chromium	mg/L	NCV	--	--	--	--	--
Chromium, Hexavalent	mg/L	0.016	--	--	--	--	--
Cobalt	mg/L	0.110	--	--	--	--	--
Copper	mg/L	NCV	--	--	--	--	--
Iron	mg/L	0.300	0.46	0.1	1.4	0.07	0.05
Lead	mg/L	NCV	ND (0.005)	ND (0.005)	0.014	0.015	ND (0.005)
Magnesium	mg/L	NS	6.1	3.8	3.9	0.08	3.7
Manganese	mg/L	NS	ND (0.005)	0.02	0.09	ND (0.005)	0.01
Mercury	mg/L	0.0014	--	--	--	--	--
Nickel	mg/L	NCV	--	--	--	--	--
Potassium	mg/L	NS	30	15	37	54	23
Selenium	mg/L	NS	--	--	--	--	--
Silicon	mg/L	NS	--	--	--	--	--
Silver	mg/L	NCV	--	--	--	--	--
Sodium	mg/L	NS	37	44	60	72	86
Thallium	mg/L	0.020	--	--	--	--	--
Vanadium	mg/L	0.190	--	--	--	--	--
Zinc	mg/L	NCV	--	--	--	--	--
General Chemistry							
pH (water)	s.u.	NS	12.09	12.13	12.31	12.67	13.2

TABLE 4.6

HISTORICAL SURFACE WATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC*	*SW-6A*	*SW-6A*	*SW-6A*	*SW-6A*	*SW-6A*
Sample ID:		*Ambient*	*Point 6A*	*Point 6A*	*Point 6A*	*Point 6A*	*Point 6A*
Sample Date:		*Water*	*6/6/1995*	*10/27/1995*	*12/13/1995*	*1/25/1996*	*4/19/1996*
Location Description:		*Quality (a)*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*
Metals							
Aluminum	mg/L	NS	--	--	ND (0.05)	--	0.18
Antimony	mg/L	NS	--	--	ND (0.05)	--	ND (0.05)
Arsenic	mg/L	0.340	--	--	ND (0.002)	--	ND (0.005)
Barium	mg/L	NS	--	--	0.24	--	0.18
Beryllium	mg/L	NS	--	--	ND (0.005)	--	ND (0.005)
Boron	mg/L	NS	--	--	--	--	--
Cadmium	mg/L	NCV	ND (0.0002)	ND (0.0002)	ND (0.005)	ND (0.0005)	ND (0.005)
Calcium	mg/L	NS	71	300	376	250	280
Chromium	mg/L	NCV	--	--	1.5	--	0.44
Chromium, Hexavalent	mg/L	0.016	--	--	0.57	--	0.36
Cobalt	mg/L	0.110	--	--	--	--	--
Copper	mg/L	NCV	--	--	ND (0.01)	--	0.01
Iron	mg/L	0.300	0.05	0.42	4.6	0.16	1
Lead	mg/L	NCV	0.008	0.005	ND (0.002)	0.002	0.006
Magnesium	mg/L	NS	1.9	2.9	376	1	1.6
Manganese	mg/L	NS	0.009	0.03	0.1	0.01	0.04
Mercury	mg/L	0.0014	--	--	ND (0.0005)	--	ND (0.001)
Nickel	mg/L	NCV	--	--	0.48	--	ND (0.02)
Potassium	mg/L	NS	64	33	38	29	30
Selenium	mg/L	NS	--	--	ND (0.002)	--	ND (0.005)
Silicon	mg/L	NS	--	--	--	--	--
Silver	mg/L	NCV	--	--	ND (0.005)	--	ND (0.005)
Sodium	mg/L	NS	74	47	72	55	64
Thallium	mg/L	0.020	--	--	0.05	--	ND (0.05)
Vanadium	mg/L	0.190	--	--	--	--	--
Zinc	mg/L	NCV	--	--	ND (0.02)	--	ND (0.02)
General Chemistry							
pH (water)	s.u.	NS	12.35	11.99 *	12.6	12.92	13.6

TABLE 4.6

HISTORICAL SURFACE WATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:*		*NYSDEC* *Ambient* *Water* *Quality* [a]	*SW-6A* *Point 6A* *7/11/1996* *NiMO/NMPA*	*SW-6A* *Point 6A* *11/1/1996* *NiMO/NMPA*	*SW-6A* *Point 6A* *1/30/1997* *NiMO/NMPA*	*SW-6A* *Point 6A* *4/30/1997* *NiMO/NMPA*	*SW-6A* *Point 6A* *10/23/1997* *NiMO/NMPA*
Metals							
Aluminum	mg/L	NS	--	--	--	--	0.23
Antimony	mg/L	NS	--	--	--	--	ND (0.24)
Arsenic	mg/L	0.340	--	--	--	--	ND (0.002)
Barium	mg/L	NS	--	--	--	--	0.178
Beryllium	mg/L	NS	--	--	--	--	ND (0.002)
Boron	mg/L	NS	--	--	--	--	--
Cadmium	mg/L	NCV	ND (0.001)	--	ND (0.001)	ND (0.001)	ND (0.016)
Calcium	mg/L	NS	440 D	120 D	410 D	230 D	180 D
Chromium	mg/L	NCV	--	--	--	--	0.530
Chromium, Hexavalent	mg/L	0.016	--	ND (0.32)	0.42	0.28	0.54
Cobalt	mg/L	0.110	--	--	--	--	--
Copper	mg/L	NCV	--	--	--	--	0.013
Iron	mg/L	0.300	0.15	0.09	0.45	0.16	0.152
Lead	mg/L	NCV	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.002)
Magnesium	mg/L	NS	1.1	ND (0.05)	0.4	1.9	0.65
Manganese	mg/L	NS	0.012	ND (0.005)	0.007	0.007	ND (0.010)
Mercury	mg/L	0.0014	--	--	--	--	ND (0.0004)
Nickel	mg/L	NCV	--	--	--	--	ND (0.050)
Potassium	mg/L	NS	65	23	87	33	26
Selenium	mg/L	NS	--	--	--	--	0.009
Silicon	mg/L	NS	--	--	--	--	--
Silver	mg/L	NCV	--	--	--	--	ND (0.010)
Sodium	mg/L	NS	66	33	70	75	39
Thallium	mg/L	0.020	--	--	--	--	ND (0.05)
Vanadium	mg/L	0.190	--	--	--	--	--
Zinc	mg/L	NCV	--	--	--	--	ND (0.016)
General Chemistry							
pH (water)	s.u.	NS	12.91	11.65	12.67	12.37	12.24

TABLE 4.6

HISTORICAL SURFACE WATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC*	*SW-6A*	*SW-7*	*SW-7*	*SW-7*	*SW-7*
Sample ID:		*Ambient*	*Point 6A*	*Location7*	*Location7*	*Location7*	*Location7*
Sample Date:		*Water*	*1/22/1998*	*3/7/1979*	*4/11/1979*	*5/14/1979*	*6/11/1979*
Location Description:		*Quality* [(a)]	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*
Metals							
Aluminum	mg/L	NS	ND (0.10)	--	--	--	--
Antimony	mg/L	NS	ND (0.24)	--	--	--	--
Arsenic	mg/L	0.340	ND (0.002)	--	--	--	--
Barium	mg/L	NS	0.382	0.05	0.10	0.20	0.20
Beryllium	mg/L	NS	ND (0.002)	--	--	--	--
Boron	mg/L	NS	--	--	--	--	--
Cadmium	mg/L	NCV	ND (0.016)	--	--	--	--
Calcium	mg/L	NS	410 D	--	--	--	--
Chromium	mg/L	NCV	0.55	0.48	0.59	0.95	1.1
Chromium, Hexavalent	mg/L	0.016	0.56	--	--	--	--
Cobalt	mg/L	0.110	--	--	--	--	--
Copper	mg/L	NCV	ND (0.010)	--	--	--	--
Iron	mg/L	0.300	ND (0.060)	0.06	0.18	0.02	0.02
Lead	mg/L	NCV	ND (0.002)	--	--	--	--
Magnesium	mg/L	NS	0.50	--	--	--	--
Manganese	mg/L	NS	ND (0.010)	0.01	0.03	0.01	ND (0.01)
Mercury	mg/L	0.0014	ND (0.0004)	--	--	--	--
Nickel	mg/L	NCV	ND (0.050)	--	--	--	--
Potassium	mg/L	NS	77	--	--	--	--
Selenium	mg/L	NS	0.015	--	--	--	--
Silicon	mg/L	NS	--	3.3	5.0	2.5	0.8
Silver	mg/L	NCV	ND (0.010)	--	--	--	--
Sodium	mg/L	NS	64	--	--	--	--
Thallium	mg/L	0.020	ND (0.05)	--	--	--	--
Vanadium	mg/L	0.190	--	--	--	--	--
Zinc	mg/L	NCV	ND (0.016)	0.01	0.01	0.01	ND (0.01)
General Chemistry							
pH (water)	s.u.	NS	12.35	11.70	11.80	11.60	12.10

TABLE 4.6

HISTORICAL SURFACE WATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:*		*NYSDEC* *Ambient* *Water* *Quality* [(a)]	*SW-7* *Location7* *12/14/1979* *NiMO/NMPA*	*SW-7* *Location7* *1/16/1980* *NiMO/NMPA*	*SW-7* *Location7* *4/11/1980* *NiMO/NMPA*	*SW-7* *Location7* *7/8/1980* *NiMO/NMPA*	*SW-7* *Location7* *10/30/1980* *NiMO/NMPA*
Metals							
Aluminum	mg/L	NS	--	--	--	--	--
Antimony	mg/L	NS	--	--	--	--	--
Arsenic	mg/L	0.340	--	--	--	--	--
Barium	mg/L	NS	0.15	ND (0.1)	0.2	0.9	0.5
Beryllium	mg/L	NS	--	--	--	--	--
Boron	mg/L	NS	--	--	--	--	--
Cadmium	mg/L	NCV	--	--	--	--	--
Calcium	mg/L	NS	--	--	--	--	--
Chromium	mg/L	NCV	0.17	0.35	1.6	2.2	0.82
Chromium, Hexavalent	mg/L	0.016	--	--	--	--	0.03
Cobalt	mg/L	0.110	--	--	--	--	--
Copper	mg/L	NCV	--	--	--	--	--
Iron	mg/L	0.300	0.12	0.06	0.02	ND (0.02)	0.07
Lead	mg/L	NCV	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	--	--
Manganese	mg/L	NS	ND (0.005)	ND (0.01)	ND (0.01)	ND (0.01)	0.02
Mercury	mg/L	0.0014	--	--	--	--	--
Nickel	mg/L	NCV	--	--	--	--	--
Potassium	mg/L	NS	--	--	--	--	--
Selenium	mg/L	NS	--	--	--	--	--
Silicon	mg/L	NS	--	0.5	0.05	ND (0.01)	0.5
Silver	mg/L	NCV	--	--	--	--	--
Sodium	mg/L	NS	--	--	--	--	--
Thallium	mg/L	0.020	--	--	--	--	--
Vanadium	mg/L	0.190	--	--	--	--	--
Zinc	mg/L	NCV	0.015	0.01	0.02	ND (0.01)	0.01
General Chemistry							
pH (water)	s.u.	NS	11.40	12.30	11.75	11.65	12.30

TABLE 4.6

HISTORICAL SURFACE WATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC*	*SW-7*	*SW-7*	*SW-7*	*SW-7*	*SW-7*
Sample ID:		*Ambient*	*Location7*	*Location7*	*Location7*	*Location7*	*Location7*
Sample Date:		*Water*	*4/7/1981*	*6/22/1981*	*10/29/1981*	*1/6/1982*	*4/14/1982*
Location Description:		*Quality* [(a)]	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*
Metals							
Aluminum	mg/L	NS	--	--	--	--	--
Antimony	mg/L	NS	--	--	--	--	--
Arsenic	mg/L	0.340	--	--	--	--	--
Barium	mg/L	NS	0.37	0.40	ND (0.2)	ND (0.2)	0.214
Beryllium	mg/L	NS	--	--	--	--	--
Boron	mg/L	NS	--	--	--	--	--
Cadmium	mg/L	NCV	--	--	--	--	--
Calcium	mg/L	NS	--	--	--	--	--
Chromium	mg/L	NCV	1.73	0.384	1.800	0.438	1.25
Chromium, Hexavalent	mg/L	0.016	1.27	0.130	0.860	0.114	0.851
Cobalt	mg/L	0.110	--	--	--	--	--
Copper	mg/L	NCV	--	--	--	--	--
Iron	mg/L	0.300	ND (0.05)	ND (0.05)	ND (0.05)	0.066	ND (0.050)
Lead	mg/L	NCV	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	--	--
Manganese	mg/L	NS	ND (0.02)	ND (0.02)	0.022	ND (0.020)	ND (0.020)
Mercury	mg/L	0.0014	--	--	--	--	--
Nickel	mg/L	NCV	--	--	--	--	--
Potassium	mg/L	NS	--	--	--	--	--
Selenium	mg/L	NS	--	--	--	--	--
Silicon	mg/L	NS	0.50	6.4	0.2	3.0	1.30
Silver	mg/L	NCV	--	--	--	--	--
Sodium	mg/L	NS	--	--	--	--	--
Thallium	mg/L	0.020	--	--	--	--	--
Vanadium	mg/L	0.190	--	--	--	--	--
Zinc	mg/L	NCV	ND (0.01)	ND (0.010)	ND (0.05)	0.029	ND (0.010)
General Chemistry							
pH (water)	s.u.	NS	12.05	10.77	11.52	11.35	11.20

TABLE 4.6

HISTORICAL SURFACE WATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC*	*SW-7*	*SW-7*	*SW-7*	*SW-7*	*SW-7*
Sample ID:		*Ambient*	*Location7*	*Location7*	*Location7*	*Location7*	*Location7*
Sample Date:		*Water*	*3/1/1983*	*10/26/1983*	*2/24/1984*	*4/11/1984*	*1/8/1985*
Location Description:		*Quality* [(a)]	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*
Metals							
Aluminum	mg/L	NS	--	--	--	--	--
Antimony	mg/L	NS	--	--	--	--	--
Arsenic	mg/L	0.340	--	--	--	--	--
Barium	mg/L	NS	ND (0.2)	--	4.9	0.06	0.276
Beryllium	mg/L	NS	--	--	--	--	--
Boron	mg/L	NS	--	--	--	--	--
Cadmium	mg/L	NCV	--	--	--	--	--
Calcium	mg/L	NS	--	--	--	--	--
Chromium	mg/L	NCV	2.640	--	0.88	--	0.927
Chromium, Hexavalent	mg/L	0.016	0.980	--	0.55	--	0.561
Cobalt	mg/L	0.110	--	--	--	--	--
Copper	mg/L	NCV	--	--	--	--	--
Iron	mg/L	0.300	ND (0.05)	--	ND (0.05)	--	ND (0.050)
Lead	mg/L	NCV	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	--	--
Manganese	mg/L	NS	ND (0.05)	--	0.014	--	ND (0.050)
Mercury	mg/L	0.0014	--	--	--	--	--
Nickel	mg/L	NCV	--	--	--	--	--
Potassium	mg/L	NS	--	--	--	--	--
Selenium	mg/L	NS	--	--	--	--	--
Silicon	mg/L	NS	2.9	--	1.9	--	ND (0.4)
Silver	mg/L	NCV	--	--	--	--	--
Sodium	mg/L	NS	--	--	--	--	--
Thallium	mg/L	0.020	--	--	--	--	--
Vanadium	mg/L	0.190	--	--	--	--	--
Zinc	mg/L	NCV	ND (0.050)	--	ND (0.02)	--	0.009
General Chemistry							
pH (water)	s.u.	NS	11.55	12.29	12.36	11.71	7.69

TABLE 4.6

HISTORICAL SURFACE WATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC*	*SW-7*	*SW-7*	*SW-7*	*SW-7*	*SW-7*
Sample ID:		*Ambient*	*Location7*	*Location7*	*Location7*	*Location7*	*Location7*
Sample Date:		*Water*	*4/3/1985*	*7/25/1985*	*10/31/1985*	*1/23/1986*	*4/2/1986*
Location Description:		*Quality* [(a)]	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*
Metals							
Aluminum	mg/L	NS	--	--	--	--	--
Antimony	mg/L	NS	--	--	--	--	--
Arsenic	mg/L	0.340	--	--	--	--	--
Barium	mg/L	NS	--	--	--	--	0.181
Beryllium	mg/L	NS	--	--	--	--	--
Boron	mg/L	NS	--	--	--	--	--
Cadmium	mg/L	NCV	--	--	--	--	--
Calcium	mg/L	NS	--	--	--	--	--
Chromium	mg/L	NCV	--	--	--	--	0.403
Chromium, Hexavalent	mg/L	0.016	--	--	--	--	0.371
Cobalt	mg/L	0.110	--	--	--	--	--
Copper	mg/L	NCV	--	--	--	--	--
Iron	mg/L	0.300	--	--	--	--	0.202
Lead	mg/L	NCV	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	--	--
Manganese	mg/L	NS	--	--	--	--	ND (0.03)
Mercury	mg/L	0.0014	--	--	--	--	--
Nickel	mg/L	NCV	--	--	--	--	--
Potassium	mg/L	NS	--	--	--	--	--
Selenium	mg/L	NS	--	--	--	--	--
Silicon	mg/L	NS	--	--	--	--	1.62
Silver	mg/L	NCV	--	--	--	--	--
Sodium	mg/L	NS	--	--	--	--	--
Thallium	mg/L	0.020	--	--	--	--	--
Vanadium	mg/L	0.190	--	--	--	--	--
Zinc	mg/L	NCV	--	--	--	--	0.247
General Chemistry							
pH (water)	s.u.	NS	11.43	12.22	11.70	12.12	12.3

TABLE 4.6

HISTORICAL SURFACE WATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC*	*SW-7*	*SW-7*	*SW-7*	*SW-7*	*SW-7*
Sample ID:		*Ambient*	*Location7*	*SW-7*	*Location7*	*Location7*	*Point 7*
Sample Date:		*Water*	*8/4/1986*	*8/4/1986*	*10/2/1986*	*4/15/1987*	*6/1/1989*
Location Description:		*Quality* [a]	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*
Metals							
Aluminum	mg/L	NS	--	--	--	--	--
Antimony	mg/L	NS	--	--	--	--	--
Arsenic	mg/L	0.340	--	--	--	--	--
Barium	mg/L	NS	--	--	--	0.148	--
Beryllium	mg/L	NS	--	--	--	--	--
Boron	mg/L	NS	--	--	--	--	--
Cadmium	mg/L	NCV	--	--	--	--	--
Calcium	mg/L	NS	--	--	--	--	--
Chromium	mg/L	NCV	--	--	--	0.281	0.23
Chromium, Hexavalent	mg/L	0.016	--	--	--	0.244	0.36
Cobalt	mg/L	0.110	--	--	--	--	--
Copper	mg/L	NCV	--	--	--	--	--
Iron	mg/L	0.300	--	--	--	0.481	--
Lead	mg/L	NCV	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	--	--
Manganese	mg/L	NS	--	--	--	0.064	--
Mercury	mg/L	0.0014	--	--	--	--	--
Nickel	mg/L	NCV	--	--	--	--	--
Potassium	mg/L	NS	--	--	--	--	--
Selenium	mg/L	NS	--	--	--	--	--
Silicon	mg/L	NS	--	--	--	2.74	--
Silver	mg/L	NCV	--	--	--	--	--
Sodium	mg/L	NS	--	--	--	--	--
Thallium	mg/L	0.020	--	--	--	--	--
Vanadium	mg/L	0.190	--	--	--	--	--
Zinc	mg/L	NCV	--	--	--	ND (0.01)	--
General Chemistry							
pH (water)	s.u.	NS	12.65	12.65	12.15	11.10	12.04

TABLE 4.6

HISTORICAL SURFACE WATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC*	*SW-7*	*SW-7*	*SW-7*	*SW-7*	*SW-7*
Sample ID:		*Ambient*	*Point 7*	*Point 7*	*Point 7*	*Point 7*	*Point 7*
Sample Date:		*Water*	*8/1/1989*	*12/1/1992*	*12/7/1993*	*3/23/1994*	*6/28/1994*
Location Description:		*Quality* [(a)]	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*
Metals							
Aluminum	mg/L	NS	--	--	--	--	--
Antimony	mg/L	NS	--	--	--	--	--
Arsenic	mg/L	0.340	--	--	--	--	--
Barium	mg/L	NS	--	--	--	--	--
Beryllium	mg/L	NS	--	--	--	--	--
Boron	mg/L	NS	--	--	--	--	--
Cadmium	mg/L	NCV	--	--	ND (0.001)	ND (0.0005)	ND (0.0005)
Calcium	mg/L	NS	--	--	170	184	187
Chromium	mg/L	NCV	0.23	0.34	--	--	--
Chromium, Hexavalent	mg/L	0.016	0.36	0.2	--	--	--
Cobalt	mg/L	0.110	--	--	--	--	--
Copper	mg/L	NCV	--	--	--	--	--
Iron	mg/L	0.300	--	--	0.09	0.3	0.95
Lead	mg/L	NCV	--	--	ND (0.005)	ND (0.005)	0.01
Magnesium	mg/L	NS	--	--	2	3.5	5.2
Manganese	mg/L	NS	--	--	ND (0.005)	0.02	0.12
Mercury	mg/L	0.0014	--	--	--	--	--
Nickel	mg/L	NCV	--	--	--	--	--
Potassium	mg/L	NS	--	--	17	40	21
Selenium	mg/L	NS	--	--	--	--	--
Silicon	mg/L	NS	--	--	--	--	--
Silver	mg/L	NCV	--	--	--	--	--
Sodium	mg/L	NS	--	--	41	45	54
Thallium	mg/L	0.020	--	--	--	--	--
Vanadium	mg/L	0.190	--	--	--	--	--
Zinc	mg/L	NCV	--	--	--	--	--
General Chemistry							
pH (water)	s.u.	NS	12.37	12.37	12.41	12.3	12.2

TABLE 4.6

HISTORICAL SURFACE WATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC*	*SW-7*	*SW-7*	*SW-7*	*SW-7*	*SW-7*
Sample ID:		*Ambient*	*Point 7*	*Point 7*	*Point 7*	*Point 7*	*Point 7*
Sample Date:		*Water*	*12/12/1994*	*3/16/1995*	*10/27/1995*	*1/24/1996*	*4/19/1996*
Location Description:		*Quality* [(a)]	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*
Metals							
Aluminum	mg/L	NS	ND (0.05)	--	--	--	ND (0.05)
Antimony	mg/L	NS	ND (0.05)	--	--	--	ND (0.05)
Arsenic	mg/L	0.340	ND (0.002)	--	--	--	ND (0.005)
Barium	mg/L	NS	0.2	--	--	--	0.11
Beryllium	mg/L	NS	ND (0.005)	--	--	--	ND (0.005)
Boron	mg/L	NS	--	--	--	--	--
Cadmium	mg/L	NCV	ND (0.005)	ND (0.0005)	ND (0.0002)	ND (0.0005)	ND (0.005)
Calcium	mg/L	NS	201	439	480	390	190
Chromium	mg/L	NCV	ND (0.01)	--	--	--	0.25
Chromium, Hexavalent	mg/L	0.016	0.32	--	--	--	0.24
Cobalt	mg/L	0.110	--	--	--	--	--
Copper	mg/L	NCV	ND (0.01)	--	--	--	ND (0.01)
Iron	mg/L	0.300	ND (0.05)	0.28	0.11	ND (0.05)	ND (0.05)
Lead	mg/L	NCV	ND (0.002)	ND (0.005)	0.002	0.005	0.005
Magnesium	mg/L	NS	1.7	ND (0.05)	0.54	0.93	1.2
Manganese	mg/L	NS	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
Mercury	mg/L	0.0014	ND (0.0005)	--	--	--	ND (0.001)
Nickel	mg/L	NCV	ND (0.02)	--	--	--	ND (0.02)
Potassium	mg/L	NS	21	92	26	93	9.2
Selenium	mg/L	NS	0.006	--	--	--	ND (0.005)
Silicon	mg/L	NS	--	--	--	--	--
Silver	mg/L	NCV	ND (0.005)	--	--	--	ND (0.005)
Sodium	mg/L	NS	70	84	40	78	67
Thallium	mg/L	0.020	ND (0.05)	--	--	--	ND (0.05)
Vanadium	mg/L	0.190	--	--	--	--	--
Zinc	mg/L	NCV	ND (0.02)	--	--	--	ND (0.02)
General Chemistry							
pH (water)	s.u.	NS	12.78	13.63	11.84	15.19	13.6

TABLE 4.6

HISTORICAL SURFACE WATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		***NYSDEC***	***SW-7***	***SW-7***	***SW-7***	***SW-7***	***SW-7***
Sample ID:		***Ambient***	***Point 7***	***Point 7***	***Point 7***	***Point 7***	***Point 7***
Sample Date:		***Water***	***11/1/1996***	***1/30/1997***	***4/30/1997***	***10/23/1997***	***1/22/1998***
Location Description:		***Quality*** [a]	***NiMO/NMPA***	***NiMO/NMPA***	***NiMO/NMPA***	***NiMO/NMPA***	***NiMO/NMPA***
Metals							
Aluminum	mg/L	NS	--	--	--	0.23	0.23
Antimony	mg/L	NS	--	--	--	ND (0.24)	ND (0.24)
Arsenic	mg/L	0.340	--	--	--	ND (0.002)	ND (0.002)
Barium	mg/L	NS	--	--	--	0.333	0.344
Beryllium	mg/L	NS	--	--	--	ND (0.002)	ND (0.002)
Boron	mg/L	NS	--	--	--	--	--
Cadmium	mg/L	NCV	--	ND (0.001)	ND (0.001)	ND (0.016)	ND (0.016)
Calcium	mg/L	NS	260 D	710 D	600 D	500 D	590 D
Chromium	mg/L	NCV	--	--	--	0.705	0.72
Chromium, Hexavalent	mg/L	0.016	0.38	0.64	0.75	0.68	0.72
Cobalt	mg/L	0.110	--	--	--	--	--
Copper	mg/L	NCV	--	--	--	0.018	0.010
Iron	mg/L	0.300	0.59	3.8	0.11	0.402	0.530
Lead	mg/L	NCV	0.008	0.008	ND (0.005)	0.002	0.003
Magnesium	mg/L	NS	3.2	11	0.27	0.80	2.2
Manganese	mg/L	NS	0.02	0.2	0.006	0.25	0.028
Mercury	mg/L	0.0014	--	--	--	ND (0.0004)	ND (0.0004)
Nickel	mg/L	NCV	--	--	--	ND (0.050)	ND (0.050)
Potassium	mg/L	NS	72	57	59	48	61
Selenium	mg/L	NS	--	--	--	0.035	0.033
Silicon	mg/L	NS	--	--	--	--	--
Silver	mg/L	NCV	--	--	--	ND (0.010)	ND (0.010)
Sodium	mg/L	NS	65	60	56	58	64
Thallium	mg/L	0.020	--	--	--	ND (0.05)	ND (0.05)
Vanadium	mg/L	0.190	--	--	--	--	--
Zinc	mg/L	NCV	--	--	--	ND (0.016)	ND (0.016)
General Chemistry							
pH (water)	s.u.	NS	11.88	12.77	12.56	12.5	12.38

TABLE 4.6

HISTORICAL SURFACE WATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC*	*SW-102*	*SW-102*	*SW-103*	*SW-105*
Sample ID:		*Ambient*	*SW-102*	*SW-102*	*SW-103*	*SW-105*
Sample Date:		*Water*	*1/1/1989*	*1/1/1989*	*1/1/1989*	*1/1/1989*
Location Description:		*Quality* [(a)]	*SKW Landfill*	*SKW Landfill Duplicate*	*NYPA/PASNY*	*NYPA/PASNY*
Metals						
Aluminum	mg/L	NS	0.179	ND (0.2)	0.051	0.188
Antimony	mg/L	NS	--	--	--	--
Arsenic	mg/L	0.340	--	--	--	--
Barium	mg/L	NS	0.0908	ND (0.2)	0.0356	0.0494
Beryllium	mg/L	NS	--	--	--	--
Boron	mg/L	NS	--	--	--	--
Cadmium	mg/L	NCV	ND (0.005)	0.003	ND (0.005)	ND (0.005)
Calcium	mg/L	NS	64.6 J	0.717 J	39.1	33.7
Chromium	mg/L	NCV	R	ND (0.01)	ND (0.01)	ND (0.01)
Chromium, Hexavalent	mg/L	0.016	0.16	0.16	ND (0.01)	ND (0.01)
Cobalt	mg/L	0.110	--	--	--	--
Copper	mg/L	NCV	0.0144	0.0106	ND (0.025)	ND (0.025)
Iron	mg/L	0.300	0.102	0.0552	0.0786	0.951
Lead	mg/L	NCV	ND (0.003)	ND (0.003)	ND (0.003)	0.0092 J
Magnesium	mg/L	NS	2.18	ND (5)	17.2	11
Manganese	mg/L	NS	0.0342 J	ND (0.015)	0.155	0.151
Mercury	mg/L	0.0014	--	--	--	--
Nickel	mg/L	NCV	--	--	--	--
Potassium	mg/L	NS	29 J	1.08 J	6.91	5.29
Selenium	mg/L	NS	0.0074	0.0068	R	R
Silicon	mg/L	NS	--	--	--	--
Silver	mg/L	NCV	--	--	--	--
Sodium	mg/L	NS	39.8 J	0.477 J	13.4	8.54
Thallium	mg/L	0.020	ND (0.01)	ND (0.01)	R	R
Vanadium	mg/L	0.190	ND (0.05)	0.0058	ND (0.05)	ND (0.05)
Zinc	mg/L	NCV	0.0124	ND (0.02)	ND (0.02)	0.0404
General Chemistry						
pH (water)	s.u.	NS	12.2	--	7.5	7.2

TABLE 4.6

HISTORICAL SURFACE WATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Notes:
* - Duplicate Analysis not within control limits.
B - Indicates a value greater than or equal to the instrument detection limit, but less than the contract required detection limit.
E - MIndicates a value estimated or not reported due to the presence of interference.
E - The associated numerical value is an estimated quantity or Compound detected below sample quantitation limit.
N - Indicates spike sample recovery was not within the control limits.
ND() - Non detect at associated value.
NW - Value Estimated
NCV - No Calculated Value. Criteria depends on hardness values.
NS - No Standard
R - Rejected
-- Not applicable
NS - No Standard
(a) - Technical Guidance for Screening Contaminated Sediments, NYSDEC, January 25, 1999.

TABLE 4.7

HISTORICAL pH RESULTS FOR SURFACE WATER
PHASE 1 WORK PLAN
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample ID	*Sample Date*	*pH Reading*	*Sample ID*	*Sample Date*	*pH Reading*
1	3/27/98	7.45	SW-6	6/11/79	11.85
3	3/27/98	12.16	SW-6	12/14/79	11.4
4	3/27/98	11.52	SW-6	1/16/80	12.3
5	3/27/98	11.65	SW-6	4/11/80	11.7
6	3/27/98	11.72	SW-6	7/8/80	11.3
7	3/27/98	9.81	SW-6	10/30/80	12.1
8	3/27/98	7.08	SW-6	4/7/81	12.05
9	3/27/98	11.8	SW-6	6/22/81	9.1
10	3/27/98	8.38	SW-6	10/29/81	11.3
12	3/27/98	8.13	SW-6	4/14/82	11.05
13	3/27/98	12.33	SW-6	3/1/83	11.18
14	3/27/98	10.77	SW-6	10/26/83	11.99
15	3/27/98	11.15	SW-6	2/24/84	12.29
16	3/27/98	10.94	SW-6	4/11/84	11.68
17	3/27/98	10.23	SW-6	1/8/85	12.27
18	3/27/98	9.98	SW-6	4/3/85	11.41
19	3/27/98	11.75	SW-6	10/31/85	9.4
20	3/27/98	8.5	SW-6	1/23/86	8.46
21	3/27/98	10.21	SW-6	4/2/86	12.5
22	3/27/98	9.18	SW-6	8/4/86	7.9
23	3/27/98	10.49	SW-6	10/2/86	11.3
24	3/27/98	10.05	SW-6	4/15/87	11.5
25	3/27/98	10.55	SW-6	4/2/89	12.5
26	3/27/98	10.7	SW-6A	1/16/80	12.2
27	3/27/98	9.53	SW-6A	4/11/80	11.75
28	3/27/98	9.42	SW-6A	7/8/80	11.55
29	3/27/98	9.06	SW-6A	10/30/80	11.9
30	3/27/98	9.88	SW-6A	4/7/81	11.91
31	3/27/98	7.95	SW-6A	6/22/81	10.05
32	3/27/98	8.48	SW-6A	10/29/81	11.4
33	3/27/98	6.16	SW-6A	1/6/82	11.25
34	3/27/98	6.49	SW-6A	4/14/82	11.15
35	3/27/98	6.48	SW-6A	3/1/83	11.15
36	3/27/98	12	SW-6A	10/26/83	12.06
Outfall	1/29/99	6.57	SW-6A	2/24/84	12.4
Outfall-1	2/12/99	7.98	SW-6A	4/11/84	11.67
SW-102	1/1/89	12.2	SW-6A	1/8/85	12.48
SW-103	1/1/89	7.5	SW-6A	4/3/85	11.48
SW-105	1/1/89	7.2	SW-6A	10/31/85	11.54
SW-6	3/7/79	11.75	SW-6A	4/2/86	12.3
SW-6	4/11/79	12.05	SW-6A	8/4/86	12.45

TABLE 4.7

HISTORICAL pH RESULTS FOR SURFACE WATER
PHASE 1 WORK PLAN
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample ID	*Sample Date*	*pH Reading*	*Sample ID*	*Sample Date*	*pH Reading*
SW-6	5/14/79	11.55	SW-6A	10/2/86	12
SW-6A	4/15/87	11.4	SW-7	10/29/81	11.52
SW-6A	1/19/89	12.69	SW-7	1/6/82	11.35
SW-6A	6/1/89	11.61	SW-7	4/14/82	11.2
SW-6A	1/11/90	12.5	SW-7	3/1/83	11.55
SW-6A	12/1/92	11.71	SW-7	10/26/83	12.29
SW-6A	6/30/93	12.53	SW-7	2/24/84	12.36
SW-6A	12/7/93	12.09	SW-7	4/11/84	11.71
SW-6A	3/23/94	12.13	SW-7	1/8/85	7.69
SW-6A	6/28/94	12.31	SW-7	4/3/85	11.43
SW-6A	9/20/94	12.67	SW-7	7/25/85	12.22
SW-6A	3/16/95	13.2	SW-7	10/31/85	11.7
SW-6A	6/6/95	12.35	SW-7	1/23/86	12.12
SW-6A	10/27/95	11.99	SW-7	4/2/86	12.3
SW-6A	12/13/95	12.6	SW-7	8/4/86	12.65
SW-6A	1/25/96	12.92	SW-7	8/4/86	12.65
SW-6A	4/19/96	13.6	SW-7	10/2/86	12.15
SW-6A	7/11/96	12.91	SW-7	4/15/87	11.1
SW-6A	11/1/96	11.65	SW-7	6/1/89	12.04
SW-6A	1/30/97	12.67	SW-7	8/1/89	12.37
SW-6A	4/30/97	12.37	SW-7	12/1/92	12.37
SW-6A	10/23/97	12.24	SW-7	12/7/93	12.41
SW-6A	1/22/98	12.35	SW-7	3/23/94	12.3
SW-7	3/7/79	11.7	SW-7	6/28/94	12.2
SW-7	4/11/79	11.8	SW-7	12/12/94	12.78
SW-7	5/14/79	11.6	SW-7	3/16/95	13.63
SW-7	6/11/79	12.1	SW-7	10/27/95	11.84
SW-7	12/14/79	11.4	SW-7	1/24/96	15.19
SW-7	1/16/80	12.3	SW-7	4/19/96	13.6
SW-7	4/11/80	11.75	SW-7	11/1/96	11.88
SW-7	7/8/80	11.65	SW-7	1/30/97	12.77
SW-7	10/30/80	12.3	SW-7	4/30/97	12.56
SW-7	4/7/81	12.05	SW-7	10/23/97	12.5
SW-7	6/22/81	10.77	SW-7	1/22/98	12.38

TABLE 4.8

HISTORICAL SHALLOW GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC Ambient*	*MW-1A*	*MW-1A*	*MW-1A*	*MW-1A*	*MW-1A*	*MW-2A*	*MW-2A*
Sample ID:		*Water Quality*	*Location1A*	*Location1A*	*Location1A*	*Location1A*	*MW-1A*	*Location2A*	*Location2A*
Sample Date:		*(mg/L)*	*4/3/1985*	*1/23/1986*	*4/2/1986*	*1/28/1987*	*1/1/1989*	*4/3/1985*	*7/25/1985*
Location Description:			*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*
Parameters	***Units***								
Metals									
Aluminum	mg/L	NA	--	--	--	--	0.0465	--	--
Antimony	mg/L	0.003	--	--	--	--	ND (0.06)	--	--
Barium	mg/L	1	--	--	0.042	--	0.0213	--	--
Calcium	mg/L	NA	--	--	--	--	87	--	--
Chromium	mg/L	0.05	--	--	ND (0.01)	--	ND (0.01)	--	--
Chromium, Hexavalent	mg/L	0.05	--	--	ND (0.01)	--	0.02	--	--
Cobalt	mg/L	NA	--	--	--	--	ND (0.05)	--	--
Copper	mg/L	0.2	--	--	--	--	0.0517	--	--
Cyanide (total)	mg/L	0.2	--	--	--	--	0.54	--	--
Iron	mg/L	0.3	--	--	1.80	--	R	--	--
Lead	mg/L	0.025	--	--	--	--	R	--	--
Magnesium	mg/L	NS	--	--	--	--	1.62	--	--
Manganese	mg/L	0.3	--	--	0.725	--	0.0113	--	--
Mercury	mg/L	0.0007	--	--	--	--	ND (0.0002)	--	--
Nickel	mg/L	0.1	--	--	--	--	ND (0.04)	--	--
Potassium	mg/L	NA	--	--	--	--	392	--	--
Silicon	mg/L	NA	--	--	5.54	--	--	--	--
Sodium	mg/L	20	--	--	--	--	251	--	--
Vanadium	mg/L	NS	--	--	--	--	ND (0.05)	--	--
Zinc	mg/L	NS	--	--	0.207	--	0.474	--	--
General Chemistry									
pH (water)	s.u.		7.44	7.67	7.70	7.90	10.59	12.14	12.23

TABLE 4.8

HISTORICAL SHALLOW GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC Ambient*	*MW-2A*	*MW-2A*	*MW-2A*	*MW-2A*	*MW-2A*	*MW-2A*	*MW-2A*
Sample ID:		*Water Quality*	*Location2A*	*Location2A*	*MW-2A*	*Location2A*	*MW-2A*	*Location2A*	*MW-2A*
Sample Date:		*(mg/L)*	*10/31/1985*	*1/23/1986*	*1/23/1986*	*4/2/1986*	*4/2/1986*	*8/4/1986*	*8/4/1986*
Location Description:			*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*
Parameters	***Units***								
Metals									
Aluminum	mg/L	NA	--	--	--	--	--	--	--
Antimony	mg/L	0.003	--	--	--	--	--	--	--
Barium	mg/L	1	--	--	--	0.46	--	--	--
Calcium	mg/L	NA	--	--	--	--	--	--	--
Chromium	mg/L	0.05	--	--	--	0.517	--	--	--
Chromium, Hexavalent	mg/L	0.05	--	--	--	0.428	--	--	--
Cobalt	mg/L	NA	--	--	--	--	--	--	--
Copper	mg/L	0.2	--	--	--	--	--	--	--
Cyanide (total)	mg/L	0.2	--	--	--	--	--	--	--
Iron	mg/L	0.3	--	--	--	0.242	--	--	--
Lead	mg/L	0.025	--	--	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	--	--	--	--
Manganese	mg/L	0.3	--	--	--	ND (0.03)	--	--	--
Mercury	mg/L	0.0007	--	--	--	--	--	--	--
Nickel	mg/L	0.1	--	--	--	--	--	--	--
Potassium	mg/L	NA	--	--	--	--	--	--	--
Silicon	mg/L	NA	--	--	--	0.640	--	--	--
Sodium	mg/L	20	--	--	--	--	--	--	--
Vanadium	mg/L	NS	--	--	--	--	--	--	--
Zinc	mg/L	NS	--	--	--	0.306	--	--	--
General Chemistry									
pH (water)	s.u.		11.7	12.61	12.61	12.7	12.7	12.70	12.70

TABLE 4.8

HISTORICAL SHALLOW GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC Ambient*	*MW-2A*	*MW-2A*	*MW-2A*	*MW-2A*	*MW-2A*	*MW-2A*	*MW-2A*
Sample ID:		*Water Quality*	*Location2A*	*MW-2A*	*Location2A*	*Location2A*	*MW-2A*	*MW-2A*	*MW-2A*
Sample Date:		*(mg/L)*	*10/2/1986*	*10/2/1986*	*1/28/1987*	*4/15/1987*	*7/23/1987*	*1/12/1988*	*1/19/1989*
Location Description:			*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*
Parameters	***Units***								
Metals									
Aluminum	mg/L	NA	--	--	--	--	--	--	--
Antimony	mg/L	0.003	--	--	--	--	--	--	--
Barium	mg/L	1	--	--	--	0.452	--	--	--
Calcium	mg/L	NA	--	--	--	--	--	--	--
Chromium	mg/L	0.05	--	--	--	0.495	--	--	--
Chromium, Hexavalent	mg/L	0.05	--	--	--	0.356	--	--	--
Cobalt	mg/L	NA	--	--	--	--	--	--	--
Copper	mg/L	0.2	--	--	--	--	--	--	--
Cyanide (total)	mg/L	0.2	--	--	--	--	--	--	--
Iron	mg/L	0.3	--	--	--	0.092	--	--	--
Lead	mg/L	0.025	--	--	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	--	--	--	--
Manganese	mg/L	0.3	--	--	--	ND (0.005)	--	--	--
Mercury	mg/L	0.0007	--	--	--	--	--	--	--
Nickel	mg/L	0.1	--	--	--	--	--	--	--
Potassium	mg/L	NA	--	--	--	--	--	--	--
Silicon	mg/L	NA	--	--	--	0.536	--	--	--
Sodium	mg/L	20	--	--	--	--	--	--	--
Vanadium	mg/L	NS	--	--	--	--	--	--	--
Zinc	mg/L	NS	--	--	--	ND (0.01)	--	--	--
General Chemistry									
pH (water)	s.u.		12.50	12.50	12.15	10.60	12.50	12.65	12.95

TABLE 4.8

HISTORICAL SHALLOW GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC Ambient*	*MW-2A*	*MW-2A*	*MW-2A*	*MW-2A*	*MW-2A*	*MW-3A*	*MW-3A*
Sample ID:		*Water Quality*	*MW-2A*	*MW-2A*	*MW-2A*	*MW-2A*	*MW-2A*	*Location3A*	*Location3A*
Sample Date:		*(mg/L)*	*4/19/1989*	*7/20/1989*	*10/4/1989*	*1/11/1990*	*4/18/1990*	*1/23/1986*	*4/2/1986*
Location Description:			*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*SKW Landfill*	*SKW Landfill*
Parameters	***Units***								
Metals									
Aluminum	mg/L	NA	--	--	--	--	--	--	--
Antimony	mg/L	0.003	--	--	--	--	--	--	--
Barium	mg/L	1	--	--	--	--	--	--	0.062
Calcium	mg/L	NA	--	--	--	--	--	--	--
Chromium	mg/L	0.05	--	--	--	--	--	--	0.149
Chromium, Hexavalent	mg/L	0.05	--	--	--	--	--	--	0.327
Cobalt	mg/L	NA	--	--	--	--	--	--	--
Copper	mg/L	0.2	--	--	--	--	--	--	--
Cyanide (total)	mg/L	0.2	--	--	--	--	--	--	--
Iron	mg/L	0.3	--	--	--	--	--	--	8.90
Lead	mg/L	0.025	--	--	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	--	--	--	--
Manganese	mg/L	0.3	--	--	--	--	--	--	0.250
Mercury	mg/L	0.0007	--	--	--	--	--	--	--
Nickel	mg/L	0.1	--	--	--	--	--	--	--
Potassium	mg/L	NA	--	--	--	--	--	--	--
Silicon	mg/L	NA	--	--	--	--	--	--	36.7
Sodium	mg/L	20	--	--	--	--	--	--	--
Vanadium	mg/L	NS	--	--	--	--	--	--	--
Zinc	mg/L	NS	--	--	--	--	--	--	0.365
General Chemistry									
pH (water)	s.u.		12.97	13.29	12.60	12.87	12.68	10.12	9.90

TABLE 4.8

HISTORICAL SHALLOW GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC Ambient*	*MW-3A*	*MW-3A*	*MW-3A*	*MW-3A*	*MW-4A*	*MW-4A*
Sample ID:		*Water Quality*	*Location3A*	*Location3A*	*Location3A*	*Location3A*	*Location4A*	*Location4A*
Sample Date:		*(mg/L)*	*8/4/1986*	*10/2/1986*	*1/28/1987*	*4/15/1987*	*4/3/1985*	*7/25/1985*
Location Description:			*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*Airco*	*Airco*
Parameters	***Units***							
Metals								
Aluminum	mg/L	NA	--	--	--	--	--	--
Antimony	mg/L	0.003	--	--	--	--	--	--
Barium	mg/L	1	--	--	--	0.325	--	--
Calcium	mg/L	NA	--	--	--	--	--	--
Chromium	mg/L	0.05	--	--	--	0.835	--	--
Chromium, Hexavalent	mg/L	0.05	--	--	--	ND (0.01)	--	--
Cobalt	mg/L	NA	--	--	--	--	--	--
Copper	mg/L	0.2	--	--	--	--	--	--
Cyanide (total)	mg/L	0.2	--	--	--	--	--	--
Iron	mg/L	0.3	--	--	--	42.0	--	--
Lead	mg/L	0.025	--	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	--	--	--
Manganese	mg/L	0.3	--	--	--	1.62	--	--
Mercury	mg/L	0.0007	--	--	--	--	--	--
Nickel	mg/L	0.1	--	--	--	--	--	--
Potassium	mg/L	NA	--	--	--	--	--	--
Silicon	mg/L	NA	--	--	--	67.0	--	--
Sodium	mg/L	20	--	--	--	--	--	--
Vanadium	mg/L	NS	--	--	--	--	--	--
Zinc	mg/L	NS	--	--	--	0.429	--	--
General Chemistry								
pH (water)	s.u.		10.15	11.00	10.89	10.20	12.23	12.25

TABLE 4.8

HISTORICAL SHALLOW GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC Ambient Water Quality (mg/L)*	*MW-4A*	*MW-4A*	*MW-4A*	*MW-4A*	*MW-4A*	*MW-4A*	*MW-4A*
Sample ID:			*Location4A*	*Location4A*	*MW-4A*	*Location4A*	*MW-4A*	*Location4A*	*MW-4A*
Sample Date:			*10/31/1985*	*1/23/1986*	*1/23/1986*	*4/2/1986*	*4/2/1986*	*8/4/1986*	*8/4/1986*
Location Description:			*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*
Parameters	***Units***								
Metals									
Aluminum	mg/L	NA	--	--	--	--	--	--	--
Antimony	mg/L	0.003	--	--	--	--	--	--	--
Barium	mg/L	1	--	--	--	0.122	--	--	--
Calcium	mg/L	NA	--	--	--	--	--	--	--
Chromium	mg/L	0.05	--	--	--	0.698	--	--	--
Chromium, Hexavalent	mg/L	0.05	--	--	--	ND (0.01)	--	--	--
Cobalt	mg/L	NA	--	--	--	--	--	--	--
Copper	mg/L	0.2	--	--	--	--	--	--	--
Cyanide (total)	mg/L	0.2	--	--	--	--	--	--	--
Iron	mg/L	0.3	--	--	--	0.082	--	--	--
Lead	mg/L	0.025	--	--	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	--	--	--	--
Manganese	mg/L	0.3	--	--	--	ND (0.03)	--	--	--
Mercury	mg/L	0.0007	--	--	--	--	--	--	--
Nickel	mg/L	0.1	--	--	--	--	--	--	--
Potassium	mg/L	NA	--	--	--	--	--	--	--
Silicon	mg/L	NA	--	--	--	0.735	--	--	--
Sodium	mg/L	20	--	--	--	--	--	--	--
Vanadium	mg/L	NS	--	--	--	--	--	--	--
Zinc	mg/L	NS	--	--	--	0.086	--	--	--
General Chemistry									
pH (water)	s.u.		11.85	12.70	12.70	12.8	12.8	12.70	12.70

TABLE 4.8

HISTORICAL SHALLOW GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:*		*NYSDEC Ambient Water Quality (mg/L)*	*MW-4A* *Location4A* *10/2/1986* *Airco*	*MW-4A* *MW-4A* *10/2/1986* *Airco*	*MW-4A* *Location4A* *1/28/1987* *Airco*	*MW-4A* *Location4A* *4/15/1987* *Airco*	*MW-4A* *MW-4A* *7/23/1987* *Airco*	*MW-4A* *MW-4A* *1/1/1989* *Airco*	*MW-4A* *MW-4A* *1/19/1989* *Airco*
Parameters	***Units***								
Metals									
Aluminum	mg/L	NA	--	--	--	--	--	ND (0.2)	--
Antimony	mg/L	0.003	--	--	--	--	--	ND (0.06)	--
Barium	mg/L	1	--	--	--	0.159	--	0.13	--
Calcium	mg/L	NA	--	--	--	--	--	694	--
Chromium	mg/L	0.05	--	--	--	0.714	--	1.48 J	--
Chromium, Hexavalent	mg/L	0.05	--	--	--	0.546	--	1.56	--
Cobalt	mg/L	NA	--	--	--	--	--	ND (0.05)	--
Copper	mg/L	0.2	--	--	--	--	--	0.008	--
Cyanide (total)	mg/L	0.2	--	--	--	--	--	ND (0.01)	--
Iron	mg/L	0.3	--	--	--	0.119	--	ND (0.1)	--
Lead	mg/L	0.025	--	--	--	--	--	R	--
Magnesium	mg/L	NS	--	--	--	--	--	ND (5)	--
Manganese	mg/L	0.3	--	--	--	ND (0.005)	--	ND (0.015)	--
Mercury	mg/L	0.0007	--	--	--	--	--	0.00079	--
Nickel	mg/L	0.1	--	--	--	--	--	ND (0.04)	--
Potassium	mg/L	NA	--	--	--	--	--	11.1	--
Silicon	mg/L	NA	--	--	--	0.386	--	--	--
Sodium	mg/L	20	--	--	--	--	--	37.2	--
Vanadium	mg/L	NS	--	--	--	--	--	ND (0.05)	--
Zinc	mg/L	NS	--	--	--	ND (0.087)	--	ND (0.02)	--
General Chemistry									
pH (water)	s.u.		12.55	12.55	12.20	10.60	12.55	13.21	12.83

TABLE 4.8

HISTORICAL SHALLOW GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC Ambient Water Quality (mg/L)*	*MW-4A*	*MW-4A*	*MW-4A*	*MW-4A*	*MW-4A*	*MW-5A*	*MW-5A*
Sample ID:			*MW-4A*	*MW-4A*	*MW-4A*	*MW-4A*	*MW-4A*	*Location5A*	*Location5A*
Sample Date:			*4/19/1989*	*7/20/1989*	*10/4/1989*	*1/11/1990*	*4/18/1990*	*7/25/1985*	*10/31/1985*
Location Description:			*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*SKW Landfill*	*SKW Landfill*
Parameters	***Units***								
Metals									
Aluminum	mg/L	NA	--	--	--	--	--	--	--
Antimony	mg/L	0.003	--	--	--	--	--	--	--
Barium	mg/L	1	--	--	--	--	--	--	--
Calcium	mg/L	NA	--	--	--	--	--	--	--
Chromium	mg/L	0.05	--	--	--	--	--	--	--
Chromium, Hexavalent	mg/L	0.05	--	--	--	--	--	--	--
Cobalt	mg/L	NA	--	--	--	--	--	--	--
Copper	mg/L	0.2	--	--	--	--	--	--	--
Cyanide (total)	mg/L	0.2	--	--	--	--	--	--	--
Iron	mg/L	0.3	--	--	--	--	--	--	--
Lead	mg/L	0.025	--	--	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	--	--	--	--
Manganese	mg/L	0.3	--	--	--	--	--	--	--
Mercury	mg/L	0.0007	--	--	--	--	--	--	--
Nickel	mg/L	0.1	--	--	--	--	--	--	--
Potassium	mg/L	NA	--	--	--	--	--	--	--
Silicon	mg/L	NA	--	--	--	--	--	--	--
Sodium	mg/L	20	--	--	--	--	--	--	--
Vanadium	mg/L	NS	--	--	--	--	--	--	--
Zinc	mg/L	NS	--	--	--	--	--	--	--
General Chemistry									
pH (water)	s.u.		12.95	12.58	12.63	12.80	12.78	7.39	7.62

TABLE 4.8

HISTORICAL SHALLOW GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:*		*NYSDEC Ambient Water Quality (mg/L)*	*MW-5A* *Location5A* *1/23/1986* *SKW Landfill*	*MW-5A* *Location5A* *4/2/1986* *SKW Landfill*	*MW-5A* *Location5A* *8/4/1986* *SKW Landfill*	*MW-5A* *Location5A* *10/2/1986* *SKW Landfill*	*MW-5A* *Location5A* *1/28/1987* *SKW Landfill*	*MW-5A* *Location5A* *4/15/1987* *SKW Landfill*
Parameters	***Units***							
Metals								
Aluminum	mg/L	NA	--	--	--	--	--	--
Antimony	mg/L	0.003	--	--	--	--	--	--
Barium	mg/L	1	--	0.142	--	--	--	0.523
Calcium	mg/L	NA	--	--	--	--	--	--
Chromium	mg/L	0.05	--	0.143	--	--	--	0.500
Chromium, Hexavalent	mg/L	0.05	--	0.060	--	--	--	0.193
Cobalt	mg/L	NA	--	--	--	--	--	--
Copper	mg/L	0.2	--	--	--	--	--	--
Cyanide (total)	mg/L	0.2	--	--	--	--	--	--
Iron	mg/L	0.3	--	4.32	--	--	--	52.7
Lead	mg/L	0.025	--	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	--	--	--
Manganese	mg/L	0.3	--	1.59	--	--	--	6.63
Mercury	mg/L	0.0007	--	--	--	--	--	--
Nickel	mg/L	0.1	--	--	--	--	--	--
Potassium	mg/L	NA	--	--	--	--	--	--
Silicon	mg/L	NA	--	13.4	--	--	--	52.5
Sodium	mg/L	20	--	--	--	--	--	--
Vanadium	mg/L	NS	--	--	--	--	--	--
Zinc	mg/L	NS	--	0.172	--	--	--	0.887
General Chemistry								
pH (water)	s.u.		7.46	7.85	7.90	7.65	7.80	7.6

TABLE 4.8

HISTORICAL SHALLOW GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:*		*NYSDEC Ambient Water Quality (mg/L)*	*MW-5A* *MW-5A* *1/1/1989* *SKW Landfill*	*MW-12A* *Location12A* *1/23/1986* *SKW Landfill*	*MW-12A* *Location12A* *4/2/1986* *SKW Landfill*	*MW-12A* *Location12A* *1/28/1987* *SKW Landfill*	*MW-12A* *Location12A* *4/15/1987* *SKW Landfill*	*MW-12A* *MW-12A* *1/1/1989* *SKW Landfill*
Parameters	***Units***							
Metals								
Aluminum	mg/L	NA	ND (0.2)	--	--	--	--	2.23
Antimony	mg/L	0.003	0.0398	--	--	--	--	ND (0.06)
Barium	mg/L	1	0.079	--	ND (0.03)	--	0.032	0.0445
Calcium	mg/L	NA	90.3	--	--	--	--	95.1
Chromium	mg/L	0.05	ND (0.01)	--	ND (0.01)	--	ND (0.01)	0.161 J
Chromium, Hexavalent	mg/L	0.05	0.09	--	ND (0.01)	--	0.030	0.04
Cobalt	mg/L	NA	ND (0.05)	--	--	--	--	0.011
Copper	mg/L	0.2	ND (0.025)	--	--	--	--	0.0187
Cyanide (total)	mg/L	0.2	ND (0.01)	--	--	--	--	ND (0.01)
Iron	mg/L	0.3	R	--	ND (0.05)	--	1.17	R
Lead	mg/L	0.025	R	--	--	--	--	R
Magnesium	mg/L	NS	42.6	--	--	--	--	64.5
Manganese	mg/L	0.3	0.237	--	0.399	--	0.269	0.148
Mercury	mg/L	0.0007	ND (0.0002)	--	--	--	--	ND (0.0002)
Nickel	mg/L	0.1	ND (0.04)	--	--	--	--	0.0235
Potassium	mg/L	NA	6.19	--	--	--	--	3.38
Silicon	mg/L	NA	--	--	6.22	--	5.58	--
Sodium	mg/L	20	41	--	--	--	--	9.79
Vanadium	mg/L	NS	ND (0.05)	--	--	--	--	0.0055
Zinc	mg/L	NS	ND (0.02)	--	0.082	--	ND (0.01)	0.0648
General Chemistry								
pH (water)	s.u.		8.12	7.49	7.65	7.25	6.60	7.95

TABLE 4.8

HISTORICAL SHALLOW GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC Ambient Water Quality (mg/L)*	*MW-13A*	*MW-13A*	*MW-13A*	*MW-13A*	*MW-13A*	*MW-13A*
Sample ID:			*Location13A*	*Location13A*	*Location13A*	*Location13A*	*Location13A*	*Location13A*
Sample Date:			*4/3/1985*	*10/31/1985*	*1/23/1986*	*4/2/1986*	*8/4/1986*	*10/2/1986*
Location Description:			*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*
Parameters	***Units***							
Metals								
Aluminum	mg/L	NA	--	--	--	--	--	--
Antimony	mg/L	0.003	--	--	--	--	--	--
Barium	mg/L	1	--	--	--	ND (0.03)	--	--
Calcium	mg/L	NA	--	--	--	--	--	--
Chromium	mg/L	0.05	--	--	--	0.703	--	--
Chromium, Hexavalent	mg/L	0.05	--	--	--	0.674	--	--
Cobalt	mg/L	NA	--	--	--	--	--	--
Copper	mg/L	0.2	--	--	--	--	--	--
Cyanide (total)	mg/L	0.2	--	--	--	--	--	--
Iron	mg/L	0.3	--	--	--	0.094	--	--
Lead	mg/L	0.025	--	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	--	--	--
Manganese	mg/L	0.3	--	--	--	ND (0.03)	--	--
Mercury	mg/L	0.0007	--	--	--	--	--	--
Nickel	mg/L	0.1	--	--	--	--	--	--
Potassium	mg/L	NA	--	--	--	--	--	--
Silicon	mg/L	NA	--	--	--	11.5	--	--
Sodium	mg/L	20	--	--	--	--	--	--
Vanadium	mg/L	NS	--	--	--	--	--	--
Zinc	mg/L	NS	--	--	--	0.095	--	--
General Chemistry								
pH (water)	s.u.		10.36	10.51	11.14	12.3	11.35	11.15

TABLE 4.8

HISTORICAL SHALLOW GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:*		*NYSDEC Ambient* *Water Quality* *(mg/L)*	*MW-13A* *Location13A* *1/28/1987* *Airco*	*MW-13A* *Location13A* *4/15/1987* *Airco*
Parameters	***Units***			
Metals				
Aluminum	mg/L	NA	--	--
Antimony	mg/L	0.003	--	--
Barium	mg/L	1	--	ND (0.01)
Calcium	mg/L	NA	--	--
Chromium	mg/L	0.05	--	0.714
Chromium, Hexavalent	mg/L	0.05	--	0.632
Cobalt	mg/L	NA	--	--
Copper	mg/L	0.2	--	--
Cyanide (total)	mg/L	0.2	--	--
Iron	mg/L	0.3	--	0.040
Lead	mg/L	0.025	--	--
Magnesium	mg/L	NS	--	--
Manganese	mg/L	0.3	--	ND (0.005)
Mercury	mg/L	0.0007	--	--
Nickel	mg/L	0.1	--	--
Potassium	mg/L	NA	--	--
Silicon	mg/L	NA	--	9.22
Sodium	mg/L	20	--	--
Vanadium	mg/L	NS	--	--
Zinc	mg/L	NS	--	ND (0.01)
General Chemistry				
pH (water)	s.u.		10.20	9.60

TABLE 4.8

HISTORICAL SHALLOW GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Notes:

* - Duplicate Analysis not within control limits.
B - Indicates a value greater than or equal to the instrument detection limit, but less than the contract required detection limit.
E - Indicates a value estimated or not reported due to the presence of interference.
J - The associated numerical value is an estimated quantity or Compound detected below sample quantitation limit.
N - Indicates spike sample recovery was not within the control limits.
ND() - Non detect at associated value.
NW - Value Estimated
NS - No Standard
R - Rejected
\- - Not applicable
NS - No Standard

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC Ambient Water Quality (mg/L)*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*
Sample ID:			*Location1*	*Location1*	*Location1*	*Location1*	*Location1*	*Location1*	*Location1*	*Location1*	*Location1*	*Location1*	*Location1*	*Location1*
Sample Date:			*3/7/1979*	*4/11/1979*	*5/14/1979*	*6/11/1979*	*12/14/1979*	*1/16/1980*	*4/11/1980*	*7/8/1980*	*1/7/1981*	*4/7/1981*	*6/22/1981*	*10/29/1981*
Location Description:			*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*
Parameters	*Units*													
Metals														
Aluminum	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Aluminum (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Antimony	mg/L	0.003	--	--	--	--	--	--	--	--	--	--	--	--
Antimony (Dissolved)	mg/L	0.003	--	--	--	--	--	--	--	--	--	--	--	--
Arsenic	mg/L	0.025	--	--	--	--	--	--	--	--	--	--	--	--
Arsenic (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--	--	--
Barium	mg/L	1	0.10	0.01	0.15	0.10	0.15	0.1	ND (0.1)	0.1	--	ND (0.2)	0.40	ND (0.2)
Barium (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--	--	--
Beryllium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Beryllium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Boron	mg/L	1	--	--	--	--	--	--	--	--	--	--	--	--
Boron (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--	--	--
Cadmium	mg/L	0.005	--	--	--	--	--	--	--	--	--	--	--	--
Cadmium (Dissolved)	mg/L	0.005	--	--	--	--	--	--	--	--	--	--	--	--
Calcium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Calcium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Chromium	mg/L	0.05	ND (0.01)	ND (0.01)	0.01	ND (0.01)	ND (0.02)	ND (0.02)	ND (0.02)	0.02	0.096	0.096	0.016	ND (0.005)
Chromium (Dissolved)	mg/L	0.05	--	--	--	--	--	--	--	--	--	--	--	--
Chromium, Hexavalent	mg/L	0.05	--	--	--	--	--	--	ND (0.01)	--	ND (0.005)	ND (0.005)	0.010	ND (0.005)
Cobalt	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Cobalt (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Copper	mg/L	0.2	--	--	--	--	--	--	--	--	--	--	--	--
Copper (Dissolved)	mg/L	0.2	--	--	--	--	--	--	--	--	--	--	--	--
Cyanide (total)	mg/L	0.2	--	--	--	--	--	--	--	--	--	--	--	--
Iron	mg/L	0.3	1.23	1.00	1.10	1.60	1.1	0.26	0.02	0.22	ND (0.050)	ND (0.05)	ND (0.05)	ND (0.05)
Iron (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	--	--	--
Lead	mg/L	0.025	--	--	--	--	--	--	--	--	--	--	--	--
Lead (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Magnesium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Manganese	mg/L	0.3	0.95	1.10	0.80	0.88	0.24	0.26	0.19	0.18	0.055	0.02	0.051	0.115
Manganese (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	--	--	--
Mercury	mg/L	0.0007	--	--	--	--	--	--	--	--	--	--	--	--
Mercury (Dissolved)	mg/L	0.0007	--	--	--	--	--	--	--	--	--	--	--	--
Nickel	mg/L	0.1	--	--	--	--	--	--	--	--	--	--	--	--
Nickel (Dissolved)	mg/L	0.1	--	--	--	--	--	--	--	--	--	--	--	--
Potassium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Potassium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Selenium	mg/L	0.01	--	--	--	--	--	--	--	--	--	--	--	--
Selenium (Dissolved)	mg/L	0.01	--	--	--	--	--	--	--	--	--	--	--	--
Silica	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Silica (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Silicon	mg/L	NS	9.8	9.0	4.9	6.2	6.2	10	6.1	4.3	7.0	10.2	3.4	0.70
Silver	mg/L	0.05	--	--	--	--	--	--	--	--	--	--	--	--

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:*		*NYSDEC Ambient Water Quality (mg/L)*	*MW-1* *Location1* *3/7/1979* *Airco*	*MW-1* *Location1* *4/11/1979* *Airco*	*MW-1* *Location1* *5/14/1979* *Airco*	*MW-1* *Location1* *6/11/1979* *Airco*	*MW-1* *Location1* *12/14/1979* *Airco*	*MW-1* *Location1* *1/16/1980* *Airco*	*MW-1* *Location1* *4/11/1980* *Airco*	*MW-1* *Location1* *7/8/1980* *Airco*	*MW-1* *Location1* *1/7/1981* *Airco*	*MW-1* *Location1* *4/7/1981* *Airco*	*MW-1* *Location1* *6/22/1981* *Airco*	*MW-1* *Location1* *10/29/1981* *Airco*
Parameters	Units													
Silver (Dissolved)	mg/L	0.05	--	--	--	--	--	--	--	--	--	--	--	--
Sodium	mg/L	20	--	--	--	--	--	--	--	--	--	--	--	--
Sodium (Dissolved)	mg/L	20	--	--	--	--	--	--	--	--	--	--	--	--
Thallium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Thallium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Vanadium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Vanadium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Zinc	mg/L	NS	0.82	0.99	0.75	0.70	0.43	0.33	0.74	0.17	ND (0.05)	0.27	0.19	0.02
Zinc (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
General Chemistry														
Nitrate (as N)	mg/L	10	--	--	--	--	--	--	--	--	--	--	--	--
pH (water)	s.u.		7.30	7.30	7.65	7.45	6.85	7.80	6.75	7.25	6.9	7.58	6.97	7.05

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC Ambient Water Quality (mg/L)*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*
Sample ID:			*Location1*	*Location1*	*Location1*	*Location1*	*Location1*	*Location1*	*Location1*	*Location1*	*Location1*	*Location1*	*Location1*	*Location1*
Sample Date:			*1/6/1982*	*4/14/1982*	*7/27/1982*	*10/20/1982*	*3/1/1983*	*7/21/1983*	*10/26/1983*	*2/24/1984*	*4/11/1984*	*7/13/1984*	*10/11/1984*	*1/8/1985*
Location Description:			*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*
Parameters	*Units*													
Metals														
Aluminum	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Aluminum (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Antimony	mg/L	0.003	--	--	--	--	--	--	--	--	--	--	--	--
Antimony (Dissolved)	mg/L	0.003	--	--	--	--	--	--	--	--	--	--	--	--
Arsenic	mg/L	0.025	--	--	--	--	--	--	--	--	--	--	--	--
Arsenic (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--	--	--
Barium	mg/L	1	ND (0.2)	0.214	ND (0.200)	ND (0.200)	ND (0.2)	--	--	1.9	0.01	--	--	0.080
Barium (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--	--	--
Beryllium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Beryllium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Boron	mg/L	1	--	--	--	--	--	--	--	--	--	--	--	--
Boron (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--	--	--
Cadmium	mg/L	0.005	--	--	--	--	--	--	--	--	--	--	--	--
Cadmium (Dissolved)	mg/L	0.005	--	--	--	--	--	--	--	--	--	--	--	--
Calcium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Calcium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Chromium	mg/L	0.05	ND (0.005)	ND (0.005)	0.148	ND (0.005)	0.005	--	--	ND (0.005)	--	--	--	0.034
Chromium (Dissolved)	mg/L	0.05	--	--	--	--	--	--	--	--	--	--	--	--
Chromium, Hexavalent	mg/L	0.05	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	0.005	--	--	ND (0.005)	--	--	--	0.009
Cobalt	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Cobalt (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Copper	mg/L	0.2	--	--	--	--	--	--	--	--	--	--	--	--
Copper (Dissolved)	mg/L	0.2	--	--	--	--	--	--	--	--	--	--	--	--
Cyanide (total)	mg/L	0.2	--	--	--	--	--	--	--	--	--	--	--	--
Iron	mg/L	0.3	ND (0.050)	ND (0.050)	ND (0.050)	0.095	ND (0.05)	--	--	ND (0.05)	--	--	--	1.58
Iron (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	--	--	--
Lead	mg/L	0.025	--	--	--	--	--	--	--	--	--	--	--	--
Lead (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Magnesium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Manganese	mg/L	0.3	0.079	0.081	0.048	0.210	0.035	--	--	0.059	--	--	--	0.083
Manganese (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	--	--	--
Mercury	mg/L	0.0007	--	--	--	--	--	--	--	--	--	--	--	--
Mercury (Dissolved)	mg/L	0.0007	--	--	--	--	--	--	--	--	--	--	--	--
Nickel	mg/L	0.1	--	--	--	--	--	--	--	--	--	--	--	--
Nickel (Dissolved)	mg/L	0.1	--	--	--	--	--	--	--	--	--	--	--	--
Potassium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Potassium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Selenium	mg/L	0.01	--	--	--	--	--	--	--	--	--	--	--	--
Selenium (Dissolved)	mg/L	0.01	--	--	--	--	--	--	--	--	--	--	--	--
Silica	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Silica (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Silicon	mg/L	NS	9.5	8.30	7.60	8.32	8.3	--	--	5.8	--	--	--	0.93
Silver	mg/L	0.05	--	--	--	--	--	--	--	--	--	--	--	--

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC Ambient Water Quality (mg/L)*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*
Sample ID:			*Location1*	*Location1*	*Location1*	*Location1*	*Location1*	*Location1*	*Location1*	*Location1*	*Location1*	*Location1*	*Location1*	*Location1*
Sample Date:			*1/6/1982*	*4/14/1982*	*7/27/1982*	*10/20/1982*	*3/1/1983*	*7/21/1983*	*10/26/1983*	*2/24/1984*	*4/11/1984*	*7/13/1984*	*10/11/1984*	*1/8/1985*
Location Description:			*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*
Parameters	***Units***													
Silver (Dissolved)	mg/L	0.05	--	--	--	--	--	--	--	--	--	--	--	--
Sodium	mg/L	20	--	--	--	--	--	--	--	--	--	--	--	--
Sodium (Dissolved)	mg/L	20	--	--	--	--	--	--	--	--	--	--	--	--
Thallium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Thallium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Vanadium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Vanadium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
Zinc	mg/L	NS	0.04	0.24	ND (0.05)	ND (0.05)	0.39	--	--	0.15	--	--	--	0.439
Zinc (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--	--
General Chemistry														
Nitrate (as N)	mg/L	10	--	--	--	--	--	--	--	--	--	--	--	--
pH (water)	s.u.		7.00	6.95	7.10	7.50	6.92	7.31	7.12	7.30	7.01	7.22	7.42	7.28

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC Ambient Water Quality (mg/L)*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*
Sample ID:			*Location1*	*Location1*	*Location1*	*Location1*	*Location1*	*Location1*	*Location1*	*Location1*	*MW-1*	*MW-1*	*MW-1*
Sample Date:			*4/3/1985*	*7/25/1985*	*10/31/1985*	*1/23/1986*	*4/2/1986*	*8/4/1986*	*10/2/1986*	*1/28/1987*	*1/1/1989*	*1/1/1989*	*3/1/2000*
Location Description:			*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco Duplicate*	*Airco*
Parameters	*Units*												
Metals													
Aluminum	mg/L	NS	--	--	--	--	--	--	--	--	0.183 J	0.421 J	0.943
Aluminum (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Antimony	mg/L	0.003	--	--	--	--	--	--	--	--	ND (0.06)	ND (0.06)	ND (0.008)
Antimony (Dissolved)	mg/L	0.003	--	--	--	--	--	--	--	--	--	--	--
Arsenic	mg/L	0.025	--	--	--	--	--	--	--	--	--	--	ND (0.0055)
Arsenic (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--	--
Barium	mg/L	1	--	--	--	--	0.062	--	--	--	0.0313	0.0358	0.0266 B
Barium (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--	--
Beryllium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	ND (0.001)
Beryllium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Boron	mg/L	1	--	--	--	--	--	--	--	--	--	--	--
Boron (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--	--
Cadmium	mg/L	0.005	--	--	--	--	--	--	--	--	--	--	ND (0.001)
Cadmium (Dissolved)	mg/L	0.005	--	--	--	--	--	--	--	--	--	--	--
Calcium	mg/L	NS	--	--	--	--	--	--	--	--	168	172	221 E
Calcium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Chromium	mg/L	0.05	--	--	--	--	ND (0.01)	--	--	--	ND (0.01)	ND (0.01)	0.0023 B
Chromium (Dissolved)	mg/L	0.05	--	--	--	--	--	--	--	--	--	--	--
Chromium, Hexavalent	mg/L	0.05	--	--	--	--	ND (0.01)	--	--	--	0.02	0.01	ND (0.01)
Cobalt	mg/L	NS	--	--	--	--	--	--	--	--	ND (0.05)	ND (0.05)	0.0023 B
Cobalt (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Copper	mg/L	0.2	--	--	--	--	--	--	--	--	0.0063	ND (0.025)	0.0051 B
Copper (Dissolved)	mg/L	0.2	--	--	--	--	--	--	--	--	--	--	--
Cyanide (total)	mg/L	0.2	--	--	--	--	--	--	--	--	ND (0.01)	ND (0.01)	--
Iron	mg/L	0.3	--	--	--	--	0.308	--	--	--	R	R	0.802
Iron (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	--	--
Lead	mg/L	0.025	--	--	--	--	--	--	--	--	R	R	0.004
Lead (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	--	--	--	--	--	76.6	787	115 E
Magnesium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Manganese	mg/L	0.3	--	--	--	--	0.044	--	--	--	0.0226 J	0.0424 J	0.0166
Manganese (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	--	--
Mercury	mg/L	0.0007	--	--	--	--	--	--	--	--	ND (0.0002)	ND (0.0002)	ND (0.0002)
Mercury (Dissolved)	mg/L	0.0007	--	--	--	--	--	--	--	--	--	--	--
Nickel	mg/L	0.1	--	--	--	--	--	--	--	--	ND (0.04)	ND (0.04)	0.0029 B
Nickel (Dissolved)	mg/L	0.1	--	--	--	--	--	--	--	--	--	--	--
Potassium	mg/L	NS	--	--	--	--	--	--	--	--	1.32	0.921	1.57 B
Potassium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Selenium	mg/L	0.01	--	--	--	--	--	--	--	--	--	--	ND (0.005)
Selenium (Dissolved)	mg/L	0.01	--	--	--	--	--	--	--	--	--	--	--
Silica	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Silica (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Silicon	mg/L	NS	--	--	--	--	7.90	--	--	--	--	--	--
Silver	mg/L	0.05	--	--	--	--	--	--	--	--	--	--	0.0046 B

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

		NYSDEC											
Sample Location:		*Ambient*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*	*MW-1*
Sample ID:		*Water Quality*	*Location1*	*Location1*	*Location1*	*Location1*	*Location1*	*Location1*	*Location1*	*Location1*	*MW-1*	*MW-1*	*MW-1*
Sample Date:		*(mg/L)*	*4/3/1985*	*7/25/1985*	*10/31/1985*	*1/23/1986*	*4/2/1986*	*8/4/1986*	*10/2/1986*	*1/28/1987*	*1/1/1989*	*1/1/1989*	*3/1/2000*
Location Description:			*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco* *Duplicate*	*Airco*
Parameters	***Units***												
Silver (Dissolved)	mg/L	0.05	--	--	--	--	--	--	--	--	--	--	--
Sodium	mg/L	20	--	--	--	--	--	--	--	--	48.8	45.7	125
Sodium (Dissolved)	mg/L	20	--	--	--	--	--	--	--	--	--	--	--
Thallium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	ND (0.01)
Thallium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Vanadium	mg/L	NS	--	--	--	--	--	--	--	--	ND (0.05)	0.0052	ND (0.002)
Vanadium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Zinc	mg/L	NS	--	--	--	--	0.390	--	--	--	0.579	0.477	0.151
Zinc (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
General Chemistry													
Nitrate (as N)	mg/L	10	--	--	--	--	--	--	--	--	--	--	--
pH (water)	s.u.		7.30	7.25	7.02	7.59	7.60	7.45	7.25	7.15	7.62	--	--

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:*		*NYSDEC Ambient Water Quality (mg/L)*	*MW-1B* *WRL-MW1B-1200* *12/5/2000* *Airco*	*MW-1B* *WRL-MW1B-0301* *3/21/2001* *Airco*	*MW-1B* *WRL-MW1B-0601* *6/13/2001* *Airco*	*MW-1B* *WRL-MW1B-0901* *9/19/2001* *Airco*	*MW-2* *Location2* *3/7/1979* *Airco*	*MW-2* *Location2* *4/11/1979* *Airco*	*MW-2* *Location2* *5/14/1979* *Airco*	*MW-2* *Location2* *6/11/1979* *Airco*	*MW-2* *Location2* *12/14/1979* *Airco*	*MW-2* *Location2* *1/16/1980* *Airco*
Parameters	***Units***											
Metals												
Aluminum	mg/L	NS	2.8	9.7	--	--	--	--	--	--	--	--
Aluminum (Dissolved)	mg/L	NS	ND (0.005)	ND (0.005)	--	--	--	--	--	--	--	--
Antimony	mg/L	0.003	ND (0.005)	ND (0.005)	--	--	--	--	--	--	--	--
Antimony (Dissolved)	mg/L	0.003	ND (0.005)	ND (0.005)	--	--	--	--	--	--	--	--
Arsenic	mg/L	0.025	ND (0.005)	ND (0.005)	--	--	--	--	--	--	--	--
Arsenic (Dissolved)	mg/L	0.025	ND (0.005)	ND (0.005)	--	--	--	--	--	--	--	--
Barium	mg/L	1	0.11	0.148	--	--	0.05	0.05	0.10	ND (0.10)	ND (0.05)	0.1
Barium (Dissolved)	mg/L	1	0.081	0.081	--	--	--	--	--	--	--	--
Beryllium	mg/L	NS	ND (0.005)	ND (0.003)	--	--	--	--	--	--	--	--
Beryllium (Dissolved)	mg/L	NS	ND (0.005)	ND (0.003)	--	--	--	--	--	--	--	--
Boron	mg/L	1	0.16	0.164	--	--	--	--	--	--	--	--
Boron (Dissolved)	mg/L	1	0.15	0.167	--	--	--	--	--	--	--	--
Cadmium	mg/L	0.005	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	--	--	--	--	--	--
Cadmium (Dissolved)	mg/L	0.005	ND (0.005)	ND (0.005)	--	--	--	--	--	--	--	--
Calcium	mg/L	NS	165	173	--	--	--	--	--	--	--	--
Calcium (Dissolved)	mg/L	NS	143	134	--	--	--	--	--	--	--	--
Chromium	mg/L	0.05	0.009	0.129	ND (0.005)	0.011	0.02	ND (0.01)	0.01	ND (0.01)	ND (0.02)	ND (0.02)
Chromium (Dissolved)	mg/L	0.05	ND (0.005)	ND (0.005)	--	--	--	--	--	--	--	--
Chromium, Hexavalent	mg/L	0.05	ND (0.01)	ND (0.00001)	ND (0.010)	ND (0.01)	--	--	--	--	--	--
Cobalt	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Cobalt (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Copper	mg/L	0.2	ND (0.005)	0.013	--	--	--	--	--	--	--	--
Copper (Dissolved)	mg/L	0.2	ND (0.005)	ND (0.005)	--	--	--	--	--	--	--	--
Cyanide (total)	mg/L	0.2	ND (0.004)	--	--	--	--	--	--	--	--	--
Iron	mg/L	0.3	2.7	7.8	0.386	3.4	0.64	1.40	0.40	2.5	0.43	1.90
Iron (Dissolved)	mg/L	0.3	ND (0.025)	0.071	--	--	--	--	--	--	--	--
Lead	mg/L	0.025	0.014	0.032	ND (0.005)	0.015	--	--	--	--	--	--
Lead (Dissolved)	mg/L	0.025	ND (0.005)	ND (0.005)	--	--	--	--	--	--	--	--
Magnesium	mg/L	NS	55.4	74.2	55.6	61.3	--	--	--	--	--	--
Magnesium (Dissolved)	mg/L	NS	46.8	54.4	--	--	--	--	--	--	--	--
Manganese	mg/L	0.3	0.61	0.895	0.628	0.672	12.0	1.1	0.35	0.60	0.11	0.51
Manganese (Dissolved)	mg/L	0.3	0.43	0.570	--	--	--	--	--	--	--	--
Mercury	mg/L	0.0007	ND (0.0002)	ND (0.0002)	--	--	--	--	--	--	--	--
Mercury (Dissolved)	mg/L	0.0007	ND (0.0002)	ND (0.0002)	--	--	--	--	--	--	--	--
Nickel	mg/L	0.1	0.007	0.052	--	--	--	--	--	--	--	--
Nickel (Dissolved)	mg/L	0.1	ND (0.005)	0.009	--	--	--	--	--	--	--	--
Potassium	mg/L	NS	6.0	8.5	--	--	--	--	--	--	--	--
Potassium (Dissolved)	mg/L	NS	4.1	4.2	--	--	--	--	--	--	--	--
Selenium	mg/L	0.01	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	--	--	--	--	--	--
Selenium (Dissolved)	mg/L	0.01	ND (0.005)	ND (0.005)	--	--	--	--	--	--	--	--
Silica	mg/L	NS	27.7	78.1	24.7	21.0	--	--	--	--	--	--
Silica (Dissolved)	mg/L	NS	16.0	21.88	--	--	--	--	--	--	--	--
Silicon	mg/L	NS	--	--	--	--	8.8	6.4	2.6	4.4	--	4.0
Silver	mg/L	0.05	ND (0.005)	ND (0.005)	--	--	--	--	--	--	--	--

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

		NYSDEC Ambient Water Quality (mg/L)										
Sample Location:			*MW-1B*	*MW-1B*	*MW-1B*	*MW-1B*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*
Sample ID:			*WRL-MW1B-1200*	*WRL-MW1B-0301*	*WRL-MW1B-0601*	*WRL-MW1B-0901*	*Location2*	*Location2*	*Location2*	*Location2*	*Location2*	*Location2*
Sample Date:			*12/5/2000*	*3/21/2001*	*6/13/2001*	*9/19/2001*	*3/7/1979*	*4/11/1979*	*5/14/1979*	*6/11/1979*	*12/14/1979*	*1/16/1980*
Location Description:			*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*
Parameters	***Units***											
Silver (Dissolved)	mg/L	0.05	ND (0.005)	ND (0.005)	--	--	--	--	--	--	--	--
Sodium	mg/L	20	82.2	102	100	137	--	--	--	--	--	--
Sodium (Dissolved)	mg/L	20	83.1	107	--	--	--	--	--	--	--	--
Thallium	mg/L	NS	0.0015	ND (0.001)	ND (0.005)	ND (0.005)	--	--	--	--	--	--
Thallium (Dissolved)	mg/L	NS	0.0016	ND (0.001)	--	--	--	--	--	--	--	--
Vanadium	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Vanadium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Zinc	mg/L	NS	34	0.559	0.261	0.270	0.15	0.18	0.06	0.27	0.03	0.27
Zinc (Dissolved)	mg/L	NS	0.12	0.217	--	--	--	--	--	--	--	--
General Chemistry												
Nitrate (as N)	mg/L	10	--	--	--	--	--	--	--	--	--	--
pH (water)	s.u.		7.56	6.05	--	--	--	--	7.8	7.95	7.70	8.0

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC Ambient Water Quality (mg/L)*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*
Sample ID:			*Location2*	*Location2*	*Location2*	*Location2*	*Location2*	*Location2*	*Location2*	*Location2*	*Location2*	*Location2*	*Location2*
Sample Date:			*4/11/1980*	*7/8/1980*	*10/30/1980*	*1/7/1981*	*4/7/1981*	*6/22/1981*	*10/29/1981*	*1/6/1982*	*4/14/1982*	*7/27/1982*	*10/20/1982*
Location Description:			*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*
Parameters	***Units***												
Metals													
Aluminum	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Aluminum (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Antimony	mg/L	0.003	--	--	--	--	--	--	--	--	--	--	--
Antimony (Dissolved)	mg/L	0.003	--	--	--	--	--	--	--	--	--	--	--
Arsenic	mg/L	0.025	--	--	--	--	--	--	--	--	--	--	--
Arsenic (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--	--
Barium	mg/L	1	ND (0.1)	0.1	ND (0.1)	--	ND (0.2)	ND (0.20)	ND (0.2)	ND (0.2)	ND (0.200)	ND (0.200)	ND (0.200)
Barium (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--	--
Beryllium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Beryllium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Boron	mg/L	1	--	--	--	--	--	--	--	--	--	--	--
Boron (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--	--
Cadmium	mg/L	0.005	--	--	--	--	--	--	--	--	--	--	--
Cadmium (Dissolved)	mg/L	0.005	--	--	--	--	--	--	--	--	--	--	--
Calcium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Calcium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Chromium	mg/L	0.05	ND (0.02)	0.02	ND (0.02)	0.064	ND (0.005)	0.006	ND (0.005)	ND (0.005)	ND (0.005)	0.043	ND (0.005)
Chromium (Dissolved)	mg/L	0.05	--	--	--	--	--	--	--	--	--	--	--
Chromium, Hexavalent	mg/L	0.05	ND (0.01)	--	ND (0.02)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	0.009	ND (0.005)
Cobalt	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Cobalt (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Copper	mg/L	0.2	--	--	--	--	--	--	--	--	--	--	--
Copper (Dissolved)	mg/L	0.2	--	--	--	--	--	--	--	--	--	--	--
Cyanide (total)	mg/L	0.2	--	--	--	--	--	--	--	--	--	--	--
Iron	mg/L	0.3	0.21	0.96	1.7	0.156	0.05	0.05	ND (0.05)	ND (0.050)	ND (0.050)	ND (0.050)	ND (0.050)
Iron (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	--	--
Lead	mg/L	0.025	--	--	--	--	--	--	--	--	--	--	--
Lead (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Magnesium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Manganese	mg/L	0.3	0.25	0.26	0.37	0.116	0.074	0.133	0.156	0.068	0.064	0.106	0.200
Manganese (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	--	--
Mercury	mg/L	0.0007	--	--	--	--	--	--	--	--	--	--	--
Mercury (Dissolved)	mg/L	0.0007	--	--	--	--	--	--	--	--	--	--	--
Nickel	mg/L	0.1	--	--	--	--	--	--	--	--	--	--	--
Nickel (Dissolved)	mg/L	0.1	--	--	--	--	--	--	--	--	--	--	--
Potassium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Potassium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Selenium	mg/L	0.01	--	--	--	--	--	--	--	--	--	--	--
Selenium (Dissolved)	mg/L	0.01	--	--	--	--	--	--	--	--	--	--	--
Silica	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Silica (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Silicon	mg/L	NS	3.8	2.7	42	2.5	4.9	8.2	0.20	4.0	4.0	5.40	6.84
Silver	mg/L	0.05	--	--	--	--	--	--	--	--	--	--	--

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC Ambient Water Quality (mg/L)*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*
Sample ID:			*Location2*	*Location2*	*Location2*	*Location2*	*Location2*	*Location2*	*Location2*	*Location2*	*Location2*	*Location2*	*Location2*
Sample Date:			*4/11/1980*	*7/8/1980*	*10/30/1980*	*1/7/1981*	*4/7/1981*	*6/22/1981*	*10/29/1981*	*1/6/1982*	*4/14/1982*	*7/27/1982*	*10/20/1982*
Location Description:			*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*
Parameters	***Units***												
Silver (Dissolved)	mg/L	0.05	--	--	--	--	--	--	--	--	--	--	--
Sodium	mg/L	20	--	--	--	--	--	--	--	--	--	--	--
Sodium (Dissolved)	mg/L	20	--	--	--	--	--	--	--	--	--	--	--
Thallium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Thallium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Vanadium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Vanadium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Zinc	mg/L	NS	0.13	0.02	0.01	ND (0.050)	0.066	0.046	0.015	0.047	ND (0.010)	ND (0.050)	ND (0.050)
Zinc (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
General Chemistry													
Nitrate (as N)	mg/L	10	--	--	--	--	--	--	--	--	--	--	--
pH (water)	s.u.		7.55	7.55	7.60	7.2	7.71	7.50	7.45	7.50	7.75	7.61	7.85

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC Ambient Water Quality (mg/L)*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*
Sample ID:			*Location2*	*Location2*	*Location2*	*Location2*	*Location2*	*Location2*	*Location2*	*Location2*	*Location2*	*Location2*	*Location2*
Sample Date:			*3/1/1983*	*7/21/1983*	*10/26/1983*	*2/24/1984*	*4/11/1984*	*7/13/1984*	*10/11/1984*	*1/8/1985*	*4/3/1985*	*7/25/1985*	*10/31/1985*
Location Description:			*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*
Parameters	*Units*												
Metals													
Aluminum	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Aluminum (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Antimony	mg/L	0.003	--	--	--	--	--	--	--	--	--	--	--
Antimony (Dissolved)	mg/L	0.003	--	--	--	--	--	--	--	--	--	--	--
Arsenic	mg/L	0.025	--	--	--	--	--	--	--	--	--	--	--
Arsenic (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--	--
Barium	mg/L	1	ND (0.2)	--	--	ND (0.2)	0.04	--	--	0.047	--	--	--
Barium (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--	--
Beryllium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Beryllium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Boron	mg/L	1	--	--	--	--	--	--	--	--	--	--	--
Boron (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--	--
Cadmium	mg/L	0.005	--	--	--	--	--	--	--	--	--	--	--
Cadmium (Dissolved)	mg/L	0.005	--	--	--	--	--	--	--	--	--	--	--
Calcium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Calcium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Chromium	mg/L	0.05	0.012	--	--	ND (0.005)	--	--	--	0.028	--	--	--
Chromium (Dissolved)	mg/L	0.05	--	--	--	--	--	--	--	--	--	--	--
Chromium, Hexavalent	mg/L	0.05	0.011	--	--	ND (0.005)	--	--	--	0.012	--	--	--
Cobalt	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Cobalt (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Copper	mg/L	0.2	--	--	--	--	--	--	--	--	--	--	--
Copper (Dissolved)	mg/L	0.2	--	--	--	--	--	--	--	--	--	--	--
Cyanide (total)	mg/L	0.2	--	--	--	--	--	--	--	--	--	--	--
Iron	mg/L	0.3	ND (0.05)	--	--	ND (0.05)	--	--	--	0.160	--	--	--
Iron (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	--	--
Lead	mg/L	0.025	--	--	--	--	--	--	--	--	--	--	--
Lead (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Magnesium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Manganese	mg/L	0.3	0.083	--	--	ND (0.005)	--	--	--	ND (0.050)	--	--	--
Manganese (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	--	--
Mercury	mg/L	0.0007	--	--	--	--	--	--	--	--	--	--	--
Mercury (Dissolved)	mg/L	0.0007	--	--	--	--	--	--	--	--	--	--	--
Nickel	mg/L	0.1	--	--	--	--	--	--	--	--	--	--	--
Nickel (Dissolved)	mg/L	0.1	--	--	--	--	--	--	--	--	--	--	--
Potassium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Potassium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Selenium	mg/L	0.01	--	--	--	--	--	--	--	--	--	--	--
Selenium (Dissolved)	mg/L	0.01	--	--	--	--	--	--	--	--	--	--	--
Silica	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Silica (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Silicon	mg/L	NS	4.3	--	--	2.5	--	--	--	ND (0.4)	--	--	--
Silver	mg/L	0.05	--	--	--	--	--	--	--	--	--	--	--

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC Ambient Water Quality (mg/L)*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*
Sample ID:			*Location2*	*Location2*	*Location2*	*Location2*	*Location2*	*Location2*	*Location2*	*Location2*	*Location2*	*Location2*	*Location2*
Sample Date:			*3/1/1983*	*7/21/1983*	*10/26/1983*	*2/24/1984*	*4/11/1984*	*7/13/1984*	*10/11/1984*	*1/8/1985*	*4/3/1985*	*7/25/1985*	*10/31/1985*
Location Description:			*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*
<u>*Parameters*</u>	<u>*Units*</u>												
Silver (Dissolved)	mg/L	0.05	--	--	--	--	--	--	--	--	--	--	--
Sodium	mg/L	20	--	--	--	--	--	--	--	--	--	--	--
Sodium (Dissolved)	mg/L	20	--	--	--	--	--	--	--	--	--	--	--
Thallium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Thallium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Vanadium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Vanadium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Zinc	mg/L	NS	ND (0.050)	--	--	ND (0.02)	--	--	--	0.003	--	--	--
Zinc (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
<u>*General Chemistry*</u>													
Nitrate (as N)	mg/L	10	--	--	--	--	--	--	--	--	--	--	--
pH (water)	s.u.		7.55	7.99	8.74	9.90	9.46	11.08	10.91	11.73	11.58	11.65	11.43

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

		NYSDEC									
Sample Location:		*Ambient*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2B*	*MW-2B*	*MW-2B*
Sample ID:		*Water Quality*	*Location2*	*Location2*	*Location2*	*Location2*	*Location2*	*Location2*	*WRL-MW2B-1200*	*WRL-MW2B-0301*	*WRL-MW2B-0601*
Sample Date:		*(mg/L)*	*1/23/1986*	*4/2/1986*	*8/4/1986*	*10/2/1986*	*1/28/1987*	*4/15/1987*	*12/6/2000*	*3/21/2001*	*6/13/2001*
Location Description:			*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*
<u>*Parameters*</u>	<u>*Units*</u>										
<u>*Metals*</u>											
Aluminum	mg/L	NS	--	--	--	--	--	--	8.0	0.658	--
Aluminum (Dissolved)	mg/L	NS	--	--	--	--	--	--	0.19	0.148	--
Antimony	mg/L	0.003	--	--	--	--	--	--	ND (0.005)	ND (0.005)	--
Antimony (Dissolved)	mg/L	0.003	--	--	--	--	--	--	ND (0.005)	ND (0.005)	--
Arsenic	mg/L	0.025	--	--	--	--	--	--	ND (0.005)	ND (0.005)	--
Arsenic (Dissolved)	mg/L	0.025	--	--	--	--	--	--	ND (0.005)	ND (0.005)	--
Barium	mg/L	1	--	0.073	--	--	--	0.063	0.33	0.292	--
Barium (Dissolved)	mg/L	1	--	--	--	--	--	--	0.34	0.294	--
Beryllium	mg/L	NS	--	--	--	--	--	--	ND (0.005)	ND (0.003)	--
Beryllium (Dissolved)	mg/L	NS	--	--	--	--	--	--	ND (0.005)	ND (0.003)	--
Boron	mg/L	1	--	--	--	--	--	--	ND	ND (0.100)	--
Boron (Dissolved)	mg/L	1	--	--	--	--	--	--	ND (0.10)	ND (0.100)	--
Cadmium	mg/L	0.005	--	--	--	--	--	--	ND (0.005)	ND (0.005)	ND (0.005)
Cadmium (Dissolved)	mg/L	0.005	--	--	--	--	--	--	ND (0.005)	ND (0.005)	--
Calcium	mg/L	NS	--	--	--	--	--	--	417	382	--
Calcium (Dissolved)	mg/L	NS	--	--	--	--	--	--	391	384	--
Chromium	mg/L	0.05	--	0.039	--	--	--	0.023	0.34	0.325	0.368
Chromium (Dissolved)	mg/L	0.05	--	--	--	--	--	--	0.26	0.309	--
Chromium, Hexavalent	mg/L	0.05	--	0.033	--	--	--	0.012	0.095	0.000298	0.360
Cobalt	mg/L	NS	--	--	--	--	--	--	--	--	--
Cobalt (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--
Copper	mg/L	0.2	--	--	--	--	--	--	0.011	0.010	--
Copper (Dissolved)	mg/L	0.2	--	--	--	--	--	--	ND (0.005)	0.018	--
Cyanide (total)	mg/L	0.2	--	--	--	--	--	--	ND (0.004)	--	--
Iron	mg/L	0.3	--	0.08	--	--	--	0.124	10.0	0.399	0.583
Iron (Dissolved)	mg/L	0.3	--	--	--	--	--	--	ND (0.025)	ND (0.025)	--
Lead	mg/L	0.025	--	--	--	--	--	--	0.025	ND (0.005)	ND (0.005)
Lead (Dissolved)	mg/L	0.025	--	--	--	--	--	--	ND (0.005)	ND (0.005)	--
Magnesium	mg/L	NS	--	--	--	--	--	--	13.9	ND (1.0)	1.1
Magnesium (Dissolved)	mg/L	NS	--	--	--	--	--	--	ND (1.0)	ND (1.0)	--
Manganese	mg/L	0.3	--	ND (0.03)	--	--	--	ND (0.005)	0.33	0.017	0.024
Manganese (Dissolved)	mg/L	0.3	--	--	--	--	--	--	ND (0.005)	ND (0.005)	--
Mercury	mg/L	0.0007	--	--	--	--	--	--	ND (0.0002)	ND (0.0002)	--
Mercury (Dissolved)	mg/L	0.0007	--	--	--	--	--	--	ND (0.0002)	ND (0.0002)	--
Nickel	mg/L	0.1	--	--	--	--	--	--	0.015	0.008	--
Nickel (Dissolved)	mg/L	0.1	--	--	--	--	--	--	0.006	0.012	--
Potassium	mg/L	NS	--	--	--	--	--	--	18.3	13.5	--
Potassium (Dissolved)	mg/L	NS	--	--	--	--	--	--	15.2	11.7	--
Selenium	mg/L	0.01	--	--	--	--	--	--	0.009	0.007	0.008
Selenium (Dissolved)	mg/L	0.01	--	--	--	--	--	--	0.009	0.010	--
Silica	mg/L	NS	--	--	--	--	--	--	28.4	16.4	7.1
Silica (Dissolved)	mg/L	NS	--	--	--	--	--	--	1.49	6.73	--
Silicon	mg/L	NS	--	2.50	--	--	--	3.08	--	--	--
Silver	mg/L	0.05	--	--	--	--	--	--	ND (0.005)	ND (0.005)	--

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2*	*MW-2B*	*MW-2B*	*MW-2B*
Sample ID:		*Ambient*	*Location2*	*Location2*	*Location2*	*Location2*	*Location2*	*Location2*	*WRL-MW2B-1200*	*WRL-MW2B-0301*	*WRL-MW2B-0601*
Sample Date:		*Water Quality*	*1/23/1986*	*4/2/1986*	*8/4/1986*	*10/2/1986*	*1/28/1987*	*4/15/1987*	*12/6/2000*	*3/21/2001*	*6/13/2001*
Location Description:		*(mg/L)*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*
Parameters	***Units***										
Silver (Dissolved)	mg/L	0.05	--	--	--	--	--	--	ND (0.005)	ND (0.005)	--
Sodium	mg/L	20	--	--	--	--	--	--	55.8	42.3	48.0
Sodium (Dissolved)	mg/L	20	--	--	--	--	--	--	48.5	40.6	--
Thallium	mg/L	NS	--	--	--	--	--	--	0.0021	0.001	ND (0.005)
Thallium (Dissolved)	mg/L	NS	--	--	--	--	--	--	0.0025	0.004	--
Vanadium	mg/L	NS	--	--	--	--	--	--	--	--	--
Vanadium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--
Zinc	mg/L	NS	--	0.115	--	--	--	0.010	0.24	0.037	0.020
Zinc (Dissolved)	mg/L	NS	--	--	--	--	--	--	0.006	0.044	--
General Chemistry											
Nitrate (as N)	mg/L	10	--	--	--	--	--	--	--	--	--
pH (water)	s.u.		12.15	12.2	12.20	11.90	11.80	10.40	11.95	11.52	--

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC Ambient Water Quality (mg/L)*	*MW-2B*	*MW-3*	*MW-3*	*MW-3*	*MW-3*	*MW-3*	*MW-3*	*MW-3*	*MW-3*
Sample ID:			*WRL-MW2B-0901*	*Location3*	*Location3*	*Location3*	*Location3*	*Location3*	*Location3*	*Location3*	*Location3*
Sample Date:			*9/19/2001*	*3/7/1979*	*4/11/1979*	*5/14/1979*	*6/11/1979*	*1/16/1980*	*4/11/1980*	*7/8/1980*	*10/30/1980*
Location Description:			*Airco*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*
<u>*Parameters*</u>	<u>*Units*</u>										
<u>*Metals*</u>											
Aluminum	mg/L	NS	--	--	--	--	--	--	--	--	--
Aluminum (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--
Antimony	mg/L	0.003	--	--	--	--	--	--	--	--	--
Antimony (Dissolved)	mg/L	0.003	--	--	--	--	--	--	--	--	--
Arsenic	mg/L	0.025	--	--	--	--	--	--	--	--	--
Arsenic (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--
Barium	mg/L	1	--	0.25	0.05	ND (0.05)	ND (0.10)	ND (0.1)	ND (0.1)	0.1	ND (0.1)
Barium (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--
Beryllium	mg/L	NS	--	--	--	--	--	--	--	--	--
Beryllium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--
Boron	mg/L	1	--	--	--	--	--	--	--	--	--
Boron (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--
Cadmium	mg/L	0.005	ND (0.005)	--	--	--	--	--	--	--	--
Cadmium (Dissolved)	mg/L	0.005	--	--	--	--	--	--	--	--	--
Calcium	mg/L	NS	--	--	--	--	--	--	--	--	--
Calcium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--
Chromium	mg/L	0.05	0.333	0.02	0.03	0.03	ND (0.01)	ND (0.02)	ND (0.02)	0.02	ND (0.02)
Chromium (Dissolved)	mg/L	0.05	--	--	--	--	--	--	--	--	--
Chromium, Hexavalent	mg/L	0.05	0.299	--	--	--	--	--	--	--	ND (0.02)
Cobalt	mg/L	NS	--	--	--	--	--	--	--	--	--
Cobalt (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--
Copper	mg/L	0.2	--	--	--	--	--	--	--	--	--
Copper (Dissolved)	mg/L	0.2	--	--	--	--	--	--	--	--	--
Cyanide (total)	mg/L	0.2	--	--	--	--	--	--	--	--	--
Iron	mg/L	0.3	0.980	0.47	4.20	9.0	10.3	16.4	3.6	22	42
Iron (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--
Lead	mg/L	0.025	0.039	--	--	--	--	--	--	--	--
Lead (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--
Magnesium	mg/L	NS	1.4	--	--	--	--	--	--	--	--
Magnesium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--
Manganese	mg/L	0.3	0.030	2.0	1.2	0.75	0.27	0.61	1.26	0.46	1.07
Manganese (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--
Mercury	mg/L	0.0007	--	--	--	--	--	--	--	--	--
Mercury (Dissolved)	mg/L	0.0007	--	--	--	--	--	--	--	--	--
Nickel	mg/L	0.1	--	--	--	--	--	--	--	--	--
Nickel (Dissolved)	mg/L	0.1	--	--	--	--	--	--	--	--	--
Potassium	mg/L	NS	--	--	--	--	--	--	--	--	--
Potassium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--
Selenium	mg/L	0.01	0.008	--	--	--	--	--	--	--	--
Selenium (Dissolved)	mg/L	0.01	--	--	--	--	--	--	--	--	--
Silica	mg/L	NS	2.91	--	--	--	--	--	--	--	--
Silica (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--
Silicon	mg/L	NS	--	23.0	12.4	4.8	2.9	2.6	4.8	0.8	2.8
Silver	mg/L	0.05	--	--	--	--	--	--	--	--	--

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC Ambient Water Quality (mg/L)*	*MW-2B*	*MW-3*	*MW-3*	*MW-3*	*MW-3*	*MW-3*	*MW-3*	*MW-3*	*MW-3*
Sample ID:			*WRL-MW2B-0901*	*Location3*	*Location3*	*Location3*	*Location3*	*Location3*	*Location3*	*Location3*	*Location3*
Sample Date:			*9/19/2001*	*3/7/1979*	*4/11/1979*	*5/14/1979*	*6/11/1979*	*1/16/1980*	*4/11/1980*	*7/8/1980*	*10/30/1980*
Location Description:			*Airco*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*
<u>Parameters</u>	*<u>Units</u>*										
Silver (Dissolved)	mg/L	0.05	--	--	--	--	--	--	--	--	--
Sodium	mg/L	20	57.1	--	--	--	--	--	--	--	--
Sodium (Dissolved)	mg/L	20	--	--	--	--	--	--	--	--	--
Thallium	mg/L	NS	ND (0.005)	--	--	--	--	--	--	--	--
Thallium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--
Vanadium	mg/L	NS	--	--	--	--	--	--	--	--	--
Vanadium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--
Zinc	mg/L	NS	0.023	0.12	0.44	0.28	0.14	0.22	0.37	0.05	0.22
Zinc (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--
<u>General Chemistry</u>											
Nitrate (as N)	mg/L	10	--	--	--	--	--	--	--	--	--
pH (water)	s.u.		--	--	10.30	9.15	8.80	7.95	7.50	6.85	--

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC Ambient Water Quality (mg/L)*	*MW-3*	*MW-3*	*MW-3*	*MW-3*	*MW-3*	*MW-3*	*MW-3*	*MW-3*	*MW-3*	*MW-3*
Sample ID:			*Location3*	*Location3*	*Location3*	*Location3*	*Location3*	*Location3*	*Location3*	*Location3*	*Location3*	*Location3*
Sample Date:			*1/7/1981*	*4/7/1981*	*6/22/1981*	*10/29/1981*	*1/6/1982*	*4/14/1982*	*7/27/1982*	*10/20/1982*	*3/1/1983*	*7/21/1983*
Location Description:			*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*
Parameters	***Units***											
Metals												
Aluminum	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Aluminum (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Antimony	mg/L	0.003	--	--	--	--	--	--	--	--	--	--
Antimony (Dissolved)	mg/L	0.003	--	--	--	--	--	--	--	--	--	--
Arsenic	mg/L	0.025	--	--	--	--	--	--	--	--	--	--
Arsenic (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--
Barium	mg/L	1	--	ND (0.2)	0.24	ND (0.2)	ND (0.2)	0.226	ND (0.200)	ND (0.200)	ND (0.2)	--
Barium (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--
Beryllium	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Beryllium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Boron	mg/L	1	--	--	--	--	--	--	--	--	--	--
Boron (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--
Cadmium	mg/L	0.005	--	--	--	--	--	--	--	--	--	--
Cadmium (Dissolved)	mg/L	0.005	--	--	--	--	--	--	--	--	--	--
Calcium	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Calcium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Chromium	mg/L	0.05	0.021	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	--
Chromium (Dissolved)	mg/L	0.05	--	--	--	--	--	--	--	--	--	--
Chromium, Hexavalent	mg/L	0.05	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	--	--
Cobalt	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Cobalt (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Copper	mg/L	0.2	--	--	--	--	--	--	--	--	--	--
Copper (Dissolved)	mg/L	0.2	--	--	--	--	--	--	--	--	--	--
Cyanide (total)	mg/L	0.2	--	--	--	--	--	--	--	--	--	--
Iron	mg/L	0.3	ND (0.050)	0.16	0.07	ND (0.05)	0.075	ND (0.050)	0.114	0.054	0.069	--
Iron (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	--
Lead	mg/L	0.025	--	--	--	--	--	--	--	--	--	--
Lead (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Magnesium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Manganese	mg/L	0.3	0.020	0.028	ND (0.02)	ND (0.020)	ND (0.020)	ND (0.020)	0.029	ND (0.020)	ND (0.02)	--
Manganese (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	--
Mercury	mg/L	0.0007	--	--	--	--	--	--	--	--	--	--
Mercury (Dissolved)	mg/L	0.0007	--	--	--	--	--	--	--	--	--	--
Nickel	mg/L	0.1	--	--	--	--	--	--	--	--	--	--
Nickel (Dissolved)	mg/L	0.1	--	--	--	--	--	--	--	--	--	--
Potassium	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Potassium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Selenium	mg/L	0.01	--	--	--	--	--	--	--	--	--	--
Selenium (Dissolved)	mg/L	0.01	--	--	--	--	--	--	--	--	--	--
Silica	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Silica (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Silicon	mg/L	NS	3.0	3.0	5.0	3.40	3.5	1.70	1.48	6.78	3.71	--
Silver	mg/L	0.05	--	--	--	--	--	--	--	--	--	--

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC Ambient Water Quality (mg/L)*	*MW-3*	*MW-3*	*MW-3*	*MW-3*	*MW-3*	*MW-3*	*MW-3*	*MW-3*	*MW-3*	*MW-3*
Sample ID:			*Location3*	*Location3*	*Location3*	*Location3*	*Location3*	*Location3*	*Location3*	*Location3*	*Location3*	*Location3*
Sample Date:			*1/7/1981*	*4/7/1981*	*6/22/1981*	*10/29/1981*	*1/6/1982*	*4/14/1982*	*7/27/1982*	*10/20/1982*	*3/1/1983*	*7/21/1983*
Location Description:			*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*
Parameters	*Units*											
Silver (Dissolved)	mg/L	0.05	--	--	--	--	--	--	--	--	--	--
Sodium	mg/L	20	--	--	--	--	--	--	--	--	--	--
Sodium (Dissolved)	mg/L	20	--	--	--	--	--	--	--	--	--	--
Thallium	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Thallium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Vanadium	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Vanadium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Zinc	mg/L	NS	ND (50)	0.010	0.013	0.050	0.010	ND (0.010)	ND (0.050)	ND (0.050)	ND (0.050)	--
Zinc (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
General Chemistry												
Nitrate (as N)	mg/L	10	--	--	--	--	--	--	--	--	--	--
pH (water)	s.u.		9.1	8.05	7.97	8.75	8.55	7.95	8.48	8.00	9.28	9.70

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:*		*NYSDEC Ambient Water Quality (mg/L)*	*MW-3* *Location3* *10/26/1983* *SKW Landfill*	*MW-3* *Location3* *2/24/1984* *SKW Landfill*	*MW-3* *Location3* *4/11/1984* *SKW Landfill*	*MW-3* *Location3* *10/11/1984* *SKW Landfill*	*MW-3* *Location3* *4/3/1985* *SKW Landfill*	*MW-3B* *WRL-MW3B-1200* *12/6/2000* *Airco*	*MW-3B* *WRL-MW3B-0301* *3/21/2001* *Airco*	*MW-3B* *WRL-MW3B-0601* *6/13/2001* *Airco*	*MW-3B* *WRL-MW3B-0901* *9/19/2001* *Airco*
<u>*Parameters*</u>	<u>*Units*</u>										
<u>*Metals*</u>											
Aluminum	mg/L	NS	--	--	--	--	--	0.11	1.3	--	--
Aluminum (Dissolved)	mg/L	NS	--	--	--	--	--	0.14	0.011	--	--
Antimony	mg/L	0.003	--	--	--	--	--	ND (0.005)	ND (0.005)	--	--
Antimony (Dissolved)	mg/L	0.003	--	--	--	--	--	ND (0.005)	ND (0.005)	--	--
Arsenic	mg/L	0.025	--	--	--	--	--	ND (0.005)	ND (0.005)	--	--
Arsenic (Dissolved)	mg/L	0.025	--	--	--	--	--	ND (0.005)	ND (0.005)	--	--
Barium	mg/L	1	--	--	--	--	--	0.014	0.017	--	--
Barium (Dissolved)	mg/L	1	--	--	--	--	--	0.010	0.012	--	--
Beryllium	mg/L	NS	--	--	--	--	--	ND (0.005)	ND (0.003)	--	--
Beryllium (Dissolved)	mg/L	NS	--	--	--	--	--	ND (0.005)	ND (0.003)	--	--
Boron	mg/L	1	--	--	--	--	--	ND (0.10)	ND (0.100)	--	--
Boron (Dissolved)	mg/L	1	--	--	--	--	--	ND (0.10)	ND (0.100)	--	--
Cadmium	mg/L	0.005	--	--	--	--	--	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
Cadmium (Dissolved)	mg/L	0.005	--	--	--	--	--	ND (0.005)	ND (0.005)	--	--
Calcium	mg/L	NS	--	--	--	--	--	27.5	26.6	--	--
Calcium (Dissolved)	mg/L	NS	--	--	--	--	--	18.8	28.7	--	--
Chromium	mg/L	0.05	--	--	--	--	--	ND (0.005)	0.012	0.010	ND (0.005)
Chromium (Dissolved)	mg/L	0.05	--	--	--	--	--	ND (0.005)	0.008	--	--
Chromium, Hexavalent	mg/L	0.05	--	--	--	--	--	ND (0.01)	ND (0.00001)	ND (0.010)	ND (0.01)
Cobalt	mg/L	NS	--	--	--	--	--	--	--	--	--
Cobalt (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--
Copper	mg/L	0.2	--	--	--	--	--	ND (0.005)	ND (0.005)	--	--
Copper (Dissolved)	mg/L	0.2	--	--	--	--	--	ND (0.005)	ND (0.005)	--	--
Cyanide (total)	mg/L	0.2	--	--	--	--	--	ND (0.004)	--	--	--
Iron	mg/L	0.3	--	--	--	--	--	0.044	1.2	2.6	0.260
Iron (Dissolved)	mg/L	0.3	--	--	--	--	--	ND (0.025)	ND (0.025)	--	--
Lead	mg/L	0.025	--	--	--	--	--	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
Lead (Dissolved)	mg/L	0.025	--	--	--	--	--	ND (0.005)	ND (0.005)	--	--
Magnesium	mg/L	NS	--	--	--	--	--	13.3	12.7	12.4	10.9
Magnesium (Dissolved)	mg/L	NS	--	--	--	--	--	7.5	14.2	--	--
Manganese	mg/L	0.3	--	--	--	--	--	0.021	0.034	0.066	0.008
Manganese (Dissolved)	mg/L	0.3	--	--	--	--	--	ND (0.005)	0.009	--	--
Mercury	mg/L	0.0007	--	--	--	--	--	ND (0.0002)	ND (0.0002)	--	--
Mercury (Dissolved)	mg/L	0.0007	--	--	--	--	--	ND (0.0002)	ND (0.0002)	--	--
Nickel	mg/L	0.1	--	--	--	--	--	ND (0.005)	0.015	--	--
Nickel (Dissolved)	mg/L	0.1	--	--	--	--	--	ND (0.005)	ND (0.005)	--	--
Potassium	mg/L	NS	--	--	--	--	--	1.4	1.7	--	--
Potassium (Dissolved)	mg/L	NS	--	--	--	--	--	2.0	1.6	--	--
Selenium	mg/L	0.01	--	--	--	--	--	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
Selenium (Dissolved)	mg/L	0.01	--	--	--	--	--	ND (0.005)	ND (0.005)	--	--
Silica	mg/L	NS	--	--	--	--	--	15.7	23.5	33.0	13.4
Silica (Dissolved)	mg/L	NS	--	--	--	--	--	18.9	17.8	--	--
Silicon	mg/L	NS	--	ND (1.8)	--	--	--	--	--	--	--
Silver	mg/L	0.05	--	--	--	--	--	ND (0.005)	ND (0.005)	--	--

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:*		*NYSDEC Ambient Water Quality (mg/L)*	*MW-3* *Location3* *10/26/1983* *SKW Landfill*	*MW-3* *Location3* *2/24/1984* *SKW Landfill*	*MW-3* *Location3* *4/11/1984* *SKW Landfill*	*MW-3* *Location3* *10/11/1984* *SKW Landfill*	*MW-3* *Location3* *4/3/1985* *SKW Landfill*	*MW-3B* *WRL-MW3B-1200* *12/6/2000* *Airco*	*MW-3B* *WRL-MW3B-0301* *3/21/2001* *Airco*	*MW-3B* *WRL-MW3B-0601* *6/13/2001* *Airco*	*MW-3B* *WRL-MW3B-0901* *9/19/2001* *Airco*
Parameters	***Units***										
Silver (Dissolved)	mg/L	0.05	--	--	--	--	--	ND (0.005)	ND (0.005)	--	--
Sodium	mg/L	20	--	--	--	--	--	44.5	42.3	46.7	44.9
Sodium (Dissolved)	mg/L	20	--	--	--	--	--	42.4	43.3	--	--
Thallium	mg/L	NS	--	--	--	--	--	0.0024	ND (0.001)	ND (0.005)	ND (0.005)
Thallium (Dissolved)	mg/L	NS	--	--	--	--	--	0.0034	0.002	--	--
Vanadium	mg/L	NS	--	--	--	--	--	--	--	--	--
Vanadium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--
Zinc	mg/L	NS	--	--	--	--	--	ND (0.005)	0.018	0.017	ND (0.005)
Zinc (Dissolved)	mg/L	NS	--	--	--	--	--	ND (0.005)	ND (0.005)	--	--
General Chemistry											
Nitrate (as N)	mg/L	10	--	--	--	--	--	--	--	--	--
pH (water)	s.u.		10.41	9.37	10.02	--	9.84	9.06	8.11	--	--

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC Ambient Water Quality (mg/L)*	*MW-3R-88*	*MW-3R-88*	*MW-3R-88*	*MW-3R-88*	*MW-3R-88*	*MW-3R-88*	*MW-3R-88*	*MW-3R-88*	*MW-3R-88*	*MW-3R-88*
Sample ID:			*mw-3R*	*MW-3R*	*MW-3R*	*MW-3R*	*MW-3R*	*MW-3R*	*MW-3R*	*MW-3R*	*MW-3R*	*MW-3R*
Sample Date:			*6/1/1989*	*8/1/1989*	*12/1/1992*	*6/30/1993*	*9/10/1993*	*12/6/1993*	*3/23/1994*	*6/28/1994*	*9/20/1994*	*12/13/1994*
Location Description:			*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*
Parameters	*Units*											
Metals												
Aluminum	mg/L	NS	--	--	--	0.22	--	--	--	--	--	2.9
Aluminum (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Antimony	mg/L	0.003	--	--	--	ND (0.05)	--	--	--	--	--	ND (0.05)
Antimony (Dissolved)	mg/L	0.003	--	--	--	--	--	--	--	--	--	--
Arsenic	mg/L	0.025	--	--	--	ND (0.005)	--	--	--	--	--	ND (0.002)
Arsenic (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--
Barium	mg/L	1	--	--	--	0.04	--	--	--	--	--	0.05
Barium (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--
Beryllium	mg/L	NS	--	--	--	ND (0.005)	--	--	--	--	--	ND (0.005)
Beryllium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Boron	mg/L	1	--	--	--	--	--	--	--	--	--	--
Boron (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--
Cadmium	mg/L	0.005	--	--	--	ND (0.005)	0.0006	ND (0.001)	ND (0.0005)	0.001	0.006	0.005
Cadmium (Dissolved)	mg/L	0.005	--	--	--	--	--	--	--	--	--	--
Calcium	mg/L	NS	--	--	--	100	111	100	89	91	106	103
Calcium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Chromium	mg/L	0.05	0.017	ND	ND	ND (0.01)	--	--	--	--	--	ND (0.01)
Chromium (Dissolved)	mg/L	0.05	--	--	--	--	--	--	--	--	--	--
Chromium, Hexavalent	mg/L	0.05	ND	ND	ND	ND (0.01)	--	--	--	--	--	ND (0.01)
Cobalt	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Cobalt (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Copper	mg/L	0.2	--	--	--	ND (0.01)	--	--	--	--	--	ND (0.01)
Copper (Dissolved)	mg/L	0.2	--	--	--	--	--	--	--	--	--	--
Cyanide (total)	mg/L	0.2	--	--	--	--	--	--	--	--	--	--
Iron	mg/L	0.3	--	--	--	0.49	0.4	0.2	0.1	1	0.19	0.31
Iron (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	--
Lead	mg/L	0.025	--	--	--	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	0.006	ND (0.005)	0.017
Lead (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	47	51	45	42.6	43	45	48
Magnesium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Manganese	mg/L	0.3	--	--	--	0.03	0.02	ND (0.005)	ND (0.005)	0.04	0.01	0.007
Manganese (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	--
Mercury	mg/L	0.0007	--	--	--	ND (0.001)	--	--	--	--	--	ND (0.0005)
Mercury (Dissolved)	mg/L	0.0007	--	--	--	--	--	--	--	--	--	--
Nickel	mg/L	0.1	--	--	--	ND (0.02)	--	--	--	--	--	ND (0.02)
Nickel (Dissolved)	mg/L	0.1	--	--	--	--	--	--	--	--	--	--
Potassium	mg/L	NS	--	--	--	ND (1.0)	ND (1.0)	ND (1.0)	ND (1.0)	1.5	ND (1.0)	1.7
Potassium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Selenium	mg/L	0.01	--	--	--	ND (0.005)	--	--	--	--	--	ND (0.002)
Selenium (Dissolved)	mg/L	0.01	--	--	--	--	--	--	--	--	--	--
Silica	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Silica (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Silicon	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Silver	mg/L	0.05	--	--	--	ND (0.005)	--	--	--	--	--	ND (0.005)

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

		NYSDEC Ambient Water Quality (mg/L)										
Sample Location:			*MW-3R-88*	*MW-3R-88*	*MW-3R-88*	*MW-3R-88*	*MW-3R-88*	*MW-3R-88*	*MW-3R-88*	*MW-3R-88*	*MW-3R-88*	*MW-3R-88*
Sample ID:			*mw-3R*	*MW-3R*	*MW-3R*	*MW-3R*	*MW-3R*	*MW-3R*	*MW-3R*	*MW-3R*	*MW-3R*	*MW-3R*
Sample Date:			*6/1/1989*	*8/1/1989*	*12/1/1992*	*6/30/1993*	*9/10/1993*	*12/6/1993*	*3/23/1994*	*6/28/1994*	*9/20/1994*	*12/13/1994*
Location Description:			*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*
__Parameters__	*__Units__*											
Silver (Dissolved)	mg/L	0.05	--	--	--	--	--	--	--	--	--	--
Sodium	mg/L	20	--	--	--	14	14	14	13.3	14	12	18
Sodium (Dissolved)	mg/L	20	--	--	--	--	--	--	--	--	--	--
Thallium	mg/L	NS	--	--	--	ND (0.05)	--	--	--	--	--	ND (0.05)
Thallium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Vanadium	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Vanadium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Zinc	mg/L	NS	--	--	--	0.07	--	--	--	--	--	0.08
Zinc (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
__General Chemistry__												
Nitrate (as N)	mg/L	10	--	--	--	0.07	ND (0.05)	0.08	0.11	0.05	0.1	ND (0.05)
pH (water)	s.u.		6.99	7.11	7.21	7.11	7.16	6.99	7.13	7.05	7.15	7.02

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:*		*NYSDEC Ambient Water Quality (mg/L)*	*MW-3R-88* *MW-3R* *3/16/1995* *SKW Landfill*	*MW-3R-88* *MW-3R* *6/6/1995* *SKW Landfill*	*MW-3R-88* *MW-3R* *10/27/1995* *SKW Landfill*	*MW-3R-88* *MW-3R* *1/25/1996* *SKW Landfill*	*MW-3R-88* *MW-3R* *4/19/1996* *SKW Landfill*	*MW-3R-88* *MW-3R* *7/11/1996* *SKW Landfill*	*MW-3R-88* *MW-3R* *11/1/1996* *SKW Landfill*	*MW-3R-88* *MW-3R* *1/30/1997* *SKW Landfill*	*MW-3R-88* *MW-3R* *4/30/1997* *NiMO/NMPA*	*MW-3R-88* *MW-3R* *7/30/1997* *SKW Landfill*
<u>*Parameters*</u>	<u>*Units*</u>											
<u>*Metals*</u>												
Aluminum	mg/L	NS	--	--	--	--	ND (0.05)	--	--	--	--	--
Aluminum (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Antimony	mg/L	0.003	--	--	--	--	ND (0.05)	--	--	--	--	--
Antimony (Dissolved)	mg/L	0.003	--	--	--	--	--	--	--	--	--	--
Arsenic	mg/L	0.025	--	--	--	--	0.005	--	--	--	--	--
Arsenic (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--
Barium	mg/L	1	--	--	--	--	0.02	--	--	--	--	--
Barium (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--
Beryllium	mg/L	NS	--	--	--	--	ND (0.005)	--	--	--	--	--
Beryllium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Boron	mg/L	1	--	--	--	--	--	--	--	--	--	--
Boron (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--
Cadmium	mg/L	0.005	0.001	0.0004	0.0019	0.0009	ND (0.005)	ND (0.001)	--	ND (0.001)	ND (0.001)	ND (0.001)
Cadmium (Dissolved)	mg/L	0.005	--	--	--	--	--	--	--	--	--	--
Calcium	mg/L	NS	105	101	27	100	104	100	100	100	99	110
Calcium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Chromium	mg/L	0.05	--	--	--	--	ND (0.01)	--	--	--	--	--
Chromium (Dissolved)	mg/L	0.05	--	--	--	--	--	--	--	--	--	--
Chromium, Hexavalent	mg/L	0.05	--	--	--	--	ND (0.04)	--	ND (0.04)	ND (0.04)	ND (0.04)	ND (0.04)
Cobalt	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Cobalt (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Copper	mg/L	0.2	--	--	--	--	ND (0.01)	--	--	--	--	--
Copper (Dissolved)	mg/L	0.2	--	--	--	--	--	--	--	--	--	--
Cyanide (total)	mg/L	0.2	--	--	--	--	--	--	--	--	--	--
Iron	mg/L	0.3	0.33	1.6	0.11	0.34	0.08	1	3.1	0.42	0.51	0.11
Iron (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	--
Lead	mg/L	0.025	ND (0.005)	0.007	ND (0.002)	ND (0.002)	ND (0.005)	ND (0.005)	0.005	ND (0.005)	ND (0.005)	0.005
Lead (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--
Magnesium	mg/L	NS	50	48	7.6	49	52	48	50	50	50	52
Magnesium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Manganese	mg/L	0.3	0.009	0.07	ND (0.005)	0.01	0.005	0.014	0.1	0.015	0.017	0.01
Manganese (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	--
Mercury	mg/L	0.0007	--	--	--	--	ND (0.001)	--	--	--	--	--
Mercury (Dissolved)	mg/L	0.0007	--	--	--	--	--	--	--	--	--	--
Nickel	mg/L	0.1	--	--	--	--	ND (0.02)	--	--	--	--	--
Nickel (Dissolved)	mg/L	0.1	--	--	--	--	--	--	--	--	--	--
Potassium	mg/L	NS	ND (1.0)	1.4	2.1	1.1	ND (1)	1.8	1.4	1.1	3	ND (1.0)
Potassium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Selenium	mg/L	0.01	--	--	--	--	ND (0.005)	--	--	--	--	--
Selenium (Dissolved)	mg/L	0.01	--	--	--	--	--	--	--	--	--	--
Silica	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Silica (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Silicon	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Silver	mg/L	0.05	--	--	--	--	ND (0.005)	--	--	--	--	--

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC Ambient Water Quality (mg/L)*	*MW-3R-88*	*MW-3R-88*	*MW-3R-88*	*MW-3R-88*	*MW-3R-88*	*MW-3R-88*	*MW-3R-88*	*MW-3R-88*	*MW-3R-88*	*MW-3R-88*
Sample ID:			*MW-3R*	*MW-3R*	*MW-3R*	*MW-3R*	*MW-3R*	*MW-3R*	*MW-3R*	*MW-3R*	*MW-3R*	*MW-3R*
Sample Date:			*3/16/1995*	*6/6/1995*	*10/27/1995*	*1/25/1996*	*4/19/1996*	*7/11/1996*	*11/1/1996*	*1/30/1997*	*4/30/1997*	*7/30/1997*
Location Description:			*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*NiMO/NMPA*	*SKW Landfill*
Parameters	***Units***											
Silver (Dissolved)	mg/L	0.05	--	--	--	--	--	--	--	--	--	--
Sodium	mg/L	20	16	13	40	16	13	15	17	15	12	15
Sodium (Dissolved)	mg/L	20	--	--	--	--	--	--	--	--	--	--
Thallium	mg/L	NS	--	--	--	--	ND (0.05)	--	--	--	--	--
Thallium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Vanadium	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Vanadium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Zinc	mg/L	NS	--	--	--	--	ND (0.02)	--	--	--	--	--
Zinc (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
General Chemistry												
Nitrate (as N)	mg/L	10	0.22	ND (0.05)	0.07	0.05	0.07	0.09	ND (0.04)	0.15	0.29	ND (0.04)
pH (water)	s.u.		6.77	7.18	7.46	7.13	7.08	7.07	7	7.17	7.1	6.95

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:*		*NYSDEC Ambient Water Quality (mg/L)*	*MW-3R-88* *MW-3R* *10/23/1997* *SKW Landfill*	*MW-3R-88* *MW-3R* *1/22/1998* *SKW Landfill*	*MW-3R-88* *MW-3R* *6/18/1998* *SKW Landfill*	*MW-3R-88* *MW-3R* *7/21/1998* *SKW Landfill*	*MW-3R-88* *MW-3R* *10/14/1998* *SKW Landfill*	*MW-3R-88* *MW-3R* *1/28/1999* *SKW Landfill*	*MW-3R-88* *MW-3R* *1/29/1999* *SKW Landfill*	*MW-4* *Location4* *3/7/1979* *Airco*	*MW-4* *Location4* *4/11/1979* *Airco*	*MW-4* *Location4* *5/14/1979* *Airco*
Parameters	***Units***											
Metals												
Aluminum	mg/L	NS	0.17	0.14	--	--	--	--	--	--	--	--
Aluminum (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Antimony	mg/L	0.003	ND (0.24)	ND (0.24)	--	--	--	--	--	--	--	--
Antimony (Dissolved)	mg/L	0.003	--	--	--	--	--	--	--	--	--	--
Arsenic	mg/L	0.025	ND (0.002)	ND (0.002)	--	--	--	--	--	--	--	--
Arsenic (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--
Barium	mg/L	1	0.050	0.028	--	--	--	--	--	0.20	0.15	0.05
Barium (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--
Beryllium	mg/L	NS	ND (0.002)	ND (0.002)	--	--	--	--	--	--	--	--
Beryllium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Boron	mg/L	1	--	--	--	--	--	--	--	--	--	--
Boron (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--
Cadmium	mg/L	0.005	ND (0.016)	ND (0.016)	ND (0.001)	ND (0.001)	0.004	ND (0.001)	ND (0.001)	--	--	--
Cadmium (Dissolved)	mg/L	0.005	--	--	--	--	--	--	--	--	--	--
Calcium	mg/L	NS	110	101	98	110	100	95	100	--	--	--
Calcium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Chromium	mg/L	0.05	ND (0.014)	ND (0.014)	--	--	--	--	--	0.02	0.01	0.02
Chromium (Dissolved)	mg/L	0.05	--	--	--	--	--	--	--	--	--	--
Chromium, Hexavalent	mg/L	0.05	ND (0.04)	ND (0.04)	ND (0.04)	ND (0.04)	ND (0.04)	--	--	--	--	--
Cobalt	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Cobalt (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Copper	mg/L	0.2	ND (0.010)	ND (0.010)	--	--	--	--	--	--	--	--
Copper (Dissolved)	mg/L	0.2	--	--	--	--	--	--	--	--	--	--
Cyanide (total)	mg/L	0.2	--	--	--	--	--	--	--	--	--	--
Iron	mg/L	0.3	0.69	0.210	0.328	0.108	7.55	0.408	2.31	0.62	0.41	0.85
Iron (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	--
Lead	mg/L	0.025	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	0.059	0.004	0.010	--	--	--
Lead (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--
Magnesium	mg/L	NS	50	51	50	53	48	46	49	--	--	--
Magnesium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Manganese	mg/L	0.3	0.015	ND (0.010)	0.039	ND (0.010)	0.255	0.016	0.094	5.5	3.8	1.25
Manganese (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	--
Mercury	mg/L	0.0007	ND (0.0004)	ND (0.0004)	--	--	--	--	--	--	--	--
Mercury (Dissolved)	mg/L	0.0007	--	--	--	--	--	--	--	--	--	--
Nickel	mg/L	0.1	ND (0.050)	ND (0.050)	--	--	--	--	--	--	--	--
Nickel (Dissolved)	mg/L	0.1	--	--	--	--	--	--	--	--	--	--
Potassium	mg/L	NS	ND (1.8)	ND (1.8)	3.1	ND (1.8)	ND (1.8)	ND (1.8)	ND (1.8)	--	--	--
Potassium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Selenium	mg/L	0.01	ND (0.004)	ND (0.004)	--	--	--	--	--	--	--	--
Selenium (Dissolved)	mg/L	0.01	--	--	--	--	--	--	--	--	--	--
Silica	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Silica (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Silicon	mg/L	NS	--	--	--	--	--	--	--	11.0	11.5	4.6
Silver	mg/L	0.05	ND (0.010)	ND (0.010)	--	--	--	--	--	--	--	--

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:*		NYSDEC *Ambient Water Quality (mg/L)*	*MW-3R-88* *MW-3R* *10/23/1997* *SKW Landfill*	*MW-3R-88* *MW-3R* *1/22/1998* *SKW Landfill*	*MW-3R-88* *MW-3R* *6/18/1998* *SKW Landfill*	*MW-3R-88* *MW-3R* *7/21/1998* *SKW Landfill*	*MW-3R-88* *MW-3R* *10/14/1998* *SKW Landfill*	*MW-3R-88* *MW-3R* *1/28/1999* *SKW Landfill*	*MW-3R-88* *MW-3R* *1/29/1999* *SKW Landfill*	*MW-4* *Location4* *3/7/1979* *Airco*	*MW-4* *Location4* *4/11/1979* *Airco*	*MW-4* *Location4* *5/14/1979* *Airco*
Parameters	***Units***											
Silver (Dissolved)	mg/L	0.05	--	--	--	--	--	--	--	--	--	--
Sodium	mg/L	20	14	14	16	14	14	12	11	--	--	--
Sodium (Dissolved)	mg/L	20	--	--	--	--	--	--	--	--	--	--
Thallium	mg/L	NS	ND (0.05)	ND (0.05)	--	--	--	--	--	--	--	--
Thallium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Vanadium	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Vanadium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Zinc	mg/L	NS	0.100	0.055	--	--	--	--	--	0.83	0.38	0.33
Zinc (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
General Chemistry												
Nitrate (as N)	mg/L	10	0.05	0.17	0.09	0.07	0.06	--	--	--	--	--
pH (water)	s.u.		7.15	7.07	7.07	7.32	7.50	--	--	7.45	7.55	7.35

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC Ambient Water Quality (mg/L)*	*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4*
Sample ID:			*Location4*	*Location4*	*Location4*	*Location4*	*Location4*	*Location4*	*Location4*	*Location4*	*Location4*	*Location4*	*Location4*
Sample Date:			*6/11/1979*	*12/14/1979*	*1/16/1980*	*4/11/1980*	*7/8/1980*	*10/30/1980*	*1/7/1981*	*4/7/1981*	*6/22/1981*	*10/29/1981*	*1/6/1982*
Location Description:			*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*
Parameters	***Units***												
Metals													
Aluminum	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Aluminum (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Antimony	mg/L	0.003	--	--	--	--	--	--	--	--	--	--	--
Antimony (Dissolved)	mg/L	0.003	--	--	--	--	--	--	--	--	--	--	--
Arsenic	mg/L	0.025	--	--	--	--	--	--	--	--	--	--	--
Arsenic (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--	--
Barium	mg/L	1	ND (0.10)	0.08	ND (0.1)	0.4	0.2	ND (0.1)	--	ND (0.2)	0.75	ND (0.2)	ND (0.2)
Barium (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--	--
Beryllium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Beryllium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Boron	mg/L	1	--	--	--	--	--	--	--	--	--	--	--
Boron (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--	--
Cadmium	mg/L	0.005	--	--	--	--	--	--	--	--	--	--	--
Cadmium (Dissolved)	mg/L	0.005	--	--	--	--	--	--	--	--	--	--	--
Calcium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Calcium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Chromium	mg/L	0.05	ND (0.01)	ND (0.02)	ND (0.02)	0.02	ND (0.02)	ND (0.02)	0.064	ND (0.005)	0.007	ND (0.005)	ND (0.005)
Chromium (Dissolved)	mg/L	0.05	--	--	--	--	--	--	--	--	--	--	--
Chromium, Hexavalent	mg/L	0.05	--	--	--	ND (0.01)	--	ND (0.02)	0.02240	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
Cobalt	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Cobalt (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Copper	mg/L	0.2	--	--	--	--	--	--	--	--	--	--	--
Copper (Dissolved)	mg/L	0.2	--	--	--	--	--	--	--	--	--	--	--
Cyanide (total)	mg/L	0.2	--	--	--	--	--	--	--	--	--	--	--
Iron	mg/L	0.3	1.6	0.32	0.15	0.05	0.20	0.56	ND (0.050)	ND (0.05)	ND (0.05)	ND (0.05)	0.379
Iron (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	--	--
Lead	mg/L	0.025	--	--	--	--	--	--	--	--	--	--	--
Lead (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Magnesium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Manganese	mg/L	0.3	0.99	0.01	1.18	0.57	0.64	0.28	0.067	0.475	0.770	0.622	0.508
Manganese (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	--	--
Mercury	mg/L	0.0007	--	--	--	--	--	--	--	--	--	--	--
Mercury (Dissolved)	mg/L	0.0007	--	--	--	--	--	--	--	--	--	--	--
Nickel	mg/L	0.1	--	--	--	--	--	--	--	--	--	--	--
Nickel (Dissolved)	mg/L	0.1	--	--	--	--	--	--	--	--	--	--	--
Potassium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Potassium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Selenium	mg/L	0.01	--	--	--	--	--	--	--	--	--	--	--
Selenium (Dissolved)	mg/L	0.01	--	--	--	--	--	--	--	--	--	--	--
Silica	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Silica (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Silicon	mg/L	NS	4.6	--	5.0	5.4	3.6	4.7	5.2	7.4	ND (5.0)	0.40	5.5
Silver	mg/L	0.05	--	--	--	--	--	--	--	--	--	--	--

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC Ambient Water Quality (mg/L)*	*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4*
Sample ID:			*Location4*	*Location4*	*Location4*	*Location4*	*Location4*	*Location4*	*Location4*	*Location4*	*Location4*	*Location4*	*Location4*
Sample Date:			*6/11/1979*	*12/14/1979*	*1/16/1980*	*4/11/1980*	*7/8/1980*	*10/30/1980*	*1/7/1981*	*4/7/1981*	*6/22/1981*	*10/29/1981*	*1/6/1982*
Location Description:			*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*
Parameters	***Units***												
Silver (Dissolved)	mg/L	0.05	--	--	--	--	--	--	--	--	--	--	--
Sodium	mg/L	20	--	--	--	--	--	--	--	--	--	--	--
Sodium (Dissolved)	mg/L	20	--	--	--	--	--	--	--	--	--	--	--
Thallium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Thallium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Vanadium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Vanadium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Zinc	mg/L	NS	0.44	0.060	0.19	0.67	0.38	0.19	ND (0.050)	0.468	0.457	0.094	0.490
Zinc (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
General Chemistry													
Nitrate (as N)	mg/L	10	--	--	--	--	--	--	--	--	--	--	--
pH (water)	s.u.		7.45	7.45	7.45	6.90	7.05	7.85	7.4	7.35	6.85	6.90	6.85

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC Ambient Water Quality (mg/L)*	*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4*
Sample ID:			*Location4*	*Location4*	*Location4*	*Location4*	*Location4*	*Location4*	*Location4*	*Location4*	*Location4*	*Location4*	*Location4*
Sample Date:			*4/14/1982*	*7/27/1982*	*10/20/1982*	*3/1/1983*	*7/21/1983*	*10/26/1983*	*2/24/1984*	*4/11/1984*	*7/13/1984*	*10/11/1984*	*1/8/1985*
Location Description:			*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*
Parameters	***Units***												
Metals													
Aluminum	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Aluminum (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Antimony	mg/L	0.003	--	--	--	--	--	--	--	--	--	--	--
Antimony (Dissolved)	mg/L	0.003	--	--	--	--	--	--	--	--	--	--	--
Arsenic	mg/L	0.025	--	--	--	--	--	--	--	--	--	--	--
Arsenic (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--	--
Barium	mg/L	1	ND (0.200)	ND (0.200)	ND (0.200)	ND (0.2)	--	--	3.1	0.04	--	--	0.058
Barium (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--	--
Beryllium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Beryllium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Boron	mg/L	1	--	--	--	--	--	--	--	--	--	--	--
Boron (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--	--
Cadmium	mg/L	0.005	--	--	--	--	--	--	--	--	--	--	--
Cadmium (Dissolved)	mg/L	0.005	--	--	--	--	--	--	--	--	--	--	--
Calcium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Calcium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Chromium	mg/L	0.05	0.029	0.295	ND (0.005)	0.0069	--	--	ND (0.005)	--	--	--	0.059
Chromium (Dissolved)	mg/L	0.05	--	--	--	--	--	--	--	--	--	--	--
Chromium, Hexavalent	mg/L	0.05	0.027	ND (0.005)	ND (0.005)	0.005	--	--	ND (0.005)	--	--	--	0.039
Cobalt	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Cobalt (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Copper	mg/L	0.2	--	--	--	--	--	--	--	--	--	--	--
Copper (Dissolved)	mg/L	0.2	--	--	--	--	--	--	--	--	--	--	--
Cyanide (total)	mg/L	0.2	--	--	--	--	--	--	--	--	--	--	--
Iron	mg/L	0.3	ND (0.050)	ND (0.050)	0.105	0.162	--	--	ND (0.05)	--	--	--	4.67
Iron (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	--	--
Lead	mg/L	0.025	--	--	--	--	--	--	--	--	--	--	--
Lead (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Magnesium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Manganese	mg/L	0.3	0.550	0.532	0.453	0.426	--	--	0.813	--	--	--	0.247
Manganese (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	--	--
Mercury	mg/L	0.0007	--	--	--	--	--	--	--	--	--	--	--
Mercury (Dissolved)	mg/L	0.0007	--	--	--	--	--	--	--	--	--	--	--
Nickel	mg/L	0.1	--	--	--	--	--	--	--	--	--	--	--
Nickel (Dissolved)	mg/L	0.1	--	--	--	--	--	--	--	--	--	--	--
Potassium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Potassium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Selenium	mg/L	0.01	--	--	--	--	--	--	--	--	--	--	--
Selenium (Dissolved)	mg/L	0.01	--	--	--	--	--	--	--	--	--	--	--
Silica	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Silica (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Silicon	mg/L	NS	5.7	4.98	7.42	6.1	--	--	4.6	--	--	--	ND (0.4)
Silver	mg/L	0.05	--	--	--	--	--	--	--	--	--	--	--

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC Ambient Water Quality (mg/L)*	*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4*
Sample ID:			*Location4*	*Location4*	*Location4*	*Location4*	*Location4*	*Location4*	*Location4*	*Location4*	*Location4*	*Location4*	*Location4*
Sample Date:			*4/14/1982*	*7/27/1982*	*10/20/1982*	*3/1/1983*	*7/21/1983*	*10/26/1983*	*2/24/1984*	*4/11/1984*	*7/13/1984*	*10/11/1984*	*1/8/1985*
Location Description:			*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*
Parameters	***Units***												
Silver (Dissolved)	mg/L	0.05	--	--	--	--	--	--	--	--	--	--	--
Sodium	mg/L	20	--	--	--	--	--	--	--	--	--	--	--
Sodium (Dissolved)	mg/L	20	--	--	--	--	--	--	--	--	--	--	--
Thallium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Thallium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Vanadium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Vanadium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Zinc	mg/L	NS	0.540	0.160	0.140	0.388	--	--	0.19	--	--	--	0.299
Zinc (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
General Chemistry													
Nitrate (as N)	mg/L	10	--	--	--	--	--	--	--	--	--	--	--
pH (water)	s.u.		7.05	7.01	7.65	6.95	7.3	7.38	7.10	6.86	7.07	7.16	7.48

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:*		*NYSDEC Ambient Water Quality (mg/L)*	*MW-4* *Location4* *4/3/1985* *Airco*	*MW-4* *Location4* *7/25/1985* *Airco*	*MW-4* *Location4* *10/31/1985* *Airco*	*MW-4* *Location4* *1/23/1986* *Airco*	*MW-4* *Location4* *4/2/1986* *Airco*	*MW-4* *Location4* *8/4/1986* *Airco*	*MW-4* *Location4* *10/2/1986* *Airco*	*MW-4* *Location4* *1/28/1987* *Airco*	*MW-4* *Location4* *4/15/1987* *Airco*	*MW-4B* *WRL MW4B* *3/21/2001* *Airco*	*MW-4B* *WRL-MW4B-0301* *3/21/2001* *Airco*
Parameters	***Units***												
Metals													
Aluminum	mg/L	NS	--	--	--	--	--	--	--	--	--	--	0.242
Aluminum (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	ND (0.005)
Antimony	mg/L	0.003	--	--	--	--	--	--	--	--	--	--	ND (0.005)
Antimony (Dissolved)	mg/L	0.003	--	--	--	--	--	--	--	--	--	--	ND (0.005)
Arsenic	mg/L	0.025	--	--	--	--	--	--	--	--	--	--	ND (0.005)
Arsenic (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--	ND (0.005)
Barium	mg/L	1	--	--	--	--	0.105	--	--	--	0.078	0.042	--
Barium (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--	0.044
Beryllium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	ND (0.003)
Beryllium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	ND (0.003)
Boron	mg/L	1	--	--	--	--	--	--	--	--	--	--	ND (0.100)
Boron (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--	ND (0.100)
Cadmium	mg/L	0.005	--	--	--	--	--	--	--	--	--	ND (0.005)	--
Cadmium (Dissolved)	mg/L	0.005	--	--	--	--	--	--	--	--	--	--	ND (0.005)
Calcium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	87.6
Calcium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	68.9
Chromium	mg/L	0.05	--	--	--	--	0.010	--	--	--	ND (0.01)	0.169	--
Chromium (Dissolved)	mg/L	0.05	--	--	--	--	--	--	--	--	--	--	0.090
Chromium, Hexavalent	mg/L	0.05	--	--	--	--	ND (0.01)	--	--	--	ND (0.01)	0.137	--
Cobalt	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Cobalt (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Copper	mg/L	0.2	--	--	--	--	--	--	--	--	--	--	0.007
Copper (Dissolved)	mg/L	0.2	--	--	--	--	--	--	--	--	--	--	0.014
Cyanide (total)	mg/L	0.2	--	--	--	--	--	--	--	--	--	--	--
Iron	mg/L	0.3	--	--	--	--	6.42	--	--	--	3.43	0.289	--
Iron (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	--	ND (0.025)
Lead	mg/L	0.025	--	--	--	--	--	--	--	--	--	--	ND (0.005)
Lead (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--	ND (0.005)
Magnesium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	55.9
Magnesium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	47.9
Manganese	mg/L	0.3	--	--	--	--	0.499	--	--	--	0.711	--	0.026
Manganese (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	0.114	--
Mercury	mg/L	0.0007	--	--	--	--	--	--	--	--	--	--	ND (0.0002)
Mercury (Dissolved)	mg/L	0.0007	--	--	--	--	--	--	--	--	--	--	ND (0.0002)
Nickel	mg/L	0.1	--	--	--	--	--	--	--	--	--	--	ND (0.005)
Nickel (Dissolved)	mg/L	0.1	--	--	--	--	--	--	--	--	--	0.009	--
Potassium	mg/L	NS	--	--	--	--	--	--	--	--	--	2.3 B*	--
Potassium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	4.1 B*	--
Selenium	mg/L	0.01	--	--	--	--	--	--	--	--	--	--	ND (0.005)
Selenium (Dissolved)	mg/L	0.01	--	--	--	--	--	--	--	--	--	--	0.005
Silica	mg/L	NS	--	--	--	--	--	--	--	--	--	--	23.2
Silica (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	24.0
Silicon	mg/L	NS	--	--	--	--	15.7	--	--	--	7.99	--	--
Silver	mg/L	0.05	--	--	--	--	--	--	--	--	--	--	ND (0.005)

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

		NYSDEC Ambient Water Quality (mg/L)											
Sample Location:			*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4*	*MW-4B*	*MW-4B*
Sample ID:			*Location4*	*Location4*	*Location4*	*Location4*	*Location4*	*Location4*	*Location4*	*Location4*	*Location4*	*WRL MW4B*	*WRL-MW4B-0301*
Sample Date:			*4/3/1985*	*7/25/1985*	*10/31/1985*	*1/23/1986*	*4/2/1986*	*8/4/1986*	*10/2/1986*	*1/28/1987*	*4/15/1987*	*3/21/2001*	*3/21/2001*
Location Description:			*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*	*Airco*
<u>Parameters</u>	*<u>Units</u>*												
Silver (Dissolved)	mg/L	0.05	--	--	--	--	--	--	--	--	--	--	ND (0.005)
Sodium	mg/L	20	--	--	--	--	--	--	--	--	--	55.3 B*	--
Sodium (Dissolved)	mg/L	20	--	--	--	--	--	--	--	--	--	105 B*	--
Thallium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	ND (0.001)
Thallium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	ND (0.001)
Vanadium	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Vanadium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	--
Zinc	mg/L	NS	--	--	--	--	0.766	--	--	--	0.302	--	0.025
Zinc (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--	0.091
<u>General Chemistry</u>													
Nitrate (as N)	mg/L	10	--	--	--	--	--	--	--	--	--	--	--
pH (water)	s.u.		6.87	7.15	7.20	7.25	7.45	7.45	7.40	7.10	7.0	--	7.30

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:*		*NYSDEC Ambient Water Quality (mg/L)*	*MW-4B* *WRL-MW4B-0601* *6/13/2001* *Airco*	*MW-5B* *WRL-MW5B-0301* *3/22/2001* *Airco*	*MW-5B* *WRL-MW5B-0601* *6/13/2001* *Airco*	*MW-6B* *WRL-1200* *12/5/2000* *Airco* *Duplicate*	*MW-6B* *WRL-MW6B-1200* *12/5/2000* *Airco*	*MW-6B* *WRL MW6B* *3/22/2001* *Airco*	*MW-6B* *WRL MW6B* *3/22/2001* *Airco* *Duplicate*	*MW-6B* *WRL-0301* *3/22/2001* *Airco* *Duplicate*	*MW-6B* *WRL-MW6B-0301* *3/22/2001* *Airco*
Parameters	***Units***										
Metals											
Aluminum	mg/L	NS	--	--	--	ND (0.005)	0.039	0.152	--	6.0	--
Aluminum (Dissolved)	mg/L	NS	--	ND (0.005)	--	ND (0.005)	ND (0.005)	--	--	ND (0.005)	ND (0.005)
Antimony	mg/L	0.003	--	ND (0.005)	--	ND (0.005)	ND (0.005)	--	--	ND (0.005)	ND (0.005)
Antimony (Dissolved)	mg/L	0.003	--	ND (0.005)	--	ND (0.005)	ND (0.005)	--	--	ND (0.005)	ND (0.005)
Arsenic	mg/L	0.025	--	ND (0.005)	--	ND (0.005)	ND (0.005)	--	--	ND (0.005)	ND (0.005)
Arsenic (Dissolved)	mg/L	0.025	--	ND (0.005)	--	ND (0.005)	ND (0.005)	--	--	ND (0.005)	ND (0.005)
Barium	mg/L	1	--	--	--	0.045	0.050	--	--	0.072	0.036
Barium (Dissolved)	mg/L	1	--	0.028	--	0.050	0.050	0.039	--	0.038	--
Beryllium	mg/L	NS	--	ND (0.003)	--	ND (0.005)	ND (0.005)	--	--	ND (0.003)	ND (0.003)
Beryllium (Dissolved)	mg/L	NS	--	ND (0.003)	--	ND (0.005)	ND (0.005)	--	--	ND (0.003)	ND (0.003)
Boron	mg/L	1	--	ND (0.100)	--	ND (0.10)	ND (0.10)	--	--	ND (0.100)	ND (0.100)
Boron (Dissolved)	mg/L	1	--	ND (0.100)	--	ND (0.10)	ND (0.10)	--	--	ND (0.100)	ND (0.100)
Cadmium	mg/L	0.005	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	--	--	ND (0.005)	ND (0.005)
Cadmium (Dissolved)	mg/L	0.005	--	ND (0.005)	--	ND (0.005)	ND (0.005)	--	--	0.008	ND (0.005)
Calcium	mg/L	NS	--	110	--	99.3	99.1	101	--	143 *	--
Calcium (Dissolved)	mg/L	NS	--	105	--	97.9	95.5	--	--	100 *	98.7
Chromium	mg/L	0.05	0.200	--	0.007	ND (0.005)	ND (0.005)	--	--	0.043	ND (0.005)
Chromium (Dissolved)	mg/L	0.05	--	0.006	--	ND (0.005)	ND (0.005)	--	--	ND (0.005)	ND (0.005)
Chromium, Hexavalent	mg/L	0.05	0.175 *	--	ND (0.010)	ND (0.01)	ND (0.01)	ND (0.01)	--	ND (0.010)	--
Cobalt	mg/L	NS	--	--	--	--	--	--	--	--	--
Cobalt (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--
Copper	mg/L	0.2	--	ND (0.005)	--	ND (0.005)	ND (0.005)	--	--	0.007	ND (0.005)
Copper (Dissolved)	mg/L	0.2	--	ND (0.005)	--	ND (0.005)	ND (0.005)	--	--	ND (0.005)	ND (0.005)
Cyanide (total)	mg/L	0.2	--	--	--	ND (0.004)	ND (0.004)	--	--	ND (0.004)	--
Iron	mg/L	0.3	5.9	0.306	0.667	ND (0.025)	0.063	0.229 B*	--	5.4 *	--
Iron (Dissolved)	mg/L	0.3	--	ND (0.025)	--	ND (0.025)	ND (0.025)	--	--	0.035 *	ND (0.025) B*
Lead	mg/L	0.025	0.014	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	--	--	ND (0.005)	ND (0.005)
Lead (Dissolved)	mg/L	0.025	--	ND (0.005)	--	ND (0.005)	ND (0.005)	--	--	ND (0.005)	ND (0.005)
Magnesium	mg/L	NS	50.5	--	70.2	69.4	65.8	--	--	90.4	76.7
Magnesium (Dissolved)	mg/L	NS	--	75.4	--	65.2	62.0	--	--	75.3 B*	77.5
Manganese	mg/L	0.3	0.107	0.023	0.051	0.062	0.044	--	--	0.373	0.090
Manganese (Dissolved)	mg/L	0.3	--	0.024	--	0.042	0.037	0.082	--	0.085	--
Mercury	mg/L	0.0007	--	ND (0.0002)	--	ND (0.0002)	ND (0.0002)	--	--	ND (0.0002)	ND (0.0002)
Mercury (Dissolved)	mg/L	0.0007	--	ND (0.0002)	--	ND (0.0002)	ND (0.0002)	--	--	ND (0.0002)	ND (0.0002)
Nickel	mg/L	0.1	--	--	--	ND (0.005)	ND (0.005)	--	--	0.125	0.007
Nickel (Dissolved)	mg/L	0.1	--	ND (0.005)	--	ND (0.005)	ND (0.005)	--	--	0.006	ND (0.005)
Potassium	mg/L	NS	--	1.1	--	2.5	2.8	--	4.9 B*	--	2.3
Potassium (Dissolved)	mg/L	NS	--	1.2	--	2.8	2.6	--	2.3 B*	--	2.3
Selenium	mg/L	0.01	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	--	--	ND (0.005)	ND (0.005)
Selenium (Dissolved)	mg/L	0.01	--	ND (0.005)	--	ND (0.005)	ND (0.005)	--	--	ND (0.005)	ND (0.005)
Silica	mg/L	NS	43.2	24.4	22.7	14.2	15.1	19.2	--	83.9	--
Silica (Dissolved)	mg/L	NS	--	23.3	--	14.4	14.3	--	--	13.4	20.7
Silicon	mg/L	NS	--	--	--	--	--	--	--	--	--
Silver	mg/L	0.05	--	ND (0.005)	--	ND (0.005)	ND (0.005)	--	--	ND (0.005)	ND (0.005)

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

		NYSDEC Ambient Water Quality (mg/L)									
Sample Location:			*MW-4B*	*MW-5B*	*MW-5B*	*MW-6B*	*MW-6B*	*MW-6B*	*MW-6B*	*MW-6B*	*MW-6B*
Sample ID:			*WRL-MW4B-0601*	*WRL-MW5B-0301*	*WRL-MW5B-0601*	*WRL-1200*	*WRL-MW6B-1200*	*WRL MW6B*	*WRL MW6B*	*WRL-0301*	*WRL-MW6B-0301*
Sample Date:			*6/13/2001*	*3/22/2001*	*6/13/2001*	*12/5/2000*	*12/5/2000*	*3/22/2001*	*3/22/2001*	*3/22/2001*	*3/22/2001*
Location Description:			*Airco*	*Airco*	*Airco*	*Airco* *Duplicate*	*Airco*	*Airco*	*Airco* *Duplicate*	*Airco* *Duplicate*	*Airco*
Parameters	***Units***										
Silver (Dissolved)	mg/L	0.05	--	ND (0.005)	--	ND (0.005)	ND (0.005)	--	--	ND (0.005)	ND (0.005)
Sodium	mg/L	20	68.5	--	64.4	56.8	50.4	--	--	64.8	68.1
Sodium (Dissolved)	mg/L	20	--	--	--	50.0	47.9	--	--	63.1	67.4
Thallium	mg/L	NS	ND (0.005)	ND (0.001)	ND (0.005)	0.0013	0.0071	--	--	ND (0.001)	ND (0.001)
Thallium (Dissolved)	mg/L	NS	--	ND (0.001)	--	0.0014	0.0063	--	--	ND (0.001)	ND (0.001)
Vanadium	mg/L	NS	--	--	--	--	--	--	--	--	--
Vanadium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--
Zinc	mg/L	NS	0.089	--	0.015	ND (0.005)	ND (0.005)	--	--	0.028	0.010
Zinc (Dissolved)	mg/L	NS	--	--	--	ND (0.005)	ND (0.005)	--	--	0.019	0.009
General Chemistry											
Nitrate (as N)	mg/L	10	--	--	--	--	--	--	--	--	--
pH (water)	s.u.		--	6.86	--	7.84	7.96	7.07	--	6.96	--

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:*		*NYSDEC Ambient Water Quality (mg/L)*	*MW-6B* *WRL-MW-0601* *6/13/2001* *Airco* *Duplicate*	*MW-6B* *WRL-MW6B-0601* *6/13/2001* *Airco*	*MW-6B* *WRL-0901* *9/19/2001* *Airco* *Duplicate*	*MW-6B* *WRL-MW6B-0901* *9/19/2001* *Airco*
Parameters	***Units***					
Metals						
Aluminum	mg/L	NS	--	--	--	--
Aluminum (Dissolved)	mg/L	NS	--	--	--	--
Antimony	mg/L	0.003	--	--	--	--
Antimony (Dissolved)	mg/L	0.003	--	--	--	--
Arsenic	mg/L	0.025	--	--	--	--
Arsenic (Dissolved)	mg/L	0.025	--	--	--	--
Barium	mg/L	1	--	--	--	--
Barium (Dissolved)	mg/L	1	--	--	--	--
Beryllium	mg/L	NS	--	--	--	--
Beryllium (Dissolved)	mg/L	NS	--	--	--	--
Boron	mg/L	1	--	--	--	--
Boron (Dissolved)	mg/L	1	--	--	--	--
Cadmium	mg/L	0.005	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
Cadmium (Dissolved)	mg/L	0.005	--	--	--	--
Calcium	mg/L	NS	--	--	--	--
Calcium (Dissolved)	mg/L	NS	--	--	--	--
Chromium	mg/L	0.05	0.017	0.016	ND (0.005)	0.007
Chromium (Dissolved)	mg/L	0.05	--	--	--	--
Chromium, Hexavalent	mg/L	0.05	ND (0.010)	ND (0.010)	ND (0.01)	ND (0.01)
Cobalt	mg/L	NS	--	--	--	--
Cobalt (Dissolved)	mg/L	NS	--	--	--	--
Copper	mg/L	0.2	--	--	--	--
Copper (Dissolved)	mg/L	0.2	--	--	--	--
Cyanide (total)	mg/L	0.2	--	--	--	--
Iron	mg/L	0.3	12.2	11.9	0.103	0.186
Iron (Dissolved)	mg/L	0.3	--	--	--	--
Lead	mg/L	0.025	0.006	0.006	ND (0.005)	ND (0.005)
Lead (Dissolved)	mg/L	0.025	--	--	--	--
Magnesium	mg/L	NS	84.4	85.2	67.6	69.2
Magnesium (Dissolved)	mg/L	NS	--	--	--	--
Manganese	mg/L	0.3	0.439	0.434	0.067	0.079
Manganese (Dissolved)	mg/L	0.3	--	--	--	--
Mercury	mg/L	0.0007	--	--	--	--
Mercury (Dissolved)	mg/L	0.0007	--	--	--	--
Nickel	mg/L	0.1	--	--	--	--
Nickel (Dissolved)	mg/L	0.1	--	--	--	--
Potassium	mg/L	NS	--	--	--	--
Potassium (Dissolved)	mg/L	NS	--	--	--	--
Selenium	mg/L	0.01	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
Selenium (Dissolved)	mg/L	0.01	--	--	--	--
Silica	mg/L	NS	118	120	12.3	12.1
Silica (Dissolved)	mg/L	NS	--	--	--	--
Silicon	mg/L	NS	--	--	--	--
Silver	mg/L	0.05	--	--	--	--

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:*		*NYSDEC Ambient Water Quality (mg/L)*	*MW-6B* *WRL-MW-0601* *6/13/2001* *Airco Duplicate*	*MW-6B* *WRL-MW6B-0601* *6/13/2001* *Airco*	*MW-6B* *WRL-0901* *9/19/2001* *Airco Duplicate*	*MW-6B* *WRL-MW6B-0901* *9/19/2001* *Airco*
Parameters	***Units***					
Silver (Dissolved)	mg/L	0.05	--	--	--	--
Sodium	mg/L	20	67.1	67.8	65.2	66.8
Sodium (Dissolved)	mg/L	20	--	--	--	--
Thallium	mg/L	NS	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
Thallium (Dissolved)	mg/L	NS	--	--	--	--
Vanadium	mg/L	NS	--	--	--	--
Vanadium (Dissolved)	mg/L	NS	--	--	--	--
Zinc	mg/L	NS	0.025	0.024	ND (0.005)	ND (0.005)
Zinc (Dissolved)	mg/L	NS	--	--	--	--
General Chemistry						
Nitrate (as N)	mg/L	10	--	--	--	--
pH (water)	s.u.		--	--	--	--

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:*		*NYSDEC Ambient Water Quality (mg/L)*	*MW-12* *Location12* *1/16/1980* *SKW Landfill*	*MW-12* *Location12* *4/11/1980* *SKW Landfill*	*MW-12* *Location12* *7/8/1980* *SKW Landfill*	*MW-12* *Location12* *10/30/1980* *SKW Landfill*	*MW-12* *Location12* *1/7/1981* *SKW Landfill*	*MW-12* *Location12* *4/7/1981* *SKW Landfill*	*MW-12* *Location12* *6/22/1981* *SKW Landfill*	*MW-12* *Location12* *10/29/1981* *SKW Landfill*	*MW-12* *Location12* *1/6/1982* *SKW Landfill*	*MW-12* *Location12* *4/14/1982* *SKW Landfill*
Parameters	*Units*											
Metals												
Aluminum	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Aluminum (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Antimony	mg/L	0.003	--	--	--	--	--	--	--	--	--	--
Antimony (Dissolved)	mg/L	0.003	--	--	--	--	--	--	--	--	--	--
Arsenic	mg/L	0.025	--	--	--	--	--	--	--	--	--	--
Arsenic (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--
Barium	mg/L	1	ND (0.1)	ND (0.1)	ND (0.1)	0.5	--	ND (0.2)	0.41	ND (0.2)	ND (0.2)	ND (0.200)
Barium (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--
Beryllium	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Beryllium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Boron	mg/L	1	--	--	--	--	--	--	--	--	--	--
Boron (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--
Cadmium	mg/L	0.005	--	--	--	--	--	--	--	--	--	--
Cadmium (Dissolved)	mg/L	0.005	--	--	--	--	--	--	--	--	--	--
Calcium	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Calcium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Chromium	mg/L	0.05	0.02	ND (0.02)	ND (0.02)	ND (0.02)	0.124	0.017	0.017	ND (0.005)	ND (0.005)	ND (0.005)
Chromium (Dissolved)	mg/L	0.05	--	--	--	--	--	--	--	--	--	--
Chromium, Hexavalent	mg/L	0.05	--	--	--	ND (0.02)	0.01250	ND (0.005)	0.008	ND (0.005)	ND (0.005)	ND (0.005)
Cobalt	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Cobalt (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Copper	mg/L	0.2	--	--	--	--	--	--	--	--	--	--
Copper (Dissolved)	mg/L	0.2	--	--	--	--	--	--	--	--	--	--
Cyanide (total)	mg/L	0.2	--	--	--	--	--	--	--	--	--	--
Iron	mg/L	0.3	0.26	0.02	0.27	3.8	ND (0.050)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.050)	ND (0.050)
Iron (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	--
Lead	mg/L	0.025	--	--	--	--	--	--	--	--	--	--
Lead (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Magnesium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Manganese	mg/L	0.3	0.11	0.15	0.21	1.39	0.105	0.217	0.133	0.156	0.088	ND (0.020)
Manganese (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	--
Mercury	mg/L	0.0007	--	--	--	--	--	--	--	--	--	--
Mercury (Dissolved)	mg/L	0.0007	--	--	--	--	--	--	--	--	--	--
Nickel	mg/L	0.1	--	--	--	--	--	--	--	--	--	--
Nickel (Dissolved)	mg/L	0.1	--	--	--	--	--	--	--	--	--	--
Nitrate (as N)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Potassium	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Potassium (Dissolved)	mg/L	0.01	--	--	--	--	--	--	--	--	--	--
Selenium	mg/L	0.01	--	--	--	--	--	--	--	--	--	--
Selenium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Silica	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Silica (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Silicon	mg/L	0.05	4.5	5.4	3.8	9.8	2.8	5.5	6.0	0.5	7.0	6.10

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:*		*NYSDEC Ambient Water Quality (mg/L)*	*MW-12* *Location12* *1/16/1980* *SKW Landfill*	*MW-12* *Location12* *4/11/1980* *SKW Landfill*	*MW-12* *Location12* *7/8/1980* *SKW Landfill*	*MW-12* *Location12* *10/30/1980* *SKW Landfill*	*MW-12* *Location12* *1/7/1981* *SKW Landfill*	*MW-12* *Location12* *4/7/1981* *SKW Landfill*	*MW-12* *Location12* *6/22/1981* *SKW Landfill*	*MW-12* *Location12* *10/29/1981* *SKW Landfill*	*MW-12* *Location12* *1/6/1982* *SKW Landfill*	*MW-12* *Location12* *4/14/1982* *SKW Landfill*
Parameters	***Units***											
Silver	mg/L	0.05	--	--	--	--	--	--	--	--	--	--
Silver (Dissolved)	mg/L	20	--	--	--	--	--	--	--	--	--	--
Sodium	mg/L	20	--	--	--	--	--	--	--	--	--	--
Sodium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Thallium	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Thallium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Vanadium	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Vanadium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Zinc	mg/L	NS	0.06	0.08	0.02	0.05	ND (0.050)	0.023	0.101	0.016	0.183	0.018
Zinc (Dissolved)	mg/L		--	--	--	--	--	--	--	--	--	--
General Chemistry												
pH (water)	s.u.		7.70	7.00	7.30	7.90	7.5	7.05	7.15	7.11	7.25	7.20

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC Ambient Water Quality (mg/L)*	*MW-12*	*MW-12*	*MW-12*	*MW-12*	*MW-12*	*MW-12*	*MW-12*	*MW-12*	*MW-12*	*MW-12*
Sample ID:			*Location12*	*Location12*	*Location12*	*Location12*	*Location12*	*Location12*	*Location12*	*Location12*	*Location12*	*Location12*
Sample Date:			*7/27/1982*	*10/20/1982*	*3/1/1983*	*7/21/1983*	*10/26/1983*	*2/24/1984*	*4/11/1984*	*7/13/1984*	*10/11/1984*	*1/8/1985*
Location Description:			*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*
Parameters	***Units***											
Metals												
Aluminum	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Aluminum (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Antimony	mg/L	0.003	--	--	--	--	--	--	--	--	--	--
Antimony (Dissolved)	mg/L	0.003	--	--	--	--	--	--	--	--	--	--
Arsenic	mg/L	0.025	--	--	--	--	--	--	--	--	--	--
Arsenic (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--
Barium	mg/L	1	ND (0.200)	ND (0.200)	ND (0.2)	--	--	1.4	0.05	--	--	0.082
Barium (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--
Beryllium	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Beryllium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Boron	mg/L	1	--	--	--	--	--	--	--	--	--	--
Boron (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--
Cadmium	mg/L	0.005	--	--	--	--	--	--	--	--	--	--
Cadmium (Dissolved)	mg/L	0.005	--	--	--	--	--	--	--	--	--	--
Calcium	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Calcium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Chromium	mg/L	0.05	0.088	ND (0.005)	0.053	--	--	0.018	--	--	--	0.163
Chromium (Dissolved)	mg/L	0.05	--	--	--	--	--	--	--	--	--	--
Chromium, Hexavalent	mg/L	0.05	ND (0.005)	ND (0.005)	ND (0.005)	--	--	0.016	--	--	--	0.084
Cobalt	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Cobalt (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Copper	mg/L	0.2	--	--	--	--	--	--	--	--	--	--
Copper (Dissolved)	mg/L	0.2	--	--	--	--	--	--	--	--	--	--
Cyanide (total)	mg/L	0.2	--	--	--	--	--	--	--	--	--	--
Iron	mg/L	0.3	ND (0.050)	ND (0.050)	ND (0.05)	--	--	ND (0.05)	--	--	--	1.36
Iron (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	--
Lead	mg/L	0.025	--	--	--	--	--	--	--	--	--	--
Lead (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Magnesium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Manganese	mg/L	0.3	0.052	0.134	0.038	--	--	0.019	--	--	--	0.076
Manganese (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	--
Mercury	mg/L	0.0007	--	--	--	--	--	--	--	--	--	--
Mercury (Dissolved)	mg/L	0.0007	--	--	--	--	--	--	--	--	--	--
Nickel	mg/L	0.1	--	--	--	--	--	--	--	--	--	--
Nickel (Dissolved)	mg/L	0.1	--	--	--	--	--	--	--	--	--	--
Nitrate (as N)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Potassium	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Potassium (Dissolved)	mg/L	0.01	--	--	--	--	--	--	--	--	--	--
Selenium	mg/L	0.01	--	--	--	--	--	--	--	--	--	--
Selenium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Silica	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Silica (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Silicon	mg/L	0.05	3.95	6.78	6.51	--	--	4.6	--	--	--	ND (0.4)

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:*		*NYSDEC Ambient Water Quality (mg/L)*	*MW-12* *Location12* *7/27/1982* *SKW Landfill*	*MW-12* *Location12* *10/20/1982* *SKW Landfill*	*MW-12* *Location12* *3/1/1983* *SKW Landfill*	*MW-12* *Location12* *7/21/1983* *SKW Landfill*	*MW-12* *Location12* *10/26/1983* *SKW Landfill*	*MW-12* *Location12* *2/24/1984* *SKW Landfill*	*MW-12* *Location12* *4/11/1984* *SKW Landfill*	*MW-12* *Location12* *7/13/1984* *SKW Landfill*	*MW-12* *Location12* *10/11/1984* *SKW Landfill*	*MW-12* *Location12* *1/8/1985* *SKW Landfill*
Parameters	***Units***											
Silver	mg/L	0.05	--	--	--	--	--	--	--	--	--	--
Silver (Dissolved)	mg/L	20	--	--	--	--	--	--	--	--	--	--
Sodium	mg/L	20	--	--	--	--	--	--	--	--	--	--
Sodium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Thallium	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Thallium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Vanadium	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Vanadium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Zinc	mg/L	NS	ND (0.050)	ND (0.050)	ND (0.050)	--	--	ND (0.02)	--	--	--	0.034
Zinc (Dissolved)	mg/L		--	--	--	--	--	--	--	--	--	--
General Chemistry												
pH (water)	s.u.		7.49	7.80	7.15	7.80	8.39	7.95	7.51	7.56	7.58	7.43

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:*		*NYSDEC Ambient Water Quality (mg/L)*	*MW-12* *Location12* *4/3/1985* *SKW Landfill*	*MW-12* *Location12* *7/25/1985* *SKW Landfill*	*MW-12* *Location12* *10/31/1985* *SKW Landfill*	*MW-12* *Location12* *1/23/1986* *SKW Landfill*	*MW-12* *Location12* *4/2/1986* *SKW Landfill*	*MW-12* *Location12* *8/4/1986* *SKW Landfill*	*MW-12* *Location12* *10/2/1986* *SKW Landfill*	*MW-12* *Location12* *1/28/1987* *SKW Landfill*	*MW-12* *Location12* *4/15/1987* *SKW Landfill*	*MW-12* *MW-12* *1/1/1989* *SKW Landfill*
Parameters	***Units***											
Metals												
Aluminum	mg/L	NS	--	--	--	--	--	--	--	--	--	3.1
Aluminum (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Antimony	mg/L	0.003	--	--	--	--	--	--	--	--	--	ND (0.06)
Antimony (Dissolved)	mg/L	0.003	--	--	--	--	--	--	--	--	--	--
Arsenic	mg/L	0.025	--	--	--	--	--	--	--	--	--	--
Arsenic (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--
Barium	mg/L	1	--	--	--	--	0.068	--	--	--	0.061	0.0979
Barium (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--
Beryllium	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Beryllium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Boron	mg/L	1	--	--	--	--	--	--	--	--	--	--
Boron (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--
Cadmium	mg/L	0.005	--	--	--	--	--	--	--	--	--	--
Cadmium (Dissolved)	mg/L	0.005	--	--	--	--	--	--	--	--	--	--
Calcium	mg/L	NS	--	--	--	--	--	--	--	--	--	167
Calcium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Chromium	mg/L	0.05	--	--	--	--	0.027	--	--	--	0.073	0.0239 J
Chromium (Dissolved)	mg/L	0.05	--	--	--	--	--	--	--	--	--	--
Chromium, Hexavalent	mg/L	0.05	--	--	--	--	0.023	--	--	--	0.064	0.03
Cobalt	mg/L	NS	--	--	--	--	--	--	--	--	--	ND (0.05)
Cobalt (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Copper	mg/L	0.2	--	--	--	--	--	--	--	--	--	0.0089
Copper (Dissolved)	mg/L	0.2	--	--	--	--	--	--	--	--	--	--
Cyanide (total)	mg/L	0.2	--	--	--	--	--	--	--	--	--	ND (0.01)
Iron	mg/L	0.3	--	--	--	--	0.068	--	--	--	0.117	R
Iron (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	--
Lead	mg/L	0.025	--	--	--	--	--	--	--	--	--	R
Lead (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	--	--	--	--	--	--	90.2
Magnesium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Manganese	mg/L	0.3	--	--	--	--	0.034	--	--	--	0.010	0.505
Manganese (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	--
Mercury	mg/L	0.0007	--	--	--	--	--	--	--	--	--	ND (0.0002)
Mercury (Dissolved)	mg/L	0.0007	--	--	--	--	--	--	--	--	--	--
Nickel	mg/L	0.1	--	--	--	--	--	--	--	--	--	ND (0.04)
Nickel (Dissolved)	mg/L	0.1	--	--	--	--	--	--	--	--	--	--
Nitrate (as N)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Potassium	mg/L	NS	--	--	--	--	--	--	--	--	--	8.95
Potassium (Dissolved)	mg/L	0.01	--	--	--	--	--	--	--	--	--	--
Selenium	mg/L	0.01	--	--	--	--	--	--	--	--	--	--
Selenium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Silica	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Silica (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Silicon	mg/L	0.05	--	--	--	--	6.84	--	--	--	5.92	--

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:*		*NYSDEC Ambient Water Quality (mg/L)*	*MW-12* *Location12* *4/3/1985* *SKW Landfill*	*MW-12* *Location12* *7/25/1985* *SKW Landfill*	*MW-12* *Location12* *10/31/1985* *SKW Landfill*	*MW-12* *Location12* *1/23/1986* *SKW Landfill*	*MW-12* *Location12* *4/2/1986* *SKW Landfill*	*MW-12* *Location12* *8/4/1986* *SKW Landfill*	*MW-12* *Location12* *10/2/1986* *SKW Landfill*	*MW-12* *Location12* *1/28/1987* *SKW Landfill*	*MW-12* *Location12* *4/15/1987* *SKW Landfill*	*MW-12* *MW-12* *1/1/1989* *SKW Landfill*
Parameters	*Units*											
Silver	mg/L	0.05	--	--	--	--	--	--	--	--	--	--
Silver (Dissolved)	mg/L	20	--	--	--	--	--	--	--	--	--	--
Sodium	mg/L	20	--	--	--	--	--	--	--	--	--	126
Sodium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Thallium	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Thallium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Vanadium	mg/L	NS	--	--	--	--	--	--	--	--	--	0.0098
Vanadium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Zinc	mg/L	NS	--	--	--	--	ND (0.05)	--	--	--	0.013	0.0494
Zinc (Dissolved)	mg/L		--	--	--	--	--	--	--	--	--	--
General Chemistry												
pH (water)	s.u.	[illegible]	7.20	7.41	7.39	8.05	7.60	7.82	7.55	7.48	6.80	7.51

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:*		*NYSDEC Ambient Water Quality (mg/L)*	*MW-12* *MW-12* *6/1/1989* *SKW Landfill*	*MW-12* *MW-12* *8/1/1989* *SKW Landfill*	*MW-12* *MW-12* *12/1/1992* *SKW Landfill*	*MW-12* *MW-12* *6/30/1993* *SKW Landfill*	*MW-12* *MW-12* *9/10/1993* *SKW Landfill*	*MW-12* *MW-12* *12/7/1993* *SKW Landfill*	*MW-12* *MW-12* *3/23/1994* *SKW Landfill*	*MW-12* *MW-12* *6/28/1994* *SKW Landfill*	*MW-12* *MW-12* *9/20/1994* *SKW Landfill*	*MW-12* *MW-12* *12/13/1994* *SKW Landfill*
Parameters	*Units*											
Metals												
Aluminum	mg/L	NS	--	--	--	0.05	--	--	--	--	--	0.25
Aluminum (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Antimony	mg/L	0.003	--	--	--	ND (0.05)	--	--	--	--	--	ND (0.05)
Antimony (Dissolved)	mg/L	0.003	--	--	--	--	--	--	--	--	--	--
Arsenic	mg/L	0.025	--	--	--	ND (0.005)	--	--	--	--	--	ND (0.002)
Arsenic (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--
Barium	mg/L	1	--	--	--	0.1	--	--	--	--	--	0.04
Barium (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--
Beryllium	mg/L	NS	--	--	--	ND (0.005)	--	--	--	--	--	ND (0.005)
Beryllium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Boron	mg/L	1	--	--	--	--	--	--	--	--	--	--
Boron (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--
Cadmium	mg/L	0.005	--	--	--	ND (0.005)	ND (0.0005)	ND (0.001)	ND (0.0005)	ND (0.0005)	ND (0.0005)	0.005
Cadmium (Dissolved)	mg/L	0.005	--	--	--	--	--	--	--	--	--	--
Calcium	mg/L	NS	--	--	--	188	154	150	122	131	145	135
Calcium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Chromium	mg/L	0.05	0.035	ND	ND	ND (0.01)	--	--	--	--	--	ND (0.01)
Chromium (Dissolved)	mg/L	0.05	--	--	--	--	--	--	--	--	--	--
Chromium, Hexavalent	mg/L	0.05	ND	ND	ND	ND (0.01)	--	--	--	--	--	ND (0.01)
Cobalt	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Cobalt (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Copper	mg/L	0.2	--	--	--	ND (0.01)	--	--	--	--	--	ND (0.01)
Copper (Dissolved)	mg/L	0.2	--	--	--	--	--	--	--	--	--	--
Cyanide (total)	mg/L	0.2	--	--	--	--	--	--	--	--	--	--
Iron	mg/L	0.3	--	--	--	0.56	0.87	0.48	0.69	0.74	0.93	0.72
Iron (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	--
Lead	mg/L	0.025	--	--	--	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.002)
Lead (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--
Magnesium	mg/L	NS	--	--	--	84	90	77	72	72	75	77
Magnesium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Manganese	mg/L	0.3	--	--	--	0.45	0.17	0.2	0.32	0.33	0.2	0.25
Manganese (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	--
Mercury	mg/L	0.0007	--	--	--	ND (0.001)	--	--	--	--	--	ND (0.0005)
Mercury (Dissolved)	mg/L	0.0007	--	--	--	--	--	--	--	--	--	--
Nickel	mg/L	0.1	--	--	--	ND (0.02)	--	--	--	--	--	ND (0.02)
Nickel (Dissolved)	mg/L	0.1	--	--	--	--	--	--	--	--	--	--
Nitrate (as N)	mg/L	NS	--	--	--	ND (0.05)	0.07	ND (0.05)	0.06	ND (0.05)	ND (0.05)	ND (0.05)
Potassium	mg/L	NS	--	--	--	9.4	9.6	8.7	8.3	8.8	9.7	9.2
Potassium (Dissolved)	mg/L	0.01	--	--	--	--	--	--	--	--	--	--
Selenium	mg/L	0.01	--	--	--	ND (0.005)	--	--	--	--	--	ND (0.002)
Selenium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Silica	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Silica (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Silicon	mg/L	0.05	--	--	--	--	--	--	--	--	--	--

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:*		*NYSDEC Ambient Water Quality (mg/L)*	*MW-12* *MW-12* *6/1/1989* *SKW Landfill*	*MW-12* *MW-12* *8/1/1989* *SKW Landfill*	*MW-12* *MW-12* *12/1/1992* *SKW Landfill*	*MW-12* *MW-12* *6/30/1993* *SKW Landfill*	*MW-12* *MW-12* *9/10/1993* *SKW Landfill*	*MW-12* *MW-12* *12/7/1993* *SKW Landfill*	*MW-12* *MW-12* *3/23/1994* *SKW Landfill*	*MW-12* *MW-12* *6/28/1994* *SKW Landfill*	*MW-12* *MW-12* *9/20/1994* *SKW Landfill*	*MW-12* *MW-12* *12/13/1994* *SKW Landfill*
Parameters	***Units***											
Silver	mg/L	0.05	--	--	--	ND (0.005)	--	--	--	--	--	ND (0.005)
Silver (Dissolved)	mg/L	20	--	--	--	--	--	--	--	--	--	--
Sodium	mg/L	20	--	--	--	131	133	135	108	109	120	114
Sodium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Thallium	mg/L	NS	--	--	--	ND (0.05)	--	--	--	--	--	ND (0.05)
Thallium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Vanadium	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Vanadium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Zinc	mg/L	NS	--	--	--	0.09	--	--	--	--	--	ND (0.02)
Zinc (Dissolved)	mg/L		--	--	--	--	--	--	--	--	--	--
General Chemistry												
pH (water)	s.u.	[illegible]	6.93	7.32	7.11	7.01	6.84	6.99	7.16	7.01	7.01	7.14

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:*		*NYSDEC Ambient Water Quality (mg/L)*	*MW-12* *MW-12* *3/16/1995* *SKW Landfill*	*MW-12* *MW-12* *6/6/1995* *SKW Landfill*	*MW-12* *MW-12* *11/1/1995* *SKW Landfill*	*MW-12* *MW-12* *1/25/1996* *SKW Landfill*	*MW-12* *MW-12* *4/19/1996* *SKW Landfill*	*MW-12* *MW-12* *7/11/1996* *SKW Landfill*	*MW-12* *MW-12* *11/1/1996* *SKW Landfill*	*MW-12* *MW-12* *1/30/1997* *SKW Landfill*	*MW-12* *MW-12* *4/30/1997* *SKW Landfill*	*MW-12* *MW-12* *7/30/1997* *SKW Landfill*
Parameters	*Units*											
Metals												
Aluminum	mg/L	NS	--	--	--	--	0.7	--	--	--	--	--
Aluminum (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Antimony	mg/L	0.003	--	--	--	--	ND (0.05)	--	--	--	--	--
Antimony (Dissolved)	mg/L	0.003	--	--	--	--	--	--	--	--	--	--
Arsenic	mg/L	0.025	--	--	--	--	ND (0.005)	--	--	--	--	--
Arsenic (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--
Barium	mg/L	1	--	--	--	--	0.04	--	--	--	--	--
Barium (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--
Beryllium	mg/L	NS	--	--	--	--	ND (0.005)	--	--	--	--	--
Beryllium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Boron	mg/L	1	--	--	--	--	--	--	--	--	--	--
Boron (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--	--
Cadmium	mg/L	0.005	ND (0.0005)	ND (0.0002)	ND (0.0002)	ND (0.0005)	ND (0.005)	ND (0.001)	--	0.002	ND (0.001)	ND (0.001)
Cadmium (Dissolved)	mg/L	0.005	--	--	--	--	--	--	--	--	--	--
Calcium	mg/L	NS	136	143	28	130	143	140	110 D	140	145 D	140 D
Calcium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Chromium	mg/L	0.05	--	--	--	--	ND (0.01)	--	--	--	--	--
Chromium (Dissolved)	mg/L	0.05	--	--	--	--	--	--	--	--	--	--
Chromium, Hexavalent	mg/L	0.05	--	--	--	--	ND (0.04)	--	ND (0.04)	ND (0.04)	ND (0.04)	ND (0.04)
Cobalt	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Cobalt (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Copper	mg/L	0.2	--	--	--	--	ND (0.01)	--	--	--	--	--
Copper (Dissolved)	mg/L	0.2	--	--	--	--	--	--	--	--	--	--
Cyanide (total)	mg/L	0.2	--	--	--	--	--	--	--	--	--	--
Iron	mg/L	0.3	0.61	0.7	ND (0.05)	3.2	1.5	1.1	2.3	2.3	0.93	1.5
Iron (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	--
Lead	mg/L	0.025	ND (0.005)	0.005	ND (0.002)	0.003	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)	ND (0.005)
Lead (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	--	--	--
Magnesium	mg/L	NS	75	78	6.8	69	74	70	68	70	70	72
Magnesium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Manganese	mg/L	0.3	0.33	0.35	ND (0.005)	0.38	0.32	0.3	0.22	0.37	0.29	0.22
Manganese (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	--	--	--
Mercury	mg/L	0.0007	--	--	--	--	ND (0.001)	--	--	--	--	--
Mercury (Dissolved)	mg/L	0.0007	--	--	--	--	--	--	--	--	--	--
Nickel	mg/L	0.1	--	--	--	--	ND (0.02)	--	--	--	--	--
Nickel (Dissolved)	mg/L	0.1	--	--	--	--	--	--	--	--	--	--
Nitrate (as N)	mg/L	NS	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.05)	ND (0.04)	ND (0.04)	ND (0.04)	ND (0.04)	0.02	ND (0.04)
Potassium	mg/L	NS	11	8	17	9.3	8.5	10	8.7	7.8	8.4	7.3
Potassium (Dissolved)	mg/L	0.01	--	--	--	--	--	--	--	--	--	--
Selenium	mg/L	0.01	--	--	--	--	ND (0.005)	--	--	--	--	--
Selenium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Silica	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Silica (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Silicon	mg/L	0.05	--	--	--	--	--	--	--	--	--	--

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:*		*NYSDEC Ambient Water Quality (mg/L)*	*MW-12* *MW-12* *3/16/1995* *SKW Landfill*	*MW-12* *MW-12* *6/6/1995* *SKW Landfill*	*MW-12* *MW-12* *11/1/1995* *SKW Landfill*	*MW-12* *MW-12* *1/25/1996* *SKW Landfill*	*MW-12* *MW-12* *4/19/1996* *SKW Landfill*	*MW-12* *MW-12* *7/11/1996* *SKW Landfill*	*MW-12* *MW-12* *11/1/1996* *SKW Landfill*	*MW-12* *MW-12* *1/30/1997* *SKW Landfill*	*MW-12* *MW-12* *4/30/1997* *SKW Landfill*	*MW-12* *MW-12* *7/30/1997* *SKW Landfill*
Parameters	***Units***											
Silver	mg/L	0.05	--	--	--	--	ND (0.005)	--	--	--	--	--
Silver (Dissolved)	mg/L	20	--	--	--	--	--	--	--	--	--	--
Sodium	mg/L	20	119	113	91	100	122	120	120	120	114	120
Sodium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Thallium	mg/L	NS	--	--	--	--	0.05	--	--	--	--	--
Thallium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Vanadium	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Vanadium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--	--
Zinc	mg/L	NS	--	--	--	--	ND (0.02)	--	--	--	--	--
Zinc (Dissolved)	mg/L		--	--	--	--	--	--	--	--	--	--
General Chemistry												
pH (water)	s.u.		7.3	7.11	6.52	7.32	6.89	7.02	6.86	6.94	7.02	6.89

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:*		*NYSDEC Ambient Water Quality (mg/L)*	*MW-12* *MW-12* *10/23/1997* *SKW Landfill*	*MW-12* *MW-12* *1/22/1998* *SKW Landfill*	*MW-12* *MW-12* *6/18/1998* *SKW Landfill*	*MW-12* *MW-12* *7/21/1998* *SKW Landfill*	*MW-12* *MW-12* *10/14/1998* *SKW Landfill*	*MW-103A* *MW-103A* *11/7/1996* *NiMO/NMPA*	*MW-103A* *MW-103A* *3/1/2000* *NiMO/NMPA*	*MW-103A* *MW-103A* *8/21/2001* *NiMO/NMPA*	*MW-103A* *WM-103A* *8/21/2001* *NiMO/NMPA*
Parameters	**Units**										
Metals											
Aluminum	mg/L	NS	0.54	0.37	--	--	--	5.06	0.832	ND (0.075)	--
Aluminum (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	0.093	--
Antimony	mg/L	0.003	ND (0.24)	ND (0.24)	--	--	--	ND (0.0048)	ND (0.008)	ND (0.050)	--
Antimony (Dissolved)	mg/L	0.003	--	--	--	--	--	--	--	ND (0.050)	--
Arsenic	mg/L	0.025	ND (0.002)	ND (0.002)	--	--	--	ND (0.0025)	ND (0.0055)	ND (0.002)	--
Arsenic (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	ND (0.002)	--
Barium	mg/L	1	0.036	0.047	--	--	--	0.218	0.106 B	0.096	--
Barium (Dissolved)	mg/L	1	--	--	--	--	--	--	--	0.1	--
Beryllium	mg/L	NS	ND (0.002)	ND (0.002)	--	--	--	ND (0.0001)	ND (0.001)	ND (0.002)	--
Beryllium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	ND (0.002)	--
Boron	mg/L	1	--	--	--	--	--	--	--	--	--
Boron (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--
Cadmium	mg/L	0.005	ND (0.016)	ND (0.016)	ND (0.001)	ND (0.001)	0.019 D	0.0011 B	ND (0.001)	ND (0.005)	--
Cadmium (Dissolved)	mg/L	0.005	--	--	--	--	--	--	--	ND (0.005)	--
Calcium	mg/L	NS	130 D	130 D	130	290 D	190 D	194.0	111 E	78.8	--
Calcium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	80.3	--
Chromium	mg/L	0.05	ND (0.014)	ND (0.014)	--	--	--	0.0075 B	ND (0.0015)	ND (0.010)	--
Chromium (Dissolved)	mg/L	0.05	--	--	--	--	--	--	--	ND (0.010)	--
Chromium, Hexavalent	mg/L	0.05	ND (0.04)	ND (0.04)	ND (0.04)	ND (0.04)	ND (0.04)	0.0236	ND (0.01)	--	ND (0.010)
Cobalt	mg/L	NS	--	--	--	--	--	0.0018 B	ND (0.0015)	ND (0.010)	--
Cobalt (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	ND (0.010)	--
Copper	mg/L	0.2	ND (0.010)	ND (0.010)	--	--	--	0.0064 B	0.0035 B	ND (0.017)	--
Copper (Dissolved)	mg/L	0.2	--	--	--	--	--	--	--	ND (0.017)	--
Cyanide (total)	mg/L	0.2	--	--	--	--	--	--	--	--	--
Iron	mg/L	0.3	1.12	0.806	1.58	22.4	23.1	7.91	0.968	0.86	--
Iron (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	0.368	--
Lead	mg/L	0.025	ND (0.002)	ND (0.002)	ND (0.002)	0.017	0.014	0.0317	ND (0.003)	ND (0.001)	--
Lead (Dissolved)	mg/L	0.025	--	--	--	--	--	--	--	0.001	--
Magnesium	mg/L	NS	62	64	64	110	78 D	142	99 E	65.3	--
Magnesium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	65.2	--
Manganese	mg/L	0.3	0.143	0.219	0.257	1.41	0.876	0.386	0.251	0.095	--
Manganese (Dissolved)	mg/L	0.3	--	--	--	--	--	--	--	0.105	--
Mercury	mg/L	0.0007	ND (0.0004)	ND (0.0004)	--	--	--	ND (0.0001)	ND (0.0002)	ND (0.0002)	--
Mercury (Dissolved)	mg/L	0.0007	--	--	--	--	--	--	--	ND (0.0002)	--
Nickel	mg/L	0.1	ND (0.050)	ND (0.050)	--	--	--	0.0056 B	0.0042 B	ND (0.012)	--
Nickel (Dissolved)	mg/L	0.1	--	--	--	--	--	--	--	0.014	--
Nitrate (as N)	mg/L	NS	ND (0.04)	0.094	ND (0.04)	ND (0.04)	0.05	--	--	--	--
Potassium	mg/L	NS	7.0	5.6	8.2	9.3	11	1.53 B	1.29 B	0.996	--
Potassium (Dissolved)	mg/L	0.01	--	--	--	--	--	--	--	1.12	--
Selenium	mg/L	0.01	ND (0.004)	ND (0.004)	--	--	--	ND (0.0045)	ND (0.005)	ND (0.002)	--
Selenium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	ND (0.002)	--
Silica	mg/L	NS	--	--	--	--	--	--	--	--	--
Silica (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--
Silicon	mg/L	0.05	--	--	--	--	--	--	--	--	--

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

		NYSDEC Ambient Water Quality (mg/L)									
Sample Location:			*MW-12*	*MW-12*	*MW-12*	*MW-12*	*MW-12*	*MW-103A*	*MW-103A*	*MW-103A*	*MW-103A*
Sample ID:			*MW-12*	*MW-12*	*MW-12*	*MW-12*	*MW-12*	*MW-103A*	*MW-103A*	*MW-103A*	*WM-103A*
Sample Date:			*10/23/1997*	*1/22/1998*	*6/18/1998*	*7/21/1998*	*10/14/1998*	*11/7/1996*	*3/1/2000*	*8/21/2001*	*8/21/2001*
Location Description:			*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*SKW Landfill*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*
Parameters	***Units***										
Silver	mg/L	0.05	ND (0.010)	ND (0.010)	--	--	--	0.0015 B	ND (0.002)	ND (0.010)	--
Silver (Dissolved)	mg/L	20	--	--	--	--	--	--	--	ND (0.010)	--
Sodium	mg/L	20	87	84	94	91	88	58.5 E	43	45.6	--
Sodium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	47.5	--
Thallium	mg/L	NS	ND (0.05)	ND (0.05)	--	--	--	ND (0.003)	ND (0.01)	ND (0.001)	--
Thallium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	ND (0.001)	--
Vanadium	mg/L	NS	--	--	--	--	--	0.0053 B	ND (0.002)	ND (0.010)	--
Vanadium (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	ND (0.010)	--
Zinc	mg/L	NS	ND (0.016)	0.036	--	--	--	0.287	0.0636	0.032	--
Zinc (Dissolved)	mg/L		--	--	--	--	--	--	--	0.025	--
General Chemistry											
pH (water)	s.u.		7.14	7.11	7.11	7.24	7.32	7.40	--	--	--

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC*	*MW-104A*	*MW-104A*	*MW-105A*	*MW-105A*	*MW-106A-99*	*MW-106B-99*	*MW-107A*	*MW-107A-99*	*MW-107B-99*
Sample ID:		*Ambient*	*MW-104A*	*MW-104A*	*MW-105A*	*MW-105A*	*MW-106A*	*MW-106B*	*MW-107A*	*MW-107A*	*MW-107B*
Sample Date:		*Water Quality*	*11/7/1996*	*8/21/2001*	*11/7/1996*	*8/21/2001*	*3/1/2000*	*3/1/2000*	*11/7/1996*	*3/1/2000*	*3/1/2000*
Location Description:		*(mg/L)*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*
Parameters	***Units***										
Metals											
Aluminum	mg/L	NS	4.95	ND (0.075)	8.65	0.115	1.75	0.0885 B	8.36	1.19	0.0862 B
Aluminum (Dissolved)	mg/L	NS	--	ND (0.075)	--	ND (0.075)	--	--	--	--	--
Antimony	mg/L	0.003	ND (0.0048)	ND (0.050)	ND (0.0048)	ND (0.050)	ND (0.008)	ND (0.008)	ND (0.0048)	ND (0.008)	0.0109 B
Antimony (Dissolved)	mg/L	0.003	--	ND (0.050)	--	ND (0.050)	--	--	--	--	--
Arsenic	mg/L	0.025	ND (0.0046)	ND (0.002)	ND (0.0038)	ND (0.002)	ND (0.0055)	ND (0.0055)	0.0055 B	ND (0.0055)	ND (0.0055)
Arsenic (Dissolved)	mg/L	0.025	--	ND (0.002)	--	ND (0.002)	--	--	--	--	--
Barium	mg/L	1	ND (0.146) B	0.121	0.121 B	0.1	0.0387 B	0.066 B	0.108 B	0.0481 B	0.104 B
Barium (Dissolved)	mg/L	1	--	0.127	--	0.099	--	--	--	--	--
Beryllium	mg/L	NS	ND (0.0001)	ND (0.002)	ND (0.0001)	ND (0.002)	ND (0.001)	ND (0.001)	0.00084 B	ND (0.001)	ND (0.001)
Beryllium (Dissolved)	mg/L	NS	--	ND (0.002)	--	ND (0.002)	--	--	--	--	--
Boron	mg/L	1	--	--	--	--	--	--	--	--	--
Boron (Dissolved)	mg/L	1	--	--	--	--	--	--	--	--	--
Cadmium	mg/L	0.005	ND (0.0002)	ND (0.005)	0.00065 B	ND (0.005)	ND (0.001)	0.0012 B	0.0015 B	0.0011 B	ND (0.001)
Cadmium (Dissolved)	mg/L	0.005	--	ND (0.005)	--	ND (0.005)	--	--	--	--	--
Calcium	mg/L	NS	128.0	83.6	137.0	83.6	81.4 E	84.6 E	103.0	88.1 E	78.6 E
Calcium (Dissolved)	mg/L	NS	--	99.6	--	83.6	--	--	--	--	--
Chromium	mg/L	0.05	0.0059 B	ND (0.010)	0.0104 B	0.029	0.0017 B	ND (0.0015)	0.0029 B	0.0038 B	ND (0.0015)
Chromium (Dissolved)	mg/L	0.05	--	ND (0.010)	--	ND (0.010)	--	--	--	--	--
Chromium, Hexavalent	mg/L	0.05	0.0188	0.014	0.0263	ND (0.010)	ND (0.01)	ND (0.01)	ND (0.003)	ND (0.01)	ND (0.01)
Cobalt	mg/L	NS	0.004 B	ND (0.010)	0.0064 B	ND (0.010)	0.0016 B	0.0019 B	0.0137 B	0.0018 B	0.0024 B
Cobalt (Dissolved)	mg/L	NS	--	ND (0.010)	--	ND (0.010)	--	--	--	--	--
Copper	mg/L	0.2	0.0046 B	ND (0.017)	0.0083 B	ND (0.017)	0.0055 B	0.0052 B	0.295	0.0086 B	0.0041 B
Copper (Dissolved)	mg/L	0.2	--	ND (0.017)	--	ND (0.017)	--	--	--	--	--
Cyanide (total)	mg/L	0.2	--	--	--	--	--	--	--	--	--
Iron	mg/L	0.3	10.9	3.27	8.98	0.333	1.48	0.0874 B	6.86	0.989	0.306
Iron (Dissolved)	mg/L	0.3	--	3.08	--	0.1	--	--	--	--	--
Lead	mg/L	0.025	0.0903	0.001	0.0176	0.003	0.0041	ND (0.003)	0.035	0.0083	0.0061
Lead (Dissolved)	mg/L	0.025	--	0.002	--	ND (0.001)	--	--	--	--	--
Magnesium	mg/L	NS	69.3	48.5	87.2	46.2	26.2 E	36.5 E	54.8	47.7 E	35.5 E
Magnesium (Dissolved)	mg/L	NS	--	51.4	--	46.3	--	--	--	--	--
Manganese	mg/L	0.3	0.455	0.39	1.2	0.702	0.147	0.0446	2.78	0.0224	0.0721
Manganese (Dissolved)	mg/L	0.3	--	0.41	--	0.703	--	--	--	--	--
Mercury	mg/L	0.0007	ND (0.0001)	ND (0.0002)	ND (0.0001)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0001)	ND (0.0002)	ND (0.0002)
Mercury (Dissolved)	mg/L	0.0007	--	ND (0.0002)	--	ND (0.0002)	--	--	--	--	--
Nickel	mg/L	0.1	0.0116 B	ND (0.012)	0.0197 B	0.023	0.0052 B	0.0041 B	0.0102 B	0.0047 B	0.004 B
Nickel (Dissolved)	mg/L	0.1	--	ND (0.012)	--	ND (0.012)	--	--	--	--	--
Nitrate (as N)	mg/L	NS	--	--	--	--	--	--	--	--	--
Potassium	mg/L	NS	1.85 B	1.34	3.14 B	2.87	1.69 B	1.94 B	1.63 B	1.39 B	1.48 B
Potassium (Dissolved)	mg/L	0.01	--	1.41	--	2.91	--	--	--	--	--
Selenium	mg/L	0.01	ND (0.0045)	ND (0.002)	ND (0.0045)	ND (0.002)	ND (0.005)	ND (0.005)	0.0113 B	ND (0.005)	ND (0.005)
Selenium (Dissolved)	mg/L	NS	--	ND (0.002)	--	ND (0.002)	--	--	--	--	--
Silica	mg/L	NS	--	--	--	--	--	--	--	--	--
Silica (Dissolved)	mg/L	NS	--	--	--	--	--	--	--	--	--
Silicon	mg/L	0.05	--	--	--	--	--	--	--	--	--

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location: *Sample ID:* *Sample Date:* *Location Description:*		*NYSDEC Ambient Water Quality (mg/L)*	*MW-104A* *MW-104A* *11/7/1996* *NiMO/NMPA*	*MW-104A* *MW-104A* *8/21/2001* *NiMO/NMPA*	*MW-105A* *MW-105A* *11/7/1996* *NiMO/NMPA*	*MW-105A* *MW-105A* *8/21/2001* *NiMO/NMPA*	*MW-106A-99* *MW-106A* *3/1/2000* *NiMO/NMPA*	*MW-106B-99* *MW-106B* *3/1/2000* *NiMO/NMPA*	*MW-107A* *MW-107A* *11/7/1996* *NiMO/NMPA*	*MW-107A-99* *MW-107A* *3/1/2000* *NiMO/NMPA*	*MW-107B-99* *MW-107B* *3/1/2000* *NiMO/NMPA*
Parameters	***Units***										
Silver	mg/L	0.05	ND (0.001)	ND (0.010)	ND (0.001)	ND (0.010)	0.002 B	0.0036 B	ND (0.001)	0.0049 B	0.002 B
Silver (Dissolved)	mg/L	20	--	ND (0.010)	--	ND (0.010)	--	--	--	--	--
Sodium	mg/L	20	134.0 E	110	108 E	112	5.69	28	15.7 E	11.3	29.6
Sodium (Dissolved)	mg/L	NS	--	118	--	115	--	--	--	--	--
Thallium	mg/L	NS	ND (0.003)	ND (0.001)	ND (0.003)	ND (0.001)	ND (0.01)	ND (0.01)	ND (0.003)	ND (0.01)	ND (0.01)
Thallium (Dissolved)	mg/L	NS	--	ND (0.001)	--	ND (0.001)	--	--	--	--	--
Vanadium	mg/L	NS	0.0056 B	ND (0.010)	0.008 B	ND (0.010)	0.0058 B	0.0027 B	0.0015 B	0.0047 B	ND (0.002)
Vanadium (Dissolved)	mg/L	NS	--	ND (0.010)	--	ND (0.010)	--	--	--	--	--
Zinc	mg/L	NS	0.585	0.021	1.02	0.142	0.0904	0.115	1.39	0.0409	0.0051 B
Zinc (Dissolved)	mg/L		--	ND (0.020)	--	0.049	--	--	--	--	--
General Chemistry											
pH (water)	s.u.		7.35	--	7.44	--	--	--	7.94	--	--

TABLE 4.9

HISTORICAL OVERBURDEN GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Notes:

*	- Duplicate Analysis not within control limits.
B	- Indicates a value greater than or equal to the instrument detection limit, but less than the contract required detection limit.
E	- Indicates a value exstimated or not reported due to the presence of interference.
J	- The associated numerical value is an estimated quantity or Compound detected below sample quantitation limit.
N	- Indicates spike sample recovery was not within the control limits.
ND()	- Non detect at associated value.
NW	- Value Estimated
NCV	- No Calculated Value. Criteria depends on hardness values.
NS	- No Standard
R	- Rejected
-	- Not applicable
NS	- No Standard

TABLE 4.10

HISTORICAL BEDROCK GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC*	*MW-101B*	*MW-102B*	*MW-102B*	*MW-102B*	*MW-103B*	*MW-103B*	*MW-103B*
Sample ID:		*Ambient*	*MW-101B (NYPA)*	*MW-102B*	*MW-102B*	*MW-102B*	*MW-103B*	*MW-103B*	*MW-103B*
Sample Date:		*Water Quality*	*11/7/1996*	*11/7/1996*	*8/21/2001*	*8/21/2001*	*11/7/1996*	*3/1/2000*	*8/21/2001*
Location Description:		*(mg/L)*	*NYPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*
						Duplicate			
Parameters	***Units***								
Metals									
Aluminum	mg/L	NS	0.0424 *	0.314	--	--	0.342	0.113 B	ND (0.075)
Aluminum (Dissolved)	mg/L	NS	--	--	--	--	--	--	ND (0.075)
Antimony	mg/L	0.003	0.0179	ND (0.0048)	--	--	ND (0.0048)	ND (0.008)	ND (0.050)
Antimony (Dissolved)	mg/L	0.003	--	--	--	--	--	--	ND (0.050)
Arsenic	mg/L	0.025	ND (0.05)	ND (0.0021)	ND (0.002)	ND (0.002)	ND (0.0021)	ND (0.0055)	ND (0.002)
Arsenic (Dissolved)	mg/L	0.025	--	--	ND (0.002)	ND (0.002)	--	--	ND (0.002)
Barium	mg/L	1	ND (0.001)	0.0331 B	--	--	0.122 B	0.101 B	0.07
Barium (Dissolved)	mg/L	1	--	--	--	--	--	--	0.072
Beryllium	mg/L	NS	0.0018 BN	ND (0.0001)	--	--	ND (0.0001)	ND (0.001)	ND (0.002)
Beryllium (Dissolved)	mg/L	NS	--	--	--	--	--	--	ND (0.002)
Cadmium	mg/L	0.005	ND (0.005)	0.00063 B	--	--	ND (0.0002)	ND (0.001)	ND (0.005)
Cadmium (Dissolved)	mg/L	0.005	--	--	--	--	--	--	ND (0.005)
Calcium	mg/L	NS	--	--	--	--	--	88.7 E	48.7
Calcium (Dissolved)	mg/L	NS	--	--	--	--	--	--	49.4
Chromium	mg/L	0.05	ND (0.01)	0.0025 B	--	--	0.0027 B	ND (0.0015)	ND (0.010)
Chromium (Dissolved)	mg/L	0.05	--	--	--	--	--	--	ND (0.010)
Chromium, Hexavalent	mg/L	0.05	ND	0.0189	0.017	0.017	ND (0.003)	ND (0.01)	--
Cobalt	mg/L	NS	0.112 N*	ND (0.0012)	--	--	ND (0.0012)	ND (0.0015)	ND (0.010)
Cobalt (Dissolved)	mg/L	NS	--	--	--	--	--	--	ND (0.010)
Copper	mg/L	0.2	0.104	0.0044 B	--	--	0.0023 NB	0.0033 B	ND (0.017)
Copper (Dissolved)	mg/L	0.2	--	--	--	--	--	--	ND (0.017)
Iron	mg/L	0.3	ND (0.001)	0.444	--	--	0.367	0.111	0.089
Iron (Dissolved)	mg/L	0.3	--	--	--	--	--	--	0.062
Lead	mg/L	0.025	39.9	ND (0.0024)	0.001	0.003	ND (0.0024)	ND (0.003)	ND (0.001)
Lead (Dissolved)	mg/L	0.025	--	--	ND (0.001)	ND (0.001)	--	--	ND (0.001)
Magnesium	mg/L	NS	0.0314	36.7	--	--	67.3	47.7 E	26.9
Magnesium (Dissolved)	mg/L	NS	--	--	--	--	--	--	27.5
Manganese	mg/L	0.3	ND (0.0002)	0.0447	--	--	0.0713	0.112	0.031
Manganese (Dissolved)	mg/L	0.3	--	--	--	--	--	--	0.032
Mercury	mg/L	0.0007	ND (0.02)	ND (0.0001)	ND (0.0002)	ND (0.0002)	ND (0.0001)	ND (0.0002)	ND (0.0002)
Mercury (Dissolved)	mg/L	0.0007	--	--	ND (0.0002)	ND (0.0002)	--	--	ND (0.0002)
Nickel	mg/L	0.1	1.85 B	0.003 B	--	--	0.0012 B	0.0017 B	ND (0.012)
Nickel (Dissolved)	mg/L	0.1	--	--	--	--	--	--	ND (0.012)

TABLE 4.10

HISTORICAL BEDROCK GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC*	*MW-101B*	*MW-102B*	*MW-102B*	*MW-102B*	*MW-103B*	*MW-103B*	*MW-103B*
Sample ID:		*Ambient*	*MW-101B (NYPA)*	*MW-102B*	*MW-102B*	*MW-102B*	*MW-103B*	*MW-103B*	*MW-103B*
Sample Date:		*Water Quality*	*11/7/1996*	*11/7/1996*	*8/21/2001*	*8/21/2001*	*11/7/1996*	*3/1/2000*	*8/21/2001*
Location Description:		*(mg/L)*	*NYPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA* *Duplicate*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*
Parameters	***Units***								
Potassium	mg/L	NS	ND (0.005)	2.89 B	--	--	2.18 B	2.9 B	4.08
Potassium (Dissolved)	mg/L	NS	--	--	--	--	--	--	4.23
Selenium	mg/L	0.01	ND (0.005)	ND (0.0045)	ND (0.002)	ND (0.002)	ND (0.0045)	ND (0.005)	ND (0.002)
Selenium (Dissolved)	mg/L	0.01	--	--	ND (0.002)	ND (0.002)	--	--	ND (0.002)
Silver	mg/L	0.05	26.8	ND (0.001)	--	--	ND (0.001)	0.0025 B	ND (0.010)
Silver (Dissolved)	mg/L	0.05	--	--	--	--	--	--	ND (0.010)
Sodium	mg/L	20	ND (0.001) N	54.7 E	--	--	37.7 E	38.2	45.8
Sodium (Dissolved)	mg/L	20	--	--	--	--	--	--	47.4
Thallium	mg/L	NS	ND (0.02)	ND (0.003)	ND (0.001)	ND (0.001)	ND (0.003)	ND (0.01)	ND (0.001)
Thallium (Dissolved)	mg/L	NS	--	--	ND (0.001)	ND (0.001)	--	--	ND (0.001)
Vanadium	mg/L	NS	0.635	ND (0.0008)	--	--	ND (0.0008)	ND (0.002)	ND (0.010)
Vanadium (Dissolved)	mg/L	NS	--	--	--	--	--	--	ND (0.010)
Zinc	mg/L	NS	0.01	0.0165 B	--	--	0.0225	0.0094 B	ND (0.020)
Zinc (Dissolved)	mg/L	NS	--	--	--	--	--	--	ND (0.020)
General Chemistry									
pH (water)	s.u.		--	8.22	--	--	7.80	--	--

TABLE 4.10

HISTORICAL BEDROCK GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC*	*MW-103B*	*MW-104B*	*MW-104B*	*MW-105B*	*MW-105B*
Sample ID:		*Ambient*	*WM-103B*	*MW-104B*	*MW-104B*	*MW-105B*	*MW-105B*
Sample Date:		*Water Quality*	*8/21/2001*	*11/7/1996*	*8/21/2001*	*11/7/1996*	*8/21/2001*
Location Description:		*(mg/L)*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*
Parameters	***Units***						
Metals							
Aluminum	mg/L	NS	--	1.03	0.132	0.39	ND (0.075)
Aluminum (Dissolved)	mg/L	NS	--	--	0.093	--	ND (0.075)
Antimony	mg/L	0.003	--	ND (0.0048)	ND (0.050)	ND (0.0048)	ND (0.050)
Antimony (Dissolved)	mg/L	0.003	--	--	ND (0.050)	--	ND (0.050)
Arsenic	mg/L	0.025	--	ND	ND (0.002)	ND (0.0033)	0.003
Arsenic (Dissolved)	mg/L	0.025	--	--	ND (0.002)	--	0.002
Barium	mg/L	1	--	0.282	0.297	0.0958 B	0.118
Barium (Dissolved)	mg/L	1	--	--	0.313	--	0.114
Beryllium	mg/L	NS	--	ND (0.0001)	ND (0.002)	ND (0.0001)	ND (0.002)
Beryllium (Dissolved)	mg/L	NS	--	--	ND (0.002)	--	ND (0.002)
Cadmium	mg/L	0.005	--	ND (0.0002)	ND (0.005)	ND (0.0002)	ND (0.005)
Cadmium (Dissolved)	mg/L	0.005	--	--	ND (0.005)	--	ND (0.005)
Calcium	mg/L	NS	--	--	108	85.5	74.6
Calcium (Dissolved)	mg/L	NS	--	--	114	--	73.9
Chromium	mg/L	0.05	--	0.0059 B	ND (0.010)	0.0013 B	0.012
Chromium (Dissolved)	mg/L	0.05	--	--	ND (0.010)	--	ND (0.010)
Chromium, Hexavalent	mg/L	0.05	0.010	0.00159	0.016	0.0115	ND (0.010) ND
Cobalt	mg/L	NS	--	ND (0.0012)	ND (0.010)	0.004 B	ND (0.010)
Cobalt (Dissolved)	mg/L	NS	--	--	ND (0.010)	--	ND (0.010)
Copper	mg/L	0.2	--	ND (0.0006)	ND (0.017)	ND (0.0006)	ND (0.017)
Copper (Dissolved)	mg/L	0.2	--	--	ND (0.017)	--	ND (0.017)
Iron	mg/L	0.3	--	1.03	0.123	1.96	3.25
Iron (Dissolved)	mg/L	0.3	--	--	0.083	--	2.69
Lead	mg/L	0.025	--	0.0063	ND (0.001)	0.0107	0.015
Lead (Dissolved)	mg/L	0.025	--	--	ND (0.001)	--	0.002
Magnesium	mg/L	NS	--	59.6	41.4	54.5	42.5
Magnesium (Dissolved)	mg/L	NS	--	--	43.3	--	42.2
Manganese	mg/L	0.3	--	0.101	0.07	0.69	0.598
Manganese (Dissolved)	mg/L	0.3	--	--	0.073	--	0.588
Mercury	mg/L	0.0007	--	ND (0.0001)	ND (0.0002)	ND (0.0001)	ND (0.0002)
Mercury (Dissolved)	mg/L	0.0007	--	--	ND (0.0002)	--	ND (0.0002)
Nickel	mg/L	0.1	--	0.0033 B	ND (0.012)	0.0097 B	0.016
Nickel (Dissolved)	mg/L	0.1	--	--	ND (0.012)	--	0.02

TABLE 4.10

HISTORICAL BEDROCK GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Location:		*NYSDEC*	*MW-103B*	*MW-104B*	*MW-104B*	*MW-105B*	*MW-105B*
Sample ID:		*Ambient*	*WM-103B*	*MW-104B*	*MW-104B*	*MW-105B*	*MW-105B*
Sample Date:		*Water Quality*	*8/21/2001*	*11/7/1996*	*8/21/2001*	*11/7/1996*	*8/21/2001*
Location Description:		*(mg/L)*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*	*NiMO/NMPA*
Parameters	*Units*						
Potassium	mg/L	NS	--	1.8 B	2.88	1.16 B	2.13
Potassium (Dissolved)	mg/L	NS	--	--	3.06	--	2.12
Selenium	mg/L	0.01	--	ND (0.0045)	ND (0.002)	ND (0.0045)	ND (0.002)
Selenium (Dissolved)	mg/L	0.01	--	--	ND (0.002)	--	ND (0.002)
Silver	mg/L	0.05	--	ND (0.001)	ND (0.010)	ND (0.001)	ND (0.010)
Silver (Dissolved)	mg/L	0.05	--	--	ND (0.010)	--	ND (0.010)
Sodium	mg/L	20	--	183 E	222	124 E	169
Sodium (Dissolved)	mg/L	20	--	--	232	--	171
Thallium	mg/L	NS	--	ND (0.003)	ND (0.001)	ND (0.003)	ND (0.001)
Thallium (Dissolved)	mg/L	NS	--	--	ND (0.001)	--	ND (0.001)
Vanadium	mg/L	NS	--	0.0097 B	ND (0.010)	ND (0.0008)	ND (0.010)
Vanadium (Dissolved)	mg/L	NS	--	--	ND (0.010)	--	ND (0.010)
Zinc	mg/L	NS	--	0.0483	0.023	0.258	0.148
Zinc (Dissolved)	mg/L	NS	--	--	ND (0.020)	--	0.091
General Chemistry							
pH (water)	s.u.		--	7.66	--	7.41	--

TABLE 4.10

HISTORICAL BEDROCK GROUNDWATER ANALYTICAL RESULTS
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Notes:

* - Duplicate Analysis not within control limits.
B - Indicates a value greater than or equal to the instrument detection limit, but less than the contract required detection limit.
E - Indicates a value estimated or not reported due to the presence of interference.
J - The associated numerical value is an estimated quantity or Compound detected below sample quantitation limit.
N - Indicates spike sample recovery was not within the control limits.
ND() - Non detect at associated value.
NS - No Standard
R - Rejected
\- - Not applicable
NS - No Standard

APPENDIX A

FIELD SAMPLING PLAN

TABLE OF CONTENTS

Page

1.0 INTRODUCTION A-1

2.0 GENERAL SAMPLING PROTOCOLS A-2

3.0 SUBSURFACE SOIL INVESTIGATION A-3
  3.1 BOREHOLE DRILLING PROCEDURES A-3
  3.2 SPLIT-SPOON SOIL SAMPLE COLLECTION A-4
  3.3 SHELBY TUBE SAMPLING PROTOCOLS A-5
  3.3.1 PACKAGING AND TRANSPORTATION PROTOCOLS FOR SHELBY TUBE SAMPLES A-6
  3.4 SURFACE SOIL SAMPLE COLLECTION A-6

4.0 GROUNDWATER MONITORING WELL INSTALLATION AND SAMPLING A-8
  4.1 MONITORING WELL CONSTRUCTION A-8
  4.2 MONITORING WELL SAMPLING A-8
  4.2.1 WATER LEVEL MEASUREMENTS A-8
  4.2.2 WELL DEVELOPMENT A-9

5.0 MONITORING WELL PURGING AND GROUNDWATER SAMPLING A-10

6.0 SURFACE WATER AND SEDIMENT SAMPLING A-11
  6.1 SURFACE WATER SAMPLING PROTOCOLS A-11
  6.2 SEDIMENT SAMPLING PROTOCOLS A-11

7.0 TEST PIT EXCAVATIONS A-12

8.0 SAMPLING EQUIPMENT CLEANING A-13

9.0 CHAIN OF CUSTODY A-14

10.0 WASTE HANDLING A-15

LIST OF FIGURES
(Following Text)

FIGURE A.1 SPLIT-SPOON SAMPLE SELECTION DETAILS

FIGURE A.2 TYPICAL OVERBURDEN GROUNDWATER MONITORING WELL DETAIL

LIST OF ATTACHMENTS

ATTACHMENT A-1 LOW-FLOW (MINIMUM DRAWDOWN) GROUNDWATER SAMPLING PROCEDURES
EPA/540/S-95/504, APRIL 1996

ATTACHMENT A-2 FIELD FORMS

1.0 INTRODUCTION

This Appendix presents the Field Sampling Plan (FSP) for the Phase 1 Investigation of Operable Unit 3 (OU3) at the Vanadium Corporation of America Site (Site) in Niagara Falls, New York. This report outlines the protocols which will be followed during the following activities:

- installation of soil borings;
- collection of subsurface and surface soil samples;
- installation of groundwater monitoring wells;
- sampling of groundwater monitoring wells;
- collection of surface water, sediment, and seep samples;
- test pit excavations;
- topographic/property survey;
- equipment cleaning; and
- waste handling.

2.0 GENERAL SAMPLING PROTOCOLS

The following general sampling procedures will be conducted for all sampling activities presented in this FSP.

1) Prior to sampling at each location, all sampling instruments and equipment will be cleaned in accordance with the protocols presented in Section 8.0;
2) Disposable gloves will be worn by samplers and changed between sampling points. Additional glove changes will be undertaken as necessary;
3) All sampling generated wastes such as gloves, tyveks, etc., will be collected and consolidated with the waste material for proper disposal;
4) Samples will be labeled noting the location and/or interval, analysis required, preservative added, date, time, and sampler's initials. A hardcover bound field book will be maintained to record all samples and sampling events. Details regarding recordkeeping and labeling are presented in the QAPP;
5) Sample containers will be packed loosely in laboratory-supplied coolers to allow for placement of cushioning materials (i.e., vermiculite) between bottles to prevent breakage;
6) Following packing of the sample cooler, the completed chain-of-custody (see Section 9.0) will be placed in a watertight plastic bag and attached to the inside of the cooler lid;
7) A signed custody seal will be placed across the cooler closure and the cooler will then be sealed with packing tape. The packing tape will not completely cover the seal;
8) Samples will be handled and shipped in accordance with the protocols described in the QAPP;
9) All samples will be delivered to the laboratory via an overnight courier; and
10) At the laboratory, all samples will be stored at 4°C (±2°C).

3.0 SUBSURFACE SOIL INVESTIGATION

As presented in the Phase 1 Work Plan, 15 boreholes will be installed, and 14 of these boreholes will be completed as monitoring wells. Borehole and monitoring well locations are presented on Figures 5.1 and 5.2, respectively, in the Phase 1 Work Plan and are summarized below:

BH1 (completed as MW15);
BH2 (completed as MW16);
BH3 (completed as MW17);
BH4 (completed as MW18);
BH5 (completed as MW19);
BH6 (completed as MW20);
BH7 (completed as MW21);
BH8 (completed as MW22);
BH9 (completed as MW23);
BH11 (completed as MW24);
BH12 (completed as MW25);
BH13 (completed as MW26);
BH14 (completed as MW27); and
BH15 (completed as MW28).

Borehole BH12 will not be completed as a monitoring well. The exact number and locations of monitoring wells to be installed will depend upon the distribution of saturated slag material.

Borehole drilling procedures are described in Section 3.1; subsurface soil sampling is described in Section 3.2; and surface soil sampling is described in Section 3.3. Monitoring well installation is discussed in Section 4.0.

3.1 BOREHOLE DRILLING PROCEDURES

Boreholes will be advanced to the top of the native silt layer using hollow-stem augers with a minimum inside diameter of 3 1/4 inches. Continuous split-spoon sampling will be performed during augering. The split-spoon sampler will be attached to the drill rod and driven into the soil the full depth (24 inches) using a 140-pound hammer, free-falling 30 inches. The driving resistance (number of hammer blows) will be recorded for each 6-inch increment of penetration. If the soil is loose, wet, or in any way unconsolidated, clean basket retainers will be used to retain the soil in the split spoon. Between samples, the split spoon will be cleaned as described in Section 8.0.

Each split spoon will be visually examined for chemical presence and logged for geologic stratigraphy. Soil samples collected from the split spoons for geologic purposes will be visually described and classified according to the Unified Soil Classification System by an experienced field geologist or engineer. Soil descriptions will be written on stratigraphic log sheets, as presented in Attachment A-2.

Following completion, boreholes that will not be completed as monitoring wells will be backfilled with cement/bentonite grout tremied to the bottom of the hole. The cement/bentonite grout will consist of a mixture of Type 1 Portland cement complying with ASTM C150 with 3 percent by volume of bentonite clay added and not more than 6 gallons of potable water per 94-pound sack of cement.

Before drilling at the initial location and after drilling at each location, the drill rig and all drilling equipment will be cleaned in accordance with the protocols presented in Section 8.0.

Following borehole installations, the location and ground elevation for each borehole will be surveyed.

3.2 SPLIT-SPOON SOIL SAMPLE COLLECTION

During the continuous split-spoon sampling, the cores will be examined for visual evidence of contamination. Two soil samples will be collected from each borehole. One soil sample will be collected from the slag material and one soil sample will be collected from the native silt layer.

A schematic representation of the split-spoon sampling detail is presented on Figure A.1. The samples for chemical analyses will be collected from the middle core of the sample using a decontaminated stainless steel trowel or spoon. The samples will be placed directly into the sample jars.

Soil samples will be analyzed for pH, TAL inorganics, and hexavalent chromium. Sample bottle requirements are presented in the QAPP in Appendix B. All samples will be recorded on sample log sheets.

Over a large portion of the Site, the slag material is covered by a soil cap. Selected soil samples from the cap material over the slag material will be collected for geotechnical analyses (e.g., grain size distribution, permeability). Soil samples to be collected for permeability testing will be collected using a Shelby tube to minimize sample disturbance. Protocols for soil sample collection using a Shelby tube are presented in Section 3.3.

3.3 SHELBY TUBE SAMPLING PROTOCOLS

Shelby tube samplers are used to collect relatively undisturbed samples of soft to stiff clayey soils. The Shelby tube has an outside diameter of 2 or 3 inches and is 3 feet long. These undisturbed samples are used for certain laboratory tests of structural properties (consolidation, hydraulic conductivity, shear strength) or other tests that might be influenced by sample disturbance. Procedures for conducting thin-walled tube sampling are provided in ASTM D1587, and are briefly described below:

- the soil deposit being sampled must be cohesive in nature, and relatively free of sand, gravel, and cobble materials, as contact with these materials will damage the sampler;
- clean out the borehole to the sampling elevation using whatever method is preferred that will ensure the material to be sampled is not disturbed. If groundwater is encountered, maintain the liquid level in the borehole at or above groundwater level during the sampling operation;
- bottom discharge bits are not permitted. Side discharge bits may be used, with caution. Jetting through an open-tube sampler to clean out the borehole to sampling elevation is not permitted. Remove loose material from the center of a casing or hollow-stem auger as carefully as possible to avoid disturbance of the material to be sampled;
- place the sample tube so that its bottom rests on the bottom of the hole. Advance the sampler into the formation without rotation by a continuous and relatively rapid motion; usually hydraulic pressure is applied to the top of the drill rods;
- determine the length of advance by the resistance and condition of the formation, but the length shall never exceed 5 to 10 diameters of the tube in sands and 10 to 15 diameters of the tube in clays;
- in no case should the length of advance be greater than the sample-tube length minus an allowance for the sampler head and a minimum of 3 inches for cuttings;

- the tube may be rotated to shear the bottom of the sample 2 to 3 minutes after pressing in, and prior to retrieval to ensure the sample does not slide out of the tube. Lift the weight of the rods off of the tube prior to rotating; and
- withdraw the sampler from the formation as carefully as possible in order to minimize disturbance of the sample.

3.3.1 PACKAGING AND TRANSPORTATION PROTOCOLS FOR SHELBY TUBE SAMPLES

Remove any sloughed material from the top of the sample using a knife or similar long bladed instrument. If it is not possible to distinguish sloughed soil from intact soil, do not remove. Following removal of sloughed material, measure the tube length and the air space in the tube above the sample and record the difference as the sample recovery. In the unusual circumstance that there is also air space at the bottom of the sample, subtract this as well and record this latter measurement as a separate entry. Seal the top and bottom of the sample with wax. First pour the liquefied wax into the top of the sample to a thickness of about 1 inch. Once this is cooled, remove approximately 1/2 inch of soil from the bottom of sample (unless there is already a cavity at the bottom of sample) and seal similarly. Fill the remaining air space above the sample with loose soil to prevent the sample from shifting in the tube, and then cap both ends of the sample with plastic caps. Tape the caps on using duct tape. Write the sample identification number on the cap using an indelible marker. Shelby tubes containing soft clays and wet silts need to be handled with care to avoid damage to the sample. Keep samples in an upright position at all times and transport either in a specifically designed cushioned box.

3.4 SURFACE SOIL SAMPLE COLLECTION

Surface soil samples will be collected at locations SS10 to SS39, as shown on Figure 5.3 in the Phase 1 Work Plan. Surficial soil samples will be collected using a precleaned stainless steel trowel or spoon. The samples will be collected from 0 to 6 inches below ground surface; however, any vegetation present will be removed using a separate precleaned stainless steel trowel or spoon prior to sampling.

As indicated on Figure 5.3 in the Phase 1 Work Plan, several surface samples are to be collected in areas where the slag material is exposed to the surface. The surface slag material may require to be broken into smaller pieces prior to placing them into the sample bottle.

- the tube may be rotated to shear the bottom of the sample 2 to 3 minutes after pressing in, and prior to retrieval to ensure the sample does not slide out of the tube. Lift the weight of the rods off of the tube prior to rotating; and
- withdraw the sampler from the formation as carefully as possible in order to minimize disturbance of the sample.

3.3.1 PACKAGING AND TRANSPORTATION PROTOCOLS FOR SHELBY TUBE SAMPLES

Remove any sloughed material from the top of the sample using a knife or similar long bladed instrument. If it is not possible to distinguish sloughed soil from intact soil, do not remove. Following removal of sloughed material, measure the tube length and the air space in the tube above the sample and record the difference as the sample recovery. In the unusual circumstance that there is also air space at the bottom of the sample, subtract this as well and record this latter measurement as a separate entry. Seal the top and bottom of the sample with wax. First pour the liquefied wax into the top of the sample to a thickness of about 1 inch. Once this is cooled, remove approximately 1/2 inch of soil from the bottom of sample (unless there is already a cavity at the bottom of sample) and seal similarly. Fill the remaining air space above the sample with loose soil to prevent the sample from shifting in the tube, and then cap both ends of the sample with plastic caps. Tape the caps on using duct tape. Write the sample identification number on the cap using an indelible marker. Shelby tubes containing soft clays and wet silts need to be handled with care to avoid damage to the sample. Keep samples in an upright position at all times and transport either in a specifically designed cushioned box.

3.4 SURFACE SOIL SAMPLE COLLECTION

Surface soil samples will be collected at locations SS10 to SS39, as shown on Figure 5.3 in the Phase 1 Work Plan. Surficial soil samples will be collected using a precleaned stainless steel trowel or spoon. The samples will be collected from 0 to 2 inches below ground surface; however, any vegetation present will be removed using a separate precleaned stainless steel trowel or spoon prior to sampling.

As indicated on Figure 5.3 in the Phase 1 Work Plan, several surface samples are to be collected in areas where the slag material is exposed to the surface. The surface slag material may require to be broken into smaller pieces prior to placing them into the sample bottle.

Surface soil samples to be split for duplicate analyses will first be homogenized in a precleaned stainless steel bowl. Surface soil samples will be analyzed for TAL inorganics and hexavalent chromium. Bottle requirements are presented in the QAPP in Appendix B.

4.0 GROUNDWATER MONITORING WELL INSTALLATION AND SAMPLING

4.1 MONITORING WELL CONSTRUCTION

As discussed in Section 3.1, all boreholes will be advanced to the top of the native silt layer. Monitoring wells will be constructed with the bottom of the well screen on top of the native silt layer. Each monitoring well will be constructed with 2-inch diameter, No. 10 slotted PVC well screen, and 2-inch diameter PVC riser pipe. The well screen may vary in length from 2 to 5 feet depending upon the depth to the top of the native silt layer and the thickness of the saturated material. A sand pack consisting of No. 4 silica sand will be placed around the well screen to a height of approximately 2 feet above the top of the screen. A 2± foot thick bentonite plug will be placed above the sand pack. The remainder of the borehole annulus will be grouted to the surface with bentonite-cement grout tremied in place using the positive displacement method. All wells will be constructed as flush-mount wells. A typical well construction detail is presented on Figure A.2. Following the installation of each monitoring well, the location and riser pipe elevation will be surveyed. Monitoring well details will be presented on well construction logs, as presented in Attachment A-2. Also, all samples will be recorded on sample log sheets.

4.2 MONITORING WELL SAMPLING

4.2.1 WATER LEVEL MEASUREMENTS

Water level measurements will be taken prior to well development, purging, and sampling as described in Sections 4.2.2 to 4.2.4.

Prior to measuring water levels, a survey mark will be placed on the riser pipe for use as a measuring point and the elevation of this measuring point will be surveyed to an accuracy of 0.01 feet.

The water levels will be obtained by measuring the distance from the top of the well riser to the top of the water column using a electronic water level meter or a chain and plopper. Measurements will be obtained to ±0.01-foot accuracy.

Water level measurements taken for the determination of groundwater flow direction and hydraulic gradient will be measured within a 24-hour period for all wells. Water levels will be allowed to stabilize for a minimum of 24 hours after well construction and development, prior to measurement. Recovery may take longer for low yield wells.

Water level measuring equipment that comes in contact with well water will be cleaned in accordance with Section 8.0 to ensure that cross-contamination does not occur.

4.2.2 WELL DEVELOPMENT

All newly installed groundwater monitoring wells will be developed to a silt-free condition of 50 nephelometric turbidity units (NTUs) or less, if possible, prior to the first sampling round in accordance with the following protocol:

1) All personnel involved in well development will wear protective clothing including Tyvek coveralls, rubber boots and rubber gloves.
2) All wells will be developed to a silt-free condition of 50 NTUs or less, if possible, following installation, by bailing, pumping or air lift pumping.
3) Water levels in all wells will be measured to ±0.01 foot prior to development utilizing an electronic water level meter or a chain and plopper as per Section 4.2.1.
4) After each well volume is removed, a sample will be collected and analyzed for turbidity, temperature, pH, and conductivity. Development will continue until two consecutive and consistent readings of temperature, pH, and conductivity are obtained and the turbidity is less than 50 NTUs, if possible. Readings will be considered consistent if consecutive conductivity, temperature, and pH values are within 10 percent of each other. In the event that these field conditions cannot be met, development will continue to a silt-free condition of less than 50 NTUs, if possible, or until a maximum of ten well volumes have been removed.
5) In wells where recharge is insufficient to conduct the development protocol described in Item 4 above, the well will be pumped/bailed to dryness on three consecutive days.
6) Acceptable methods of water extraction during development include bailers, peristaltic pumps, bladder pumps, Waterra pumps, centrifugal and submersible pumps. The development method selected will be based upon the well depth, the water level in the well, and the recharge characteristics.
7) All water extraction equipment will be cleaned in accordance with the protocols presented in Section 8.0.
8) All development water will be collected, stored, analyzed, and disposed of in accordance with State and Federal regulations.

5.0 MONITORING WELL PURGING AND GROUNDWATER SAMPLING

Groundwater sampling will be conducted using low-flow purge and sampling methods as described in EPA/540/S-95/504, dated April 1996 (see Attachment A-1 to this Appendix). During purging of the well, turbidity will be measured in the field with a nephelometer and the field indicator parameters temperature, conductivity, and pH will be measured by a multi-meter monitor.

All monitoring wells will be sampled, and groundwater samples will be analyzed for total TAL inorganics and total hexavalent chromium. Select monitoring wells will also be sampled and analyzed for dissolved TAL inorganics and dissolved hexavalent chromium. Groundwater samples submitted for dissolved TAL inorganics and dissolved hexavalent chromium will be filtered using in-line high capacity 0.45 micron non-metallic water filters (Geogard or equivalent). The filter apparatus will be attached directly to the discharge line of the sampling pump. A new filter will be used for each sample. Bottle requirements are presented in the QAPP in Appendix B. All samples will be recorded on sample log sheets.

6.0 SURFACE WATER AND SEDIMENT SAMPLING

As presented in the Phase 1 Work Plan, one surface water sample and one sediment sample will be collected at each of 17 locations. Surface water/sediment sampling locations are presented on Figure 5.4 in the RI Work Plan. These locations are identified as SW8 to SW24.

6.1 SURFACE WATER SAMPLING PROTOCOLS

Surface water samples will be collected starting from the most downstream location, followed by more progressively upstream locations. Surface water samples will be collected without disturbing the stream bed in order to avoid entrained sediments. Surface water samples will be collected in areas of the surface water body that are representative of the surface water body conditions.

When collecting surface water samples, direct dipping of the sample container into the stream is acceptable unless the sample bottle contains preservatives. In this case, precleaned bottles with no preservatives will be used to collect the water sample. The water sample will subsequently be transferred to the appropriate bottle containing preservatives.

All surface water samples will be analyzed for TAL inorganics, hexavalent chromium, and pH. A multi-meter will be used to measure pH in the field. Bottle requirements are presented in the QAPP in Appendix B. All samples will be recorded on sample log sheets.

6.2 SEDIMENT SAMPLING PROTOCOLS

Sediment samples will be collected using a stainless steel spoon. Sediment samples collected for chemical analysis will be thoroughly mixed in a stainless steel bowl, prior to being placed in the sample bottles.

All sediment samples will be analyzed for TAL inorganics, hexavalent chromium, and pH. Bottle requirements are presented in the QAPP in Appendix B. All samples will be recorded on sample log sheets.

7.0 TEST PIT EXCAVATIONS

Test pits will be excavated in order to further delineate the areal extent of buried slag material. Particular attention will be given to the northern portion of OU3 and east of the capped area. The exact number and locations of the proposed test pits will be determined in the field. Excavated material will be temporarily staged next to the test pit, and subsequently backfilled upon completion of the test pit. Stratigraphic information will be recorded on standard test pit logs by the field engineer/geologist, as presented in Attachment A-2. Test pit locations will be staked and surveyed.

8.0 SAMPLING EQUIPMENT CLEANING

Prior to mobilization of the drill rig it shall be thoroughly cleaned to remove oil, grease, mud, and other foreign matter. Subsequently, before initiating drilling at each borehole, samplers, drill steel, and associated equipment will be cleaned to prevent cross-contamination from the previous drilling location. All cleaning will be conducted at the on-Site decontamination pad. Cleaning will be accomplished by flushing and wiping the components to remove all visible sediments followed by thorough high pressure water wash. Special attention will be given to the threaded sections of the drill rods and the soil samples.

Reusable sampling equipment will be cleaned between sampling events using the following rinse sequence.

1) Wash and scrub with tap water and low phosphate detergent.
2) Rinse with tap water.
3) Rinse with 10 percent HNO_3, ultrapure (dilute to 1 percent HNO_3 if carbon samplers utilized).
4) Thoroughly rinse with deionized demonstrated analyte-free water. The volume of water used must be at least five times the volume of solvent used in step 3).
5) Air dry for 15 minutes.
6) Following the final rinse, sampling equipment will be visually inspected to verify that it is free of particulates and other solid material which may contribute to possible sample cross-contamination. Fluids used for cleaning will not be recycled. Washwater, rinse water, and decontamination fluids will be collected and transferred to wastewater storage tanks pending final disposal.

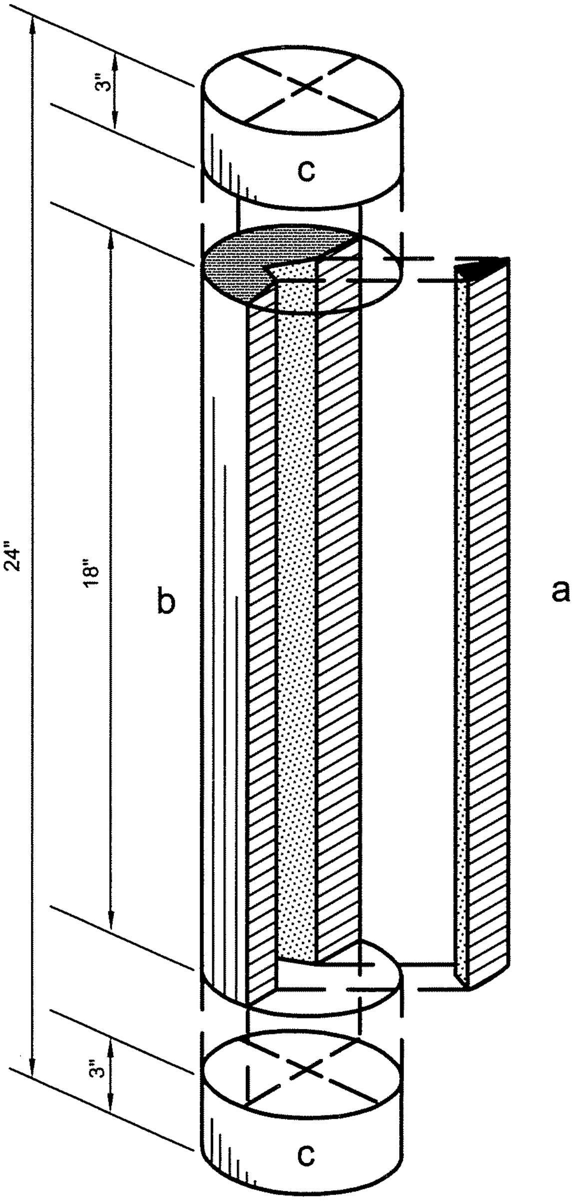
9.0 CHAIN OF CUSTODY

Samples will remain under the control of the sampling personnel in the field until relinquished to the delivery firm or directly to the laboratory. Chain-of-custody documents will be completed for each cooler. The original and two copies will be placed within the cooler. The fourth copy will be retained by the sampler. In addition, Field Sampling Data Sheets and a sample log of samples collected and shipped off Site will be maintained on Site. A sample chain-of-custody is presented in Attachment A-2.

10.0 WASTE HANDLING

All soil cuttings brought to the surface will be collected in 55-gallon DOT-approved drums and transferred to an on-Site interim drum staging area. Any borehole fluid will also be contained, collected, and transferred to the on-Site drum staging area. All wastes will be sampled and analyzed, and will be disposed of in accordance with State and Federal regulations.

All coveralls, gloves, etc., will be collected in plastic bags for disposal.



TYPICAL SOIL CORE

a

PORTION OF SAMPLE FOR CHEMICAL ANALYSIS

-CONTACT WITH NON-DECONTAMINATED
MATERIAL IS NOT ACCEPTABLE

-STORAGE - REFRIGERATED (4°C)

-SHIPPING - ON ICE BY COURIER TO DESIGNATED LAB

- CONTAINER - PER QAPP

b

PORTION OF SAMPLE TO BE RETAINED FOR GEOLOGIC RECORDS

-CONTACT WITH NON-DECONTAMINATED
MATERIALS IS NOT A PROBLEM

-CONTAINER - CLEAN GLASS JAR
- CLEAR GLASS IS SUITABLE

-STORAGE - IN STANDARD SHIPPING CARTON
- NO REFRIGERATION REQUIRED

c

PORTION OF SAMPLE TO BE DISCARDED

-DISCARDED WITHIN 55 GALLON DRUM
MAINTAINED ON-SITE

figure A.1

SPLIT SPOON SAMPLE SELECTION DETAILS
VANADIUM CORPORATION OF AMERICA SITE
Niagara Falls, NY

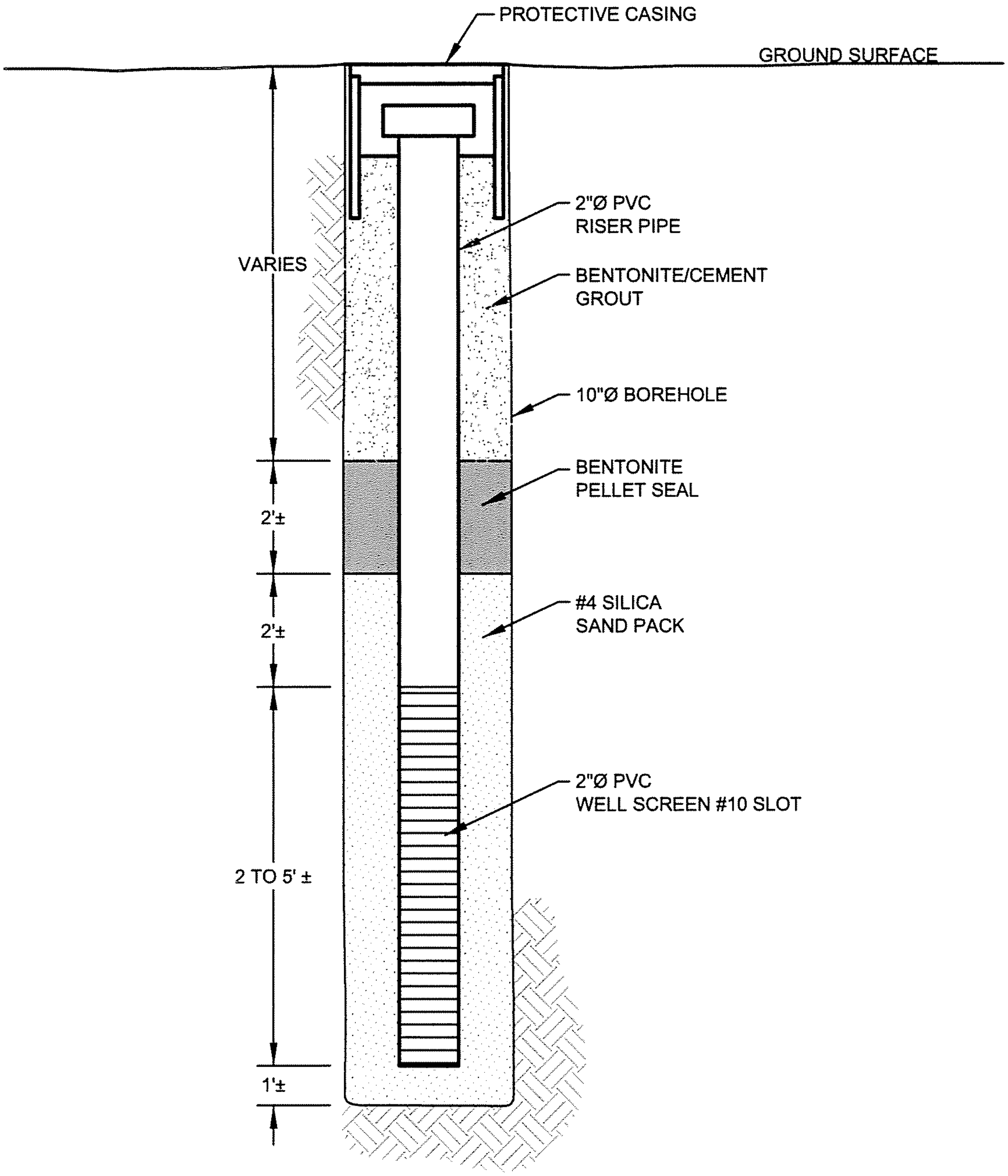


figure A.2

TYPICAL SHALLOW MONITORING WELL WITH FLUSH MOUNT
VANADIUM CORPORATION OF AMERICA SITE
Niagara Falls, NY

ATTACHMENT A-1

LOW-FLOW (MINIMUM DRAWDOWN) GROUNDWATER SAMPLING PROCEDURES
EPA/540/S-95/504, APRIL 1996

United States
Environmental Protection
Agency

Office of
Research and
Development

Office of Solid Waste
and Emergency
Response

EPA/540/S-95/504
April 1996

EPA Ground Water Issue

LOW-FLOW (MINIMAL DRAWDOWN) GROUND-WATER SAMPLING PROCEDURES

by Robert W. Puls[1] and Michael J. Barcelona[2]

Background

The Regional Superfund Ground Water Forum is a group of ground-water scientists, representing EPA's Regional Superfund Offices, organized to exchange information related to ground-water remediation at Superfund sites. One of the major concerns of the Forum is the sampling of ground water to support site assessment and remedial performance monitoring objectives. This paper is intended to provide background information on the development of low-flow sampling procedures and its application under a variety of hydrogeologic settings. It is hoped that the paper will support the production of standard operating procedures for use by EPA Regional personnel and other environmental professionals engaged in ground-water sampling.

For further information contact: Robert Puls, 405-436-8543, Subsurface Remediation and Protection Division, NRMRL, Ada, Oklahoma.

I. Introduction

The methods and objectives of ground-water sampling to assess water quality have evolved over time. Initially the emphasis was on the assessment of water quality of aquifers as sources of drinking water. Large water-bearing units were identified and sampled in keeping with that objective. These were highly productive aquifers that supplied drinking water via private wells or through public water supply systems. Gradually, with the increasing awareness of subsurface pollution of these water resources, the understanding of complex hydrogeochemical processes which govern the fate and transport of contaminants in the subsurface increased. This increase in understanding was also due to advances in a number of scientific disciplines and improvements in tools used for site characterization and ground-water sampling. Ground-water quality investigations where pollution was detected initially borrowed ideas, methods, and materials for site characterization from the water supply field and water analysis from public health practices. This included the materials and manner in which monitoring wells were installed and the way in which water was brought to the surface, treated, preserved and analyzed. The prevailing conceptual ideas included convenient generalizations of ground-water resources in terms of large and relatively homogeneous hydrologic *units.* With time it became apparent that conventional water supply generalizations of *homogeneity* did not adequately represent field data regarding pollution of these subsurface resources. The important role of *heterogeneity* became increasingly clear not only in geologic terms, but also in terms of complex physical,

---

[1] National Risk Management Research Laboratory, U.S. EPA
[2] University of Michigan

Superfund Technology Support Center for Ground Water

National Risk Management Research Laboratory
Subsurface Protection and Remediation Division
Robert S. Kerr Environmental Research Center
Ada, Oklahoma

Technology Innovation Office
Office of Solid Waste and Emergency
Response, US EPA, Washington, DC

Walter W. Kovalick, Jr., Ph.D.
Director

chemical and biological subsurface processes. With greater appreciation of the role of heterogeneity, it became evident that subsurface pollution was ubiquitous and encompassed the unsaturated zone to the deep subsurface and included unconsolidated sediments, fractured rock, and *aquitards* or low-yielding or impermeable formations. Small-scale processes and heterogeneities were shown to be important in identifying contaminant distributions and in controlling water and contaminant flow paths.

It is beyond the scope of this paper to summarize all the advances in the field of ground-water quality investigations and remediation, but two particular issues have bearing on ground-water sampling today: aquifer heterogeneity and colloidal transport. Aquifer heterogeneities affect contaminant flow paths and include variations in geology, geochemistry, hydrology and microbiology. As methods and the tools available for subsurface investigations have become increasingly sophisticated and understanding of the subsurface environment has advanced, there is an awareness that in most cases a primary concern for site investigations is characterization of contaminant flow paths rather than entire aquifers. In fact, in many cases, plume thickness can be less than well screen lengths (e.g., 3-6 m) typically installed at hazardous waste sites to detect and monitor plume movement over time. Small-scale differences have increasingly been shown to be important and there is a general trend toward smaller diameter wells and shorter screens.

The hydrogeochemical significance of colloidal-size particles in subsurface systems has been realized during the past several years (Gschwend and Reynolds, 1987; McCarthy and Zachara, 1989; Puls, 1990; Ryan and Gschwend, 1990). This realization resulted from both field and laboratory studies that showed faster contaminant migration over greater distances and at higher concentrations than flow and transport model predictions would suggest (Buddemeier and Hunt, 1988; Enfield and Bengtsson, 1988; Penrose et al., 1990). Such models typically account for interaction between the mobile aqueous and immobile solid phases, but do not allow for a mobile, reactive solid phase. It is recognition of this third *phase* as a possible means of contaminant transport that has brought increasing attention to the manner in which samples are collected and processed for analysis (Puls et al., 1990; McCarthy and Degueldre, 1993; Backhus et al., 1993; U. S. EPA, 1995). If such a phase is present in sufficient mass, possesses high sorption reactivity, large surface area, and remains stable in suspension, it can serve as an important mechanism to facilitate contaminant transport in many types of subsurface systems.

Colloids are particles that are sufficiently small so that the surface free energy of the particle dominates the bulk free energy. Typically, in ground water, this includes particles with diameters between 1 and 1000 nm. The most commonly observed mobile particles include: secondary clay minerals; hydrous iron, aluminum, and manganese oxides; dissolved and particulate organic materials, and viruses and bacteria. These reactive particles have been shown to be mobile under a variety of conditions in both field studies and laboratory column experiments, and as such need to be included in monitoring programs where identification of the *total* mobile contaminant loading (dissolved + naturally suspended particles) at a site is an objective. To that end, sampling methodologies must be used which do not artificially bias *naturally* suspended particle concentrations.

Currently the most common ground-water purging and sampling methodology is to purge a well using bailers or high speed pumps to remove 3 to 5 casing volumes followed by sample collection. This method can cause adverse impacts on sample quality through collection of samples with high levels of turbidity. This results in the inclusion of otherwise immobile artifactual particles which produce an overestimation of certain analytes of interest (e.g., metals or hydrophobic organic compounds). Numerous documented problems associated with filtration (Danielsson, 1982; Laxen and Chandler, 1982; Horowitz et al., 1992) make this an undesirable method of rectifying the turbidity problem, and include the removal of potentially mobile (contaminant-associated) particles during filtration, thus artificially biasing contaminant concentrations low. Sampling-induced turbidity problems can often be mitigated by using low-flow purging and sampling techniques.

Current subsurface conceptual models have undergone considerable refinement due to the recent development and increased use of field screening tools. So-called hydraulic *push* technologies (e.g., cone penetrometer, Geoprobe®, QED HydroPunch®) enable relatively fast screening site characterization which can then be used to design and install a monitoring well network. Indeed, alternatives to conventional monitoring wells are now being considered for some hydrogeologic settings. The ultimate design of any monitoring system should however be based upon adequate site characterization and be consistent with established monitoring objectives.

If the sampling program objectives include accurate assessment of the magnitude and extent of subsurface contamination over time and/or accurate assessment of subsequent remedial performance, then some information regarding plume delineation in three-dimensional space is necessary prior to monitoring well network design and installation. This can be accomplished with a variety of different tools and equipment ranging from hand-operated augers to screening tools mentioned above and large drilling rigs. Detailed information on ground-water flow velocity, direction, and horizontal and vertical variability are essential baseline data requirements. Detailed soil and geologic data are required prior to and during the installation of sampling points. This includes historical as well as detailed soil and geologic logs which accumulate during the site investigation. The use of borehole geophysical techniques is also recommended. With this information (together with other site characterization data) and a clear understanding of sampling objectives, then appropriate location, screen length, well diameter, slot size, etc. for the monitoring well network can be decided. This is especially critical for new in situ remedial approaches or natural attenuation assessments at hazardous waste sites.

In general, the overall goal of any ground-water sampling program is to collect water samples with no alteration in water chemistry; analytical data thus obtained may be used for a variety of specific monitoring programs depending on the regulatory requirements. The sampling methodology described in this paper assumes that the monitoring goal is to sample monitoring wells for the presence of contaminants and it is applicable whether mobile colloids are a concern or not and whether the analytes of concern are metals (and metalloids) or organic compounds.

II. Monitoring Objectives and Design Considerations

The following issues are important to consider prior to the design and implementation of any ground-water monitoring program, including those which anticipate using low-flow purging and sampling procedures.

A. Data Quality Objectives (DQOs)

Monitoring objectives include four main types: detection, assessment, corrective-action evaluation and resource evaluation, along with *hybrid* variations such as site-assessments for property transfers and water availability investigations. Monitoring objectives may change as contamination or water quality problems are discovered. However, there are a number of common components of monitoring programs which should be recognized as important regardless of initial objectives. These components include:

1) Development of a conceptual model that incorporates elements of the regional geology to the local geologic framework. The conceptual model development also includes initial site characterization efforts to identify hydrostratigraphic units and likely flow-paths using a minimum number of borings and well completions;

2) Cost-effective and well documented collection of high quality data utilizing simple, accurate, and reproducible techniques; and

3) Refinement of the conceptual model based on supplementary data collection and analysis.

These fundamental components serve many types of monitoring programs and provide a basis for future efforts that evolve in complexity and level of spatial detail as purposes and objectives expand. High quality, reproducible data collection is a common goal regardless of program objectives.

High quality data collection implies data of sufficient accuracy, precision, and completeness (i.e., ratio of valid analytical results to the minimum sample number called for by the program design) to meet the program objectives. Accuracy depends on the correct choice of monitoring tools and procedures to minimize sample and subsurface disturbance from collection to analysis. Precision depends on the repeatability of sampling and analytical protocols. It can be assured or improved by replication of sample analyses including blanks, field/lab standards and reference standards.

B. Sample Representativeness

An important goal of any monitoring program is collection of data that is truly representative of conditions at the site. The term *representativeness* applies to chemical and hydrogeologic data collected via wells, borings, piezometers, geophysical and soil gas measurements, lysimeters, and temporary sampling points. It involves a recognition of the statistical variability of individual subsurface physical properties, and contaminant or major ion concentration levels, while explaining extreme values. Subsurface temporal and spatial variability are facts. Good professional practice seeks to maximize representativeness by using proven accurate and reproducible techniques to define limits on the distribution of measurements collected at a site. However, measures of representativeness are dynamic and are controlled by evolving site characterization and monitoring objectives. An evolutionary site characterization model, as shown in Figure 1, provides a systematic approach to the goal of consistent data collection.

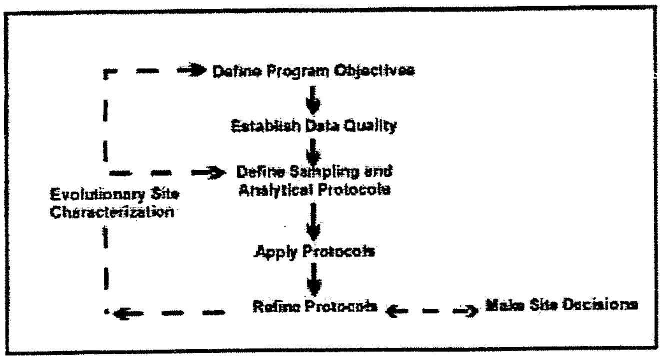


Figure 1. Evolutionary Site Characterization Model

The model emphasizes a recognition of the causes of the variability (e.g., use of inappropriate technology such as using bailers to purge wells; imprecise or operator-dependent methods) and the need to control avoidable errors.

1) Questions of Scale

A sampling plan designed to collect representative samples must take into account the potential scale of changes in site conditions through space and time as well as the chemical associations and behavior of the parameters that are targeted for investigation. In subsurface systems, physical (i.e., aquifer) and chemical properties over time or space are not statistically independent. In fact, samples taken in close proximity (i.e., within distances of a few meters) or within short time periods (i.e., more frequently than monthly) are highly auto-correlated. This means that designs employing high-sampling frequency (e.g., monthly) or dense spatial monitoring designs run the risk of redundant data collection and misleading inferences regarding trends in values that aren't statistically valid. In practice, contaminant detection and assessment monitoring programs rarely suffer these *over-sampling* concerns. In corrective-action evaluation programs, it is also possible that too little data may be collected over space or time. In these cases, false interpretation of the spatial extent of contamination or underestimation of temporal concentration variability may result.

2) Target Parameters

Parameter selection in monitoring program design is most often dictated by the regulatory status of the site. However, background water quality constituents, purging indicator parameters, and contaminants, all represent targets for data collection programs. The tools and procedures used in these programs should be equally rigorous and applicable to all categories of data, since all may be needed to determine or support regulatory action.

C. Sampling Point Design and Construction

Detailed site characterization is central to all decision-making purposes and the basis for this characterization resides in identification of the geologic framework and major hydro-stratigraphic units. Fundamental data for sample point location include: subsurface lithology, head-differences and background geochemical conditions. Each sampling point has a proper use or uses which should be documented at a level which is appropriate for the program's data quality objectives. Individual sampling points may not always be able to fulfill multiple monitoring objectives (e.g., detection, assessment, corrective action).

1) Compatibility with Monitoring Program and Data Quality Objectives

Specifics of sampling point location and design will be dictated by the complexity of subsurface lithology and variability in contaminant and/or geochemical conditions. It should be noted that, regardless of the ground-water sampling approach, few sampling points (e.g., wells, drive-points, screened augers) have zones of influence in excess of a few feet. Therefore, the spatial frequency of sampling points should be carefully selected and designed.

2) Flexibility of Sampling Point Design

In most cases *well-point* diameters in excess of 1 7/8 inches will permit the use of most types of submersible pumping devices for low-flow (minimal drawdown) sampling. It is suggested that *short* (e.g., less than 1.6 m) screens be incorporated into the monitoring design where possible so that comparable results from one device to another might be expected. *Short*, of course, is relative to the degree of vertical water quality variability expected at a site.

3) Equilibration of Sampling Point

Time should be allowed for equilibration of the well or sampling point with the formation after installation. Placement of well or sampling points in the subsurface produces some disturbance of ambient conditions. Drilling techniques (e.g., auger, rotary, etc.) are generally considered to cause more disturbance than *direct-push* technologies. In either case, there may be a period (i.e., days to months) during which water quality near the point may be distinctly different from that in the formation. Proper development of the sampling point and adjacent formation to remove fines created during emplacement will shorten this water quality *recovery* period.

III. Definition of Low-Flow Purging and Sampling

It is generally accepted that water in the well casing is non-representative of the formation water and needs to be purged prior to collection of ground-water samples. However, the water in the screened interval may indeed be representative of the formation, depending upon well construction and site hydrogeology. Wells are purged to some extent for the following reasons: the presence of the air interface at the top of the water column resulting in an oxygen concentration gradient with depth, loss of volatiles up the water column, leaching from or sorption to the casing or filter pack, chemical changes due to clay seals or backfill, and surface infiltration.

Low-flow purging, whether using portable or dedicated systems, should be done using pump-intake located in the middle or slightly above the middle of the screened interval. Placement of the pump too close to the bottom of the well will cause increased entrainment of solids which have collected in the well over time. These particles are present as a result of well development, prior purging and sampling events, and natural colloidal transport and deposition. Therefore, placement of the pump in the middle or toward the top of the screened interval is suggested. Placement of the pump at the top of the water column for sampling is only recommended in unconfined aquifers, screened across the water table, where this is the desired sampling point. Low-flow purging has the advantage of minimizing mixing between the overlying stagnant casing water and water within the screened interval.

A. Low-Flow Purging and Sampling

Low-flow refers to the velocity with which water enters the pump intake and that is imparted to the formation pore water in the immediate vicinity of the well screen. It does not necessarily refer to the flow rate of water discharged at the surface which can be affected by flow regulators or restrictions. Water level drawdown provides the best indication of the stress imparted by a given flow-rate for a given hydrological situation. The objective is to pump in a manner that minimizes stress (drawdown) to the system to the extent practical taking into account established site sampling objectives. Typically, flow rates on the order of 0.1 - 0.5 L/min are used, however this is dependent on site-specific hydrogeology. Some extremely coarse-textured formations have been successfully sampled in this manner at flow rates to 1 L/min. The effectiveness of using low-flow purging is intimately linked with proper screen location, screen length, and well construction and development techniques. The reestablishment of natural flow paths in both the vertical and horizontal directions is important for correct interpretation of the data. For high resolution sampling needs, screens less than 1 m should be used. Most of the need for purging has been found to be due to passing the sampling device through the overlying casing water which causes mixing of these stagnant waters and the dynamic waters within the screened interval. Additionally, there is disturbance to suspended sediment collected in the bottom of the casing and the displacement of water out into the formation immediately adjacent to the well screen. These disturbances and impacts can be avoided using dedicated sampling equipment, which precludes the need to insert the sampling device prior to purging and sampling.

Isolation of the screened interval water from the overlying stagnant casing water may be accomplished using low-flow minimal drawdown techniques. If the pump intake is located within the screened interval, most of the water pumped will be drawn in directly from the formation with little mixing of casing water or disturbance to the sampling zone. However, if the wells are not constructed and developed properly, zones other than those intended may be sampled. At some sites where geologic heterogeneities are sufficiently different within the screened interval, higher conductivity zones may be preferentially sampled. This is another reason to use shorter screened intervals, especially where high spatial resolution is a sampling objective.

B. Water Quality Indicator Parameters

It is recommended that water quality indicator parameters be used to determine purging needs prior to sample collection in each well. Stabilization of parameters such as pH, specific conductance, dissolved oxygen, oxidation-reduction potential, temperature and turbidity should be used to determine when formation water is accessed during purging. In general, the order of stabilization is pH, temperature, and specific conductance, followed by oxidation-reduction potential, dissolved oxygen and turbidity. Temperature and pH, while commonly used as purging indicators, are actually quite insensitive in distinguishing between formation water and stagnant casing water; nevertheless, these are important parameters for data interpretation purposes and should also be measured. Performance criteria for determination of stabilization should be based on water-level drawdown, pumping rate and equipment specifications for measuring indicator parameters. Instruments are available which utilize in-line flow cells to continuously measure the above parameters.

It is important to establish specific well stabilization criteria and then consistently follow the same methods thereafter, particularly with respect to drawdown, flow rate and sampling device. Generally, the time or purge volume required for parameter stabilization is independent of well depth or well volumes. Dependent variables are well diameter, sampling device, hydrogeochemistry, pump flow rate, and whether the devices are used in a portable or dedicated manner. If the sampling device is already in place (i.e., dedicated sampling systems), then the time and purge volume needed for stabilization is much shorter. Other advantages of dedicated equipment include less purge water for waste disposal, much less decontamination of equipment, less time spent in preparation of sampling as well as time in the field, and more consistency in the sampling approach which probably will translate into less variability in sampling results. The use of dedicated equipment is strongly recommended at wells which will undergo routine sampling over time.

If parameter stabilization criteria are too stringent, then minor oscillations in indicator parameters may cause purging operations to become unnecessarily protracted. It should also be noted that turbidity is a very conservative parameter in terms of stabilization. Turbidity is always the last parameter to stabilize. Excessive purge times are invariably related to the establishment of too stringent turbidity stabilization criteria. It should be noted that natural turbidity levels in ground water may exceed 10 nephelometric turbidity units (NTU).

C. Advantages and Disadvantages of Low-Flow (Minimum Drawdown) Purging

In general, the advantages of low-flow purging include:

- samples which are representative of the *mobile* load of contaminants present (dissolved and colloid-associated);
- minimal disturbance of the sampling point thereby minimizing sampling artifacts;
- less operator variability, greater operator control;

- reduced stress on the formation (minimal drawdown);
- less mixing of stagnant casing water with formation water;
- reduced need for filtration and, therefore, less time required for sampling;
- smaller purging volume which decreases waste disposal costs and sampling time;
- better sample consistency; reduced artificial sample variability.

Some disadvantages of low-flow purging are:

- higher initial capital costs,
- greater set-up time in the field,
- need to transport additional equipment to and from the site,
- increased training needs,
- resistance to change on the part of sampling practitioners,
- concern that new data will indicate a *change in conditions* and trigger an *action*.

IV. Low-Flow (Minimal Drawdown) Sampling Protocols

The following ground-water sampling procedure has evolved over many years of experience in ground-water sampling for organic and inorganic compound determinations and as such summarizes the authors' (and others) experiences to date (Barcelona et al., 1984, 1994; Barcelona and Helfrich, 1986; Puls and Barcelona, 1989; Puls et. al. 1990, 1992; Puls and Powell, 1992; Puls and Paul, 1995). High-quality chemical data collection is essential in ground-water monitoring and site characterization. The primary limitations to the collection of *representative* ground-water samples include: mixing of the stagnant casing and *fresh* screen waters during insertion of the sampling device or ground-water level measurement device; disturbance and resuspension of settled solids at the bottom of the well when using high pumping rates or raising and lowering a pump or bailer; introduction of atmospheric gases or degassing from the water during sample handling and transfer, or inappropriate use of vacuum sampling device, etc.

A. *Sampling Recommendations*

Water samples should not be taken immediately following well development. Sufficient time should be allowed for the ground-water flow regime in the vicinity of the monitoring well to stabilize and to approach chemical equilibrium with the well construction materials. This lag time will depend on site conditions and methods of installation but often exceeds one week.

Well purging is nearly always necessary to obtain samples of water flowing through the geologic formations in the screened interval. Rather than using a general but arbitrary guideline of purging three casing volumes prior to sampling, it is recommended that an in-line water quality measurement device (e.g., flow-through cell) be used to establish the stabilization time for several parameters (e.g. , pH, specific conductance, redox, dissolved oxygen, turbidity) on a well-specific basis. Data on pumping rate, drawdown, and volume required for parameter stabilization can be used as a guide for conducting subsequent sampling activities.

The following are recommendations to be considered before, during and after sampling:

- use low-flow rates (<0.5 L/min), during both purging and sampling to maintain minimal drawdown in the well;
- maximize tubing wall thickness, minimize tubing length;
- place the sampling device intake at the desired sampling point;
- minimize disturbances of the stagnant water column above the screened interval during water level measurement and sampling device insertion;
- make proper adjustments to stabilize the flow rate as soon as possible;
- monitor water quality indicators during purging;
- collect unfiltered samples to estimate contaminant loading and transport potential in the subsurface system.

B. *Equipment Calibration*

Prior to sampling, all sampling device and monitoring equipment should be calibrated according to manufacturer's recommendations and the site Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP). Calibration of pH should be performed with at least two buffers which bracket the expected range. Dissolved oxygen calibration must be corrected for local barometric pressure readings and elevation.

C. *Water Level Measurement and Monitoring*

It is recommended that a device be used which will least disturb the water surface in the casing. Well depth should be obtained from the well logs. Measuring to the bottom of the well casing will only cause resuspension of settled solids from the formation and require longer purging times for turbidity equilibration. Measure well depth after sampling is completed. The water level measurement should be taken from a permanent reference point which is surveyed relative to ground elevation.

D. *Pump Type*

The use of low-flow (e.g., 0.1-0.5 L/min) pumps is suggested for purging and sampling all types of analytes. All pumps have some limitation and these should be investigated with respect to application at a particular site. Bailers are inappropriate devices for low-flow sampling.

1) General Considerations

There are no unusual requirements for ground-water sampling devices when using low-flow, minimal drawdown techniques. The major concern is that the device give consistent results and minimal disturbance of the sample across a range of *low* flow rates (i.e., < 0.5 L/min). Clearly, pumping rates that cause minimal to no drawdown in one well could easily cause *significant* drawdown in another well finished in a less transmissive formation. In this sense, the pump should not cause undue pressure or temperature changes or physical disturbance on the water sample over a reasonable sampling range. Consistency in operation is critical to meet accuracy and precision goals.

2) Advantages and Disadvantages of Sampling Devices

A variety of sampling devices are available for low-flow (minimal drawdown) purging and sampling and include peristaltic pumps, bladder pumps, electrical submersible pumps, and gas-driven pumps. Devices which lend themselves to both dedication and consistent operation at definable low-flow rates are preferred. It is desirable that the pump be easily adjustable and operate reliably at these lower flow rates. The peristaltic pump is limited to shallow applications and can cause degassing resulting in alteration of pH, alkalinity, and some volatiles loss. Gas-driven pumps should be of a type that does not allow the gas to be in direct contact with the sampled fluid.

Clearly, bailers and other *grab* type samplers are ill-suited for low-flow sampling since they will cause repeated disturbance and mixing of *stagnant* water in the casing and the *dynamic* water in the screened interval. Similarly, the use of inertial lift foot-valve type samplers may cause too much disturbance at the point of sampling. Use of these devices also tends to introduce uncontrolled and unacceptable operator variability.

Summaries of advantages and disadvantages of various sampling devices are listed in Herzog et al. (1991), U. S. EPA (1992), Parker (1994) and Thurnblad (1994).

E. Pump Installation

Dedicated sampling devices (left in the well) capable of pumping and sampling are preferred over <u>any</u> other type of device. Any portable sampling device should be slowly and carefully lowered to the middle of the screened interval or slightly above the middle (e.g., 1-1.5 m below the top of a 3 m screen). This is to minimize excessive mixing of the stagnant water in the casing above the screen with the screened interval zone water, and to minimize resuspension of solids which will have collected at the bottom of the well. These two disturbance effects have been shown to directly affect the time required for purging. There also appears to be a direct correlation between size of portable sampling devices relative to the well bore and resulting purge volumes and times. The key is to minimize disturbance of water and solids in the well casing.

F. Filtration

Decisions to filter samples should be dictated by sampling objectives rather than as a *fix* for poor sampling practices, and field-filtering of certain constituents should not be the default. Consideration should be given as to what the application of field-filtration is trying to accomplish. For assessment of truly dissolved (as opposed to operationally *dissolved* [i.e., samples filtered with 0.45 µm filters]) concentrations of major ions and trace metals, 0.1 µm filters are recommended although 0.45 µm filters are normally used for most regulatory programs. Alkalinity samples must also be filtered if significant particulate calcium carbonate is suspected, since this material is likely to impact alkalinity titration results (although filtration itself may alter the CO_2 composition of the sample and, therefore, affect the results).

Although filtration may be appropriate, filtration of a sample may cause a number of unintended changes to occur (e.g. oxidation, aeration) possibly leading to filtration-induced artifacts during sample analysis and uncertainty in the results. Some of these unintended changes may be unavoidable but the factors leading to them must be recognized. Deleterious effects can be minimized by consistent application of certain filtration guidelines. Guidelines should address selection of filter type, media, pore size, etc. in order to identify and minimize potential sources of uncertainty when filtering samples.

In-line filtration is recommended because it provides better consistency through less sample handling, and minimizes sample exposure to the atmosphere. In-line filters are available in both disposable (barrel filters) and non-disposable (in-line filter holder, flat membrane filters) formats and various filter pore sizes (0.1-5.0 µm). Disposable filter cartridges have the advantage of greater sediment handling capacity when compared to traditional membrane filters. Filters must be pre-rinsed following manufacturer's recommendations. If there are no recommendations for rinsing, pass through a minimum of 1 L of ground water following purging and prior to sampling. Once filtration has begun, a filter cake may develop as particles larger than the pore size accumulate on the filter membrane. The result is that the effective pore diameter of the membrane is reduced and particles smaller than the stated pore size are excluded from the filtrate. Possible corrective measures include prefiltering (with larger pore size filters), minimizing particle loads to begin with, and reducing sample volume.

G. Monitoring of Water Level and Water Quality Indicator Parameters

Check water level periodically to monitor drawdown in the well as a guide to flow rate adjustment. The goal is minimal drawdown (<0.1 m) during purging. This goal may be difficult to achieve under some circumstances due to geologic heterogeneities within the screened interval, and may require adjustment based on site-specific conditions and personal experience. In-line water quality indicator parameters should be continuously monitored during purging. The water quality indicator parameters monitored can include pH, redox potential, conductivity, dissolved oxygen (DO) and turbidity. The last three parameters are often most sensitive. Pumping rate, drawdown, and the time or volume required to obtain stabilization of parameter readings can be used as a future guide to purge the well. Measurements should be taken every three to five minutes if the above suggested rates are used. Stabilization is achieved after all parameters have stabilized for three successive readings. In lieu of measuring all five parameters, a minimum subset would include pH, conductivity, and turbidity or DO. Three successive readings should be within ± 0.1 for pH, ± 3% for conductivity, ± 10 mv for redox potential, and ± 10% for turbidity and DO. Stabilized purge indicator parameter trends are generally obvious and follow either an exponential or asymptotic change to stable values during purging. Dissolved oxygen and turbidity usually require the longest time for stabilization. The above stabilization guidelines are provided for rough estimates based on experience.

H. Sampling, Sample Containers, Preservation and Decontamination

Upon parameter stabilization, sampling can be initiated. If an in-line device is used to monitor water quality parameters, it should be disconnected or bypassed during sample collection. Sampling flow rate may remain at established purge rate or may be adjusted slightly to minimize aeration, bubble formation, turbulent filling of sample bottles, or loss of volatiles due to extended residence time in tubing. Typically, flow rates less than 0.5 L/min are appropriate. The same device should be used for sampling as was used for purging. Sampling should occur in a progression from least to most contaminated well, if this is known. Generally, volatile (e.g., solvents and fuel constituents) and gas sensitive (e.g., Fe^{2+}, CH_4, H_2S/HS^-, alkalinity) parameters should be sampled first. The sequence in which samples for most inorganic parameters are collected is immaterial unless filtered (dissolved) samples are desired. Filtering should be done last and in-line filters should be used as discussed above. During both well purging and sampling, proper protective clothing and equipment must be used based upon the type and level of contaminants present.

The appropriate sample container will be prepared in advance of actual sample collection for the analytes of interest and include sample preservative where necessary. Water samples should be collected directly into this container from the pump tubing.

Immediately after a sample bottle has been filled, it must be preserved as specified in the site (QAPP). Sample preservation requirements are based on the analyses being performed (use site QAPP, FSP, RCRA guidance document [U. S. EPA, 1992] or EPA SW-846 [U. S. EPA, 1982]). It may be advisable to add preservatives to sample bottles in a controlled setting prior to entering the field in order to reduce the chances of improperly preserving sample bottles or introducing field contaminants into a sample bottle while adding the preservatives.

The preservatives should be transferred from the chemical bottle to the sample container using a disposable polyethylene pipet and the disposable pipet should be used only once and then discarded.

After a sample container has been filled with ground water, a Teflon™ (or tin)-lined cap is screwed on tightly to prevent the container from leaking. A sample label is filled out as specified in the FSP. The samples should be stored inverted at 4°C.

Specific decontamination protocols for sampling devices are dependent to some extent on the type of device used and the type of contaminants encountered. Refer to the site QAPP and FSP for specific requirements.

I. Blanks

The following blanks should be collected:

(1) field blank: one field blank should be collected from each source water (distilled/deionized water) used for sampling equipment decontamination or for assisting well development procedures.

(2) equipment blank: one equipment blank should be taken prior to the commencement of field work, from each set of sampling equipment to be used for that day. Refer to site QAPP or FSP for specific requirements.

(3) trip blank: a trip blank is required to accompany each volatile sample shipment. These blanks are prepared in the laboratory by filling a 40-mL volatile organic analysis (VOA) bottle with distilled/deionized water.

V. Low-Permeability Formations and Fractured Rock

The overall sampling program goals or sampling objectives will drive how the sampling points are located, installed, and choice of sampling device. Likewise, site-specific hydrogeologic factors will affect these decisions. Sites with very low permeability formations or fractures causing discrete flow channels may require a unique monitoring approach. Unlike water supply wells, wells installed for ground-water quality assessment and restoration programs are often installed in low water-yielding settings (e.g., clays, silts). Alternative types of sampling points and sampling methods are often needed in these types of environments, because low-permeability settings may require extremely low-flow purging (<0.1 L/min) and may be technology-limited. Where devices are not readily available to pump at such low flow rates, the primary consideration is to avoid dewatering of the well screen. This may require repeated recovery of the water during purging while leaving the pump in place within the well screen.

Use of low-flow techniques may be impractical in these settings, depending upon the water recharge rates. The sampler and the end-user of data collected from such wells need to understand the limitations of the data collected; i.e., a strong potential for underestimation of actual contaminant concentrations for volatile organics, potential false negatives for filtered metals and potential false positives for unfiltered metals. It is suggested that comparisons be made between samples recovered using low-flow purging techniques and samples recovered using passive sampling techniques (i.e., two sets of samples). Passive sample collection would essentially entail acquisition of the sample with no or very little purging using a dedicated sampling system installed within the screened interval or a passive sample collection device.

A. Low-Permeability Formations (<0.1 L/min recharge)

1. Low-Flow Purging and Sampling with Pumps

a. "portable or non-dedicated mode" - Lower the pump (one capable of pumping at <0.1 L/min) to mid-screen or slightly above and set in place for minimum of 48 hours (to lessen purge volume requirements). After 48 hours, use procedures listed in Part IV above regarding monitoring water quality parameters for stabilization, etc., but do not dewater the screen. If excessive drawdown and slow recovery is a problem, then alternate approaches such as those listed below may be better.

b. "dedicated mode" - Set the pump as above at least a week prior to sampling; that is, operate in a dedicated pump mode. With this approach significant reductions in purge volume should be realized. Water quality parameters should stabilize quite rapidly due to less disturbance of the sampling zone.

2. Passive Sample Collection

Passive sampling collection requires insertion of the device into the screened interval for a sufficient time period to allow flow and sample equilibration before extraction for analysis. Conceptually, the extraction of water from low yielding formations seems more akin to the collection of water from the unsaturated zone and passive sampling techniques may be more appropriate in terms of obtaining "representative" samples. Satisfying usual sample volume requirements is typically a problem with this approach and some latitude will be needed on the part of regulatory entities to achieve sampling objectives.

B. Fractured Rock

In fractured rock formations, a low-flow to zero purging approach using pumps in conjunction with packers to isolate the sampling zone in the borehole is suggested. Passive multi-layer sampling devices may also provide the most "representative" samples. It is imperative in these settings to identify flow paths or water-producing fractures prior to sampling using tools such as borehole flowmeters and/or other geophysical tools.

After identification of water-bearing fractures, install packer(s) and pump assembly for sample collection using low-flow sampling in "dedicated mode" or use a passive sampling device which can isolate the identified water-bearing fractures.

VI. Documentation

The usual practices for documenting the sampling event should be used for low-flow purging and sampling techniques. This should include, at a minimum: information on the conduct of purging operations (flow-rate, drawdown, water-quality parameter values, volumes extracted and times for measurements), field instrument calibration data, water sampling forms and chain of custody forms. See Figures 2 and 3 and "Ground Water Sampling Workshop -- A Workshop Summary" (U. S. EPA, 1995) for example forms and other documentation suggestions and information. This information coupled with laboratory analytical data and validation data are needed to judge the "useability" of the sampling data.

VII. Notice

The U.S. Environmental Protection Agency through its Office of Research and Development funded and managed the research described herein as part of its in-house research program and under Contract No. 68-C4-0031 to Dynamac Corporation. It has been subjected to the Agency's peer and administrative review and has been approved for publication as an EPA document. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

VIII. References

Backhus, D,A., J.N. Ryan, D.M. Groher, J.K. McFarlane, and P.M. Gschwend. 1993. Sampling Colloids and Colloid-Associated Contaminants in Ground Water. *Ground Water*, 31(3):466-479.

Barcelona, M.J., J.A. Helfrich, E.E. Garske, and J.P. Gibb. 1984. A laboratory evaluation of groundwater sampling mechanisms. *Ground Water Monitoring Review*, 4(2):32-41.

Barcelona, M.J. and J.A. Helfrich. 1986. Well construction and purging effects on ground-water samples. *Environ. Sci. Technol.*, 20(11):1179-1184.

Barcelona, M.J., H.A. Wehrmann, and M.D. Varljen. 1994. Reproducible well purging procedures and VOC stabilization criteria for ground-water sampling. *Ground Water*, 32(1):12-22.

Buddemeier, R.W. and J.R. Hunt. 1988. Transport of Colloidal Contaminants in Ground Water: Radionuclide Migration at the Nevada Test Site. *Applied Geochemistry*, 3: 535-548.

Danielsson, L.G. 1982. On the Use of Filters for Distinguishing Between Dissolved and Particulate Fractions in Natural Waters. *Water Research*, 16:179.

Enfield, C.G. and G. Bengtsson. 1988. Macromolecular Transport of Hydrophobic Contaminants in Aqueous Environments. *Ground Water*, 26(1): 64-70.

Gschwend, P.M. and M.D. Reynolds. 1987. Monodisperse Ferrous Phosphate Colloids in an Anoxic Groundwater Plume, *J. of Contaminant Hydrol.*, 1: 309-327.

Herzog, B., J. Pennino, and G. Nielsen. 1991. Ground-Water Sampling. In **Practical Handbook of Ground-Water Monitoring** (D.M. Nielsen, ed.). Lewis Publ., Chelsea, MI, pp. 449-499.

Horowitz, A.J., K.A. Elrick, and M.R. Colberg. 1992. The effect of membrane filtration artifacts on dissolved trace element concentrations. *Water Res.*, 26(6):753-763.

Laxen, D.P.H. and I.M. Chandler. 1982. Comparison of Filtration Techniques for Size Distribution in Freshwaters. *Analytical Chemistry*, 54(8):1350.

McCarthy, J.F. and J.M. Zachara. 1989. Subsurface Transport of Contaminants, *Environ. Sci. Technol.*, 5(23):496-502.

McCarthy, J.F. and C. Degueldre. 1993. Sampling and Characterization of Colloids and Ground Water for Studying Their Role in Contaminant Transport. In: Environmental Particles (J. Buffle and H.P. van Leeuwen, eds.), Lewis Publ., Chelsea, MI, pp. 247-315.

Parker, L.V. 1994. The Effects of Ground Water Sampling Devices on Water Quality: A Literature Review. *Ground Water Monitoring and Remediation*, 14(2):130-141.

Penrose, W.R., W.L. Polzer, E.H. Essington, D.M. Nelson, and K.A. Orlandini. 1990. Mobility of Plutonium and Americium through a Shallow Aquifer in a Semiarid Region, *Environ. Sci. Technol.*, 24:228-234.

Puls, R.W. and M.J. Barcelona. 1989. Filtration of Ground Water Samples for Metals Analyses. *Hazardous Waste and Hazardous Materials*, 6(4):385-393.

Puls, R.W., J.H. Eychaner, and R.M. Powell. 1990. Colloidal-Facilitated Transport of Inorganic Contaminants in Ground Water: Part I. Sampling Considerations. EPA/600/M-90/023, NTIS PB 91-168419.

Puls, R.W. 1990. Colloidal Considerations in Groundwater Sampling and Contaminant Transport Predictions. *Nuclear Safety*, 31(1):58-65.

Puls, R.W. and R.M. Powell. 1992. Acquisition of Representative Ground Water Quality Samples for Metals. *Ground Water Monitoring Review*, 12(3):167-176.

Puls, R.W., D.A. Clark, B.Bledsoe, R.M. Powell, and C.J. Paul. 1992. Metals in Ground Water: Sampling Artifacts and Reproducibility. *Hazardous Waste and Hazardous Materials*, 9(2): 149-162.

Puls, R.W. and C.J. Paul. 1995. Low-Flow Purging and Sampling of Ground-Water Monitoring Wells with Dedicated Systems. *Ground Water Monitoring and Remediation*, 15(1):116-123.

Ryan, J.N. and P.M. Gschwend. 1990. Colloid Mobilization in Two Atlantic Coastal Plain Aquifers. *Water Resour. Res.*, 26: 307-322.

Thurnblad, T. 1994. Ground Water Sampling Guidance: Development of Sampling Plans, Sampling Protocols, and Sampling Reports. Minnesota Pollution Control Agency.

U. S. EPA. 1992. RCRA Ground-Water Monitoring: Draft Technical Guidance. Office of Solid Waste, Washington, DC EPA/530/R-93/001, NTIS PB 93-139350.

U. S. EPA. 1995. Ground Water Sampling Workshop – A Workshop Summary, Dallas, TX, November 30 - December 2, 1993. EPA/600/R-94/205, NTIS PB 95-193249, 126 pp.

U. S. EPA. 1982. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA SW-846. Office of Solid Waste and Emergency Response, Washington, D.C.

Figure 2. **Ground Water Sampling Log**

Project ______________ **Site** ______________ **Well No.** ____________ **Date** ________________________

Well Depth ___________ **Screen Length** _________ **Well Diameter** ________ **Casing Type** ___________

Sampling Device ______________ **Tubing type** ____________________ **Water Level** _________________

Measuring Point __________________ **Other Infor** ____

____

Sampling Personnel ____

Time	pH	Temp	Cond.	Dis.O_2	Turb.	[ ]Conc			Notes

Type of Samples Collected

____

Information: 2 in = 617 ml/ft, 4 in = 2470 ml/ft: $Vol_{cyl} = \pi r^2 h$, $Vol_{sphere} = 4/3\pi r^3$

Figure 3. **Ground Water Sampling Log** (with automatic data logging for most water quality parameters)

Project ______________ **Site** ______________ **Well No.** ____________ **Date** ____________________
Well Depth ____________ **Screen Length** __________ **Well Diameter** ________ **Casing Type** ____________
Sampling Device _______________ **Tubing type** ____________________ **Water Level** ________________
Measuring Point ___________________ **Other Infor** ____
____
Sampling Personnel ____

Time	Pump Rate	Turbidity	Alkalinity	[ ] Conc	Notes

Type of Samples Collected

____

Information: 2 in = 617 ml/ft, 4 in = 2470 ml/ft: $Vol_{cyl} = \pi r^2 h$, $Vol_{sphere} = 4/3\pi\ r^3$

ATTACHMENT A-2

FIELD FORMS

TEST PIT STRATIGRAPHY LOG

Page ___ of ___

Project Name:	**Contractor:**	**Test Pit Designation:**
Project Number:		**Date Started:**
Client:	**Surface Elevation:**	**Date Completed:**
Location:	**Test Pit Method:**	**CRA Supervisor:**

Depth (m/ft)			*Soil Symbol, Primary Component, Secondary Components, Relative Density/Consistency, Grain Size/Plasticity, Gradation/Structure, Colour, Moisture Content, Supplementary Descriptors*	*Sample No.*	*Sample Interval*	*PID*	*Location:*
From	*At*	*To*					*Geologic Profile*

Completed by: ______________________

Date: ______________________

CRA

CRA 1001 (29) Rev. 5, September 13, 1999, Form SP-03

STRATIGRAPHY LOG (OVERBURDEN)

PAGE ____ OF ____

PROJECT NAME ____________________
PROJECT NUMBER ____________________
CLIENT ____________________
LOCATION ____________________

DRILLING CONTRACTOR ____________________
DRILLER ____________________
SURFACE ELEVATION ____________________
WEATHER (A.M.) ____________________
(P.M.) ____________________

HOLE DESIGNATION ____________________
DATE/TIME STARTED ____________________
DATE/TIME COMPLETED ____________________
DRILLING METHOD ____________________
CRA SUPERVISOR ____________________

STRATIGRAPHIC INTERVALS (DEPTHS IN ft/m BGS			SAMPLE DESCRIPTION	SAMPLE DETAILS							PID / FID (ppm)	CHEMICAL ANALYSIS	GRAIN SIZE
FROM	AT	TO	ORDER OF DESCRIPTORS: SOIL TYPE SYMBOL(S) – MAIN COMPONENT(S), (NATURE OF DEPOSIT), SECONDARY COMPONENTS, RELATIVE DENSITY/CONSISTENCY, GRAIN SIZE/PLASTICITY, GRADATION/STRUCTURE, COLOUR, MOISTURE CONTENT, SUPPLEMENTARY DESCRIPTORS NOTE: PLASTICITY DETERMINATION REQUIRES THE ADDITION OF MOISTURE IF THE SAMPLE IS TOO DRY TO ROLL (INDICATE IF MOISTURE WAS ADDED OR NOT).	SAMPLE #	SAMPLING METHOD	PENETRATION RECORD SPLIT SPOON BLOWS (RECORD N-VALUES & RECOVERIES)				SAMPLE INTERVAL			
						6"	6"	6"	6"				

NOTES AND COMMENTS

DEPTH OF BOREHOLE CAVING __________ DEPTH OF FIRST GROUNDWATER ENCOUNTER __________ TOPSOIL THICKNESS __________
WATER LEVEL IN OPEN BOREHOLE ON COMPLETION __________, AFTER _____ HOURS _____
COMPLETION DETAILS: ____________________

NOTE: FOR EACH SPLIT-SPOON SAMPLE, RECORD BLOW COUNTS, N-VALUE, SAMPLE RECOVERY LENGTH, AND SAMPLE INTERVAL.

CRA

010[illegible]-00(029)GN-WA023 SEP 13/99 (SP-17) REVISION 3

OVERBURDEN INSTRUMENTATION LOG

PROJECT NAME ____________________

PROJECT NUMBER ________________

CLIENT ___________________________

LOCATION _________________________

HOLE DESIGNATION _______________________

DATE COMPLETED _________________________

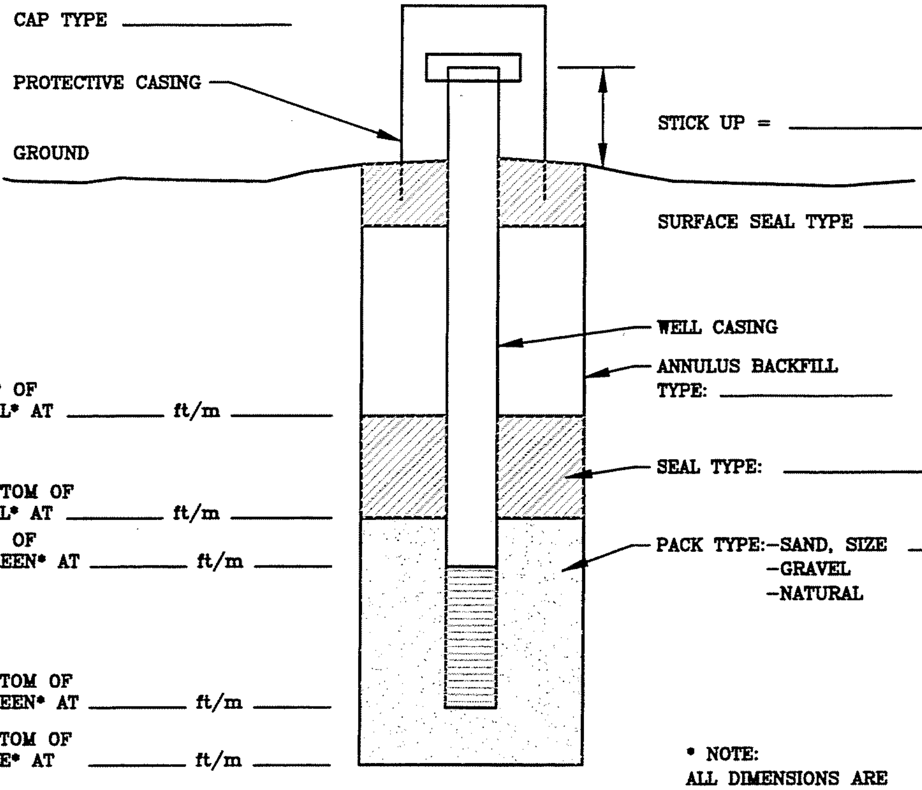
DRILLING METHOD ________________________

CRA SUPERVISOR _________________________

CAP TYPE ______________

PROTECTIVE CASING

GROUND



STICK UP = ____________ ft/m

SURFACE SEAL TYPE ______________

WELL CASING

ANNULUS BACKFILL TYPE: ______________

TOP OF SEAL* AT ________ ft/m ________

SEAL TYPE: ______________

BOTTOM OF SEAL* AT ________ ft/m ________

TOP OF SCREEN* AT ________ ft/m ________

PACK TYPE:
-SAND, SIZE ______________
-GRAVEL
-NATURAL

BOTTOM OF SCREEN* AT ________ ft/m ________

BOTTOM OF HOLE* AT ________ ft/m ________

* NOTE:
ALL DIMENSIONS ARE
BELOW GROUND SURFACE (BGS)

SCREEN TYPE: ☐ continuous slot ☐ perforated ☐ louvre ☐ other: ______________

SCREEN MATERIAL: ☐ stainless steel ☐ plastic ☐ other: ______________

SCREEN LENGTH: __________ ft/m SCREEN DIAMETER: __________ in/cm SCREEN SLOT SIZE: __________

WELL CASING MATERIAL: ______________ WELL CASING DIAMETER: ______________ in/cm

HOLE DIAMETER: ______________

DEVELOPMENT: METHOD: ______________ DURATION: ______________

CRA

WELL DEVELOPMENT AND STABILIZATION FORM

PROJECT NAME: ____________________ PROJECT NO.: __________

DATE OF WELL DEVELOPMENT: ____________________

DEVELOPMENT CREW MEMBERS: ____________________

PURGING METHOD: ____________________

SAMPLE NO.: ____________________

SAMPLE TIME: ____________________

WELL INFORMATION

WELL NUMBER: ____________________

WELL TYPE (diameter/material) ____________________

MEASURING POINT ELEVATION: ____________________

STATIC WATER DEPTH: ____________________ ELEVATION: __________

BOTTOM DEPTH: ____________________ ELEVATION: __________

WATER COLUMN LENGTH: ____________________

SCREENED INTERVAL: ____________________

WELL VOLUME: ____________________

Note: For 2-inch diameter well: 1 foot = 0.14 gallons (imp) or 0.16 gallons (us)
1 meter = 2 liters

	UNITS	1	2	3	4	5	*TOTAL/ AVERAGE*
VOLUME PURGED (volume/total volume):							
FIELD pH:							
FIELD TEMPERATURE:							
FIELD CONDUCTIVITY:							
CLARITY/TURBIDITY VALUES:							
COLOR:							
ODOR:							
COMMENTS:							

COPIES TO: ____

MONITORING WELL RECORD FOR LOW-FLOW PURGING

Project Data:

Project Name: ______________________
Ref. No.: ______________________

Date: ______________________
Personnel: ______________________
____

Monitoring Well Data:

Well No.: ______________________
Measurement Point: ______________________
Constructed Well Depth (ft): ______________________
Measured Well Depth (ft): ______________________
Depth of Sediment (ft): ______________________

Screen Length (ft): ______________________
Depth to Pump Intake (ft)[1]: ______________________
Well Diameter, D (in): ______________________
Well Screen Volume, V_s (mL)[2]: ______________________
Initial Depth to Water (ft): ______________________

Time	*Pumping Rate (mL/min)*	*Depth to Water (ft)*	*Drawdown from Initial Water Level*[3] *(ft)*	*pH*	*Temperature °C*	*Conductivity (mS/cm)*	*ORP (mV)*	*DO (mg/L)*	*Turbidity (NTU)*	*Volume Purged, V_p (mL)*	*No. of Well Screen Volumes Purged*[4]

Notes:

(1) The pump intake will be placed at the well screen mid-point or at a minimum of 2 ft above any sediment accumulated at the well bottom.

(2) The well screen volume will be based on a 5-foot screen length, $V_s=p*(D/2)^2*(5*12)*(2.54)^3$

(3) The drawdown from the initial water level should not exceed 0.3 ft.

(4) Purging will continue until stabilization is achieved or until 20 well screen volumes have been purged (unless purge water remains visually turbid and appears to be clearing, or unless stabilization parameters are varying slightly outside of the stablization criteria and appear to be stablizing), No. of Well Screen Volumes Purged= Vp/Vs.

SAMPLE COLLECTION DATA SHEET - GROUNDWATER SAMPLING PROGRAM

PROJECT NAME ______________________ PROJECT NO. ______________

SAMPLING CREW MEMBERS ______________________ SUPERVISOR ______________

DATE OF SAMPLE COLLECTION ______________________

[Note: For 2" dia. well, 1 ft. = 0.14 gal (imp) or 0.16 gal (us)]

Sample I.D. Number	Well Number	Measuring Point Elev. (ft. AMSL)	Bottom Depth (ft. btoc)	Water Depth (ft. btoc)	Water Elevation (ft. AMSL)	Well Volume (gallons)	Bailer Volume No. Bails	Volume Purged (gallons)	Field pH	Field Temp.	Field Cond.	Time	Sample Description & Analysis

Additional Comments: ______________________

Copies to: ______________________

CRA

APPENDIX B

QUALITY ASSURANCE PROJECT PLAN

TABLE OF CONTENTS

Page

1.0 INTRODUCTION B-1

2.0 PROJECT BACKGROUND B-2
  2.1 GENERAL B-2

3.0 PROJECT ORGANIZATION AND RESPONSIBILITY B-3

4.0 PROJECT OBJECTIVES B-6
  4.1 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA B-6
  4.2 LABORATORY QUALITY ASSURANCE B-6
  4.2.1 ACCURACY, PRECISION, AND SENSITIVITY OF ANALYSES B-6
  4.2.2 COMPLETENESS, REPRESENTATIVENESS, AND COMPARABILITY B-7
  4.3 FIELD MEASUREMENT QUALITY ASSURANCE B-7

5.0 SAMPLING PROCEDURES B-8

6.0 SAMPLE CUSTODY AND DOCUMENT CONTROL B-9
  6.1 FIELD LOG BOOK B-9
  6.2 SAMPLE NUMBERING B-10
  6.3 CHAIN OF CUSTODY RECORDS B-10
  6.4 SAMPLE DOCUMENTATION IN THE LABORATORY B-11
  6.5 STORAGE OF SAMPLES B-12
  6.6 SAMPLE DOCUMENTATION B-12

7.0 ANALYTICAL PROCEDURES FOR CHEMICAL ANALYSES B-13

8.0 CALIBRATION PROCEDURES AND FREQUENCY B-14
  8.1 INSTRUMENTATION FOR INORGANIC ANALYSES B-14

9.0 DATA REDUCTION, VALIDATION, ASSESSMENT, AND REPORTING B-15
  9.1 GENERAL B-15
  9.2 LABORATORY REPORTING, DATA PRESENTATION, AND FINAL REPORT B-16
  9.3 DOCUMENT CONTROL SYSTEM B-16
  9.4 QC CHECK POINTS AND DATA FLOW B-16

10.0 INTERNAL QUALITY CONTROL CHECKS AND FREQUENCY B-18
  10.1 QC FOR LABORATORY ANALYSES B-18
  10.1.1 REAGENT BLANKS B-18
  10.1.2 MATRIX SPIKE (MS) AND DUPLICATE ANALYSES B-18
  10.2 QC FOR FIELD SAMPLING B-18
  10.2.1 FIELD BLANKS B-18

TABLE OF CONTENTS

Page

10.2.2 FIELD DUPLICATE SAMPLES B-19

11.0 PERFORMANCE AND SYSTEM AUDITS B-20

12.0 PREVENTATIVE MAINTENANCE B-21

13.0 SPECIFIC ROUTINE PROCEDURES USES TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS B-22
13.1 QA MEASUREMENT QUALITY INDICATORS B-22
13.1.1 PRECISION B-22
13.1.2 ACCURACY B-22
13.1.3 COMPLETENESS B-23
13.1.4 OUTLIERS B-23

14.0 CORRECTIVE ACTION B-24

15.0 QUALITY ASSURANCE REPORTS B-25

LIST OF TABLES
(Following Text)

TABLE B.4.1 TARGET QUANTITATION LIMITS

TABLE B.4.2 SAMPLING AND ANALYSIS SUMMARY

TABLE B.5.1 SAMPLE CONTAINER, PRESERVATION, AND HOLDING TIME PERIODS

TABLE B.9.1 LABORATORY REPORTING DELIVERABLES

1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) is Site-specific and has been prepared for the Vanadium Corporation of America Site (Site), located in Niagara Falls, New York, to define the current quality of on-Site groundwater, surface water, and soil.

The objectives of this QAPP are to provide documentation that the data collected during the remedial investigation are of sufficient quality to support remedial discussions.

This QAPP provides comprehensive information regarding the project personnel responsibilities, and sets forth specific procedures to be used during sampling of relevant environmental matrices and analyses of data.

2.0 PROJECT BACKGROUND

2.1 GENERAL

This QAPP provides Quality Assurance/Quality Control (QA/QC) criteria for work efforts associated with soil, soil gas, and groundwater sample analyses. Methods for sample analyses have been selected to provide results which characterize the samples, such that the sampling objectives can be met.

3.0 PROJECT ORGANIZATION AND RESPONSIBILITY

Brief descriptions of the duties of the key project personnel are presented below. Individuals may function in one or several of these roles.

Project Director:

i) provides overall project management;

ii) ensures professional services by the Contractor are cost effective and of highest quality;

iii) ensures all resources of the Contractor are available on an as-required basis;

iv) participates in key technical negotiations; and

v) provides managerial and technical guidance to the Contractor's Coordinator.

Project Manager:

i) provides day-to-day project management;

ii) provides managerial guidance to the QA/QC Office - Sampling and Analytical Activities;

iii) prepares and reviews reports;

iv) conducts preliminary chemical data interpretation and assessment; and

v) responsible for overall project completion in accordance with the approved design.

QA/QC Officer - Sampling and Analytical Activities:

i) oversees and reviews laboratory activities;

ii) determines laboratory data corrective action;

iii) performs analytical data validation and assessment;

iv) reviews laboratory QA/QC;

v) assists in preparation and review of final report;

vi) provides technical representation for analytical activities;

vii) oversees and reviews field activities;

viii) provides managerial and technical guidance to the Field Sampling Supervisor;

ix) performs field sampling performance audit(s);

x) ensures that field and Chain of Custody records are properly maintained; and

xi) determines field procedure corrective actions.

Field Sampling Supervisor:

i) provides immediate supervision of all on-Site activities;

ii) provides field management of sample collection and field QA/QC;

iii) provides technical representation for field activities; and

iv) is responsible for maintenance of the field equipment.

Laboratory - Project Manager, Analytical Contractor:

i) ensures resources of laboratory are available on an as-required basis;

ii) coordinates laboratory analyses;

iii) supervises laboratory's in-house Chain of Custody;

iv) schedules analyses of samples;

v) oversees review of data;

vi) oversees preparation of analytical reports; and

vii) approves final analytical reports.

Laboratory - Quality Assurance/Quality Control Officer, Analytical Contractor:

i) overviews laboratory QA/QC;

ii) overviews QA/QC documentation;

iii) conducts detailed data review;

iv) decides laboratory corrective actions, if required; and

v) provides technical representation for laboratory QA/QC procedures.

Laboratory - Sample Custodian - Analytical Contractor:

i) receives and inspects the sample containers;

ii) records the condition of the sample containers;

iii) signs appropriate documents;

iv) verifies Chain of Custody and their correctness;

v) notifies laboratory Project Manager and laboratory QA/QC Officer of sample receipt and inspection;

vi) assigns a unique laboratory identification number correlated to the field sample identification number, and enters each into the sample receiving log;

vii) initiates transfer of samples to the appropriate lab sections with assistance from the laboratory Project Manager; and

viii) controls and monitors access to and storage of samples and extracts.

The analytical laboratories selected to perform the analyses will be full-service chemical analytical laboratories certified by the New York State Department of Health (NYSDOH) through the Environmental Laboratory Approval Program (ELAP) and the Contract Laboratory Program (CLP) for the appropriate categories of analysis.

4.0 PROJECT OBJECTIVES

4.1 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

The overall Quality Assurance (QA) objective is to develop and implement procedures for sample collection and analyses which will provide data with an acceptable level of accuracy and precision.

Quality assurance measures for this project will begin with sample containers. Sample containers will be purchased from a certified manufacturer and will be precleaned (I-Chem Series 200 or equivalent).

4.2 LABORATORY QUALITY ASSURANCE

The following subsections define the QA goals required to meet the Data Quality Objectives (DQOs) of the project.

4.2.1 ACCURACY, PRECISION, AND SENSITIVITY OF ANALYSES

The fundamental QA objective with respect to the accuracy, precision, and sensitivity of analytical data is to meet the QC acceptance criteria of each analytical protocol. Analytical methods and targeted detection limits listed have been specified to meet the project DQOs.

A summary of the targeted detection limits is provided in Table B.4.1. It should be noted that these limits are targeted detection limits only; limits are highly matrix dependent and may not always be achieved.

The method accuracy (percent recovery) will be determined by spiking selected samples (matrix spikes) with the method recommended spiking compounds. Accuracy will be reported as the percent recovery of the spiking compound(s) and will compare with the criteria given in the appropriate methods, as identified in Section 7.0.

The method(s) precision (reproducibility between duplicate analyses) will be determined based on the duplicate analysis of matrix spike samples for organic parameters and duplicate sample analyses for inorganic parameters. Precision will be reported as Relative Percent Differences (RPDs) between duplicate analyses; acceptance criteria will be as specified in the appropriate methods identified in Section 7.0.

4.2.2 COMPLETENESS, REPRESENTATIVENESS, AND COMPARABILITY

A completeness requirement of 90 percent will be targeted for the program (see Section 13.1.3 for definition of completeness).

The quantity of samples to be collected has been estimated in an effort to effectively represent the population being studied. A summary of the sampling and analysis program is presented in Table B.4.2.

4.3 FIELD MEASUREMENT QUALITY ASSURANCE

Measurement data will be generated during field activities. These activities include, but are not limited to, the following:

i) documenting time and weather conditions; and

ii) observation of sample appearance and other conditions.

The general QA objective for measurement data is to obtain reproducible and comparable measurements to a degree of accuracy consistent with the use of standardized procedures.

5.0 SAMPLING PROCEDURES

The sample collection procedures are described in the Sampling and Analysis Plan (SAP).

The sample container, preservation, shipping, and packaging requirements are identified in Table B.5.1 and Section 6.3.

6.0 SAMPLE CUSTODY AND DOCUMENT CONTROL

The following documentation procedures will be used during sampling and analysis to provide Chain of Custody control during transfer of samples from collection through storage. Recordkeeping documentation will include use of the following:

i) field log books (bound with numbered pages) to document sampling activities in the field;
ii) labels to identify individual samples;
iii) Chain of Custody record sheet to document analyses to be performed; and
iv) laboratory sample custody log book.

6.1 FIELD LOG BOOK

In the field, the sampler will record the following information in the field log book (bound) for each sample collected:

i) project number;
ii) sample matrix;
iii) name of sampler;
iv) sample source;
v) time and date;
vi) pertinent data (e.g., depth, PID, etc.);
vii) analysis to be conducted;
viii) sampling method/equipment used;
ix) appearance of each sample (i.e., color, evidence of soil staining);
x) sample preservation added, if any;
xi) number of sample bottles collected; and
xii) pertinent weather data.

In the case of groundwater samples, the following will also be recorded:

i) water level;
ii) sounded depth;
iii) calculation of well volume;

iv) volume of water purged;
v) water quality measurements; and
vi) initial and final water quality descriptions.

Field log books will be numbered and maintained in a safe location. Entries will be made only in indelible ink. Any corrections will be marked through with a single line so as to remain legible and will be initialed. Each field log book page will be signed by the sampler.

6.2 SAMPLE NUMBERING

A unique sample numbering system will be used to identify each collected sample. This system will provide a tracking number to allow retrieval and cross-referencing of sample information. The sample numbering system to be used is described as follows:

Example:	S-121695 - AA-XXX
Where:	S - Designates sample Type (S=Soil)
121695:	Date of collection (mm/dd/yy)
AA:	Sampler initials
XXX:	Unique sample number

QC samples will also be numbered with a unique sample number.

6.3 CHAIN OF CUSTODY RECORDS

Chain of Custody forms will be completed for all samples collected during the program.

The Chain of Custody form will document the transfer of sample containers. Custody seals will be placed on each cooler. The cooler will then be sealed with packing tape. Sample container labels will include sample number, place of collection and date and time of collection. All samples will be refrigerated using wet ice at 4°C (±2°C) and delivered to the analytical laboratory within 24 to 48 hours of collection. All samples will be delivered to the laboratory by commercial courier or Contractor personnel. All samples will be stored at 4°C (±2°C) at the laboratory.

The Chain of Custody record, completed at the time of sampling, will contain, but not be limited to, the sample number, date and time of sampling, and the name of the sampler. The Chain of Custody document will be signed, timed, and dated by the sampler when transferring the samples.

Each sample cooler being shipped to the laboratory will contain a Chain of Custody form. The Chain of Custody form will consist of four copies which will be distributed as follows: The shipper will maintain a copy while the other three copies will be enclosed in a waterproof envelop within the cooler with the samples. The cooler will then be sealed properly for shipment. The laboratory, upon receiving the samples, will complete the three remaining copies. The laboratory will maintain one copy for their records. One copy will be returned to the QA/QC Officer-Sampling and Analytical Activities upon receipt of the samples by the laboratory. One copy will be returned with the data deliverables package.

Upon receipt of the cooler at the laboratory, the shipping cooler and the custody seal will be inspected by the Sample Custodian. The condition of the cooler and the custody seal will be noted on the Chain of Custody record sheet by the Sample Custodian. The Sample Custodian will record the temperature of one sample (or temperature blank) from each cooler and the temperature will be noted on the Chain of Custody. If the shipping cooler seal is intact, the sample containers will be accepted for analyses. The Sample Custodian will document the date and time of receipt of the container, and sign the form.

If damage or discrepancies are noticed (including sample temperature exceedances), they will be recorded in the remarks column of the record sheet, dated, and signed. Any damage or discrepancies will be reported to the Laboratory Project Manager and Laboratory QA/QC Officer before samples are processed.

6.4 SAMPLE DOCUMENTATION IN THE LABORATORY

Each sample or group of samples shipped to the laboratory for analysis will be given a unique identification number. The Sample Custodian will record the client name, number of samples and date of receipt of samples in the Sample Control Log Book. Samples removed from storage for analyses will be documented in the Sample Control Log Book.

The laboratory will be responsible for maintaining analytical log books and laboratory data as well as a sample (on hand) inventory for submittal to the QA/QC Officer -

Sampling and Analytical Activities on an as-required basis. Raw laboratory data produced from the analysis of samples submitted for this program will be inventoried and maintained by the laboratory for a period of five years at which time the QA/QC Officer - Sampling and Analytical Activities will advise the laboratory regarding the need for additional storage.

6.5 STORAGE OF SAMPLES

After the Sample Custodian has completed the Chain of Custody forms and the incoming sample log, the Chain of Custody will be checked to ensure that all samples are stored in the appropriate locations. All samples will be stored within an access controlled custody room and will be maintained at 4°C (±2°C) until all analytical work is complete.

6.6 SAMPLE DOCUMENTATION

Evidentiary files for the entire project shall be inventoried and maintained by the QA/QC Officer - Sampling and Analytical Activities and shall consist of the following:

i) project related plans;
ii) project log books;
iii) field data records;
iv) sample identification documents;
v) Chain of Custody records;
vi) report notes, calculations, etc.;
vii) lab data, etc.;
viii) references, copies of pertinent literature;
ix) miscellaneous - photos, maps, drawings, etc.; and
x) copies of all final reports pertaining to the project.

The evidentiary file materials shall be the responsibility of the Project Manager with respect to maintenance and document removal.

7.0 ANALYTICAL PROCEDURES FOR CHEMICAL ANALYSES

Samples collected for laboratory chemical analyses will be analyzed for the parameters listed in Table B.4.1 using the methods cited in Table B.4.2. These methods have been selected to meet the DQOs for each sampling activity.

All reporting and deliverables shall be in accordance with the New York State Department of Environmental Conservation (NYSDEC) Analytical Services Protocol (ASP) Category B. Table B.9.1 describes the minimum deliverable required by the laboratory. Electronic deliverables of all results will also be required.

All sample results will be calculated using external standards with the exception of the samples analyzed by gas chromatograph/mass spectrometer (GC/MS); these methods employ the use of internal standards or isotopic dilution for analyte quantitation. The specific procedures for target analyte quantitation are detailed in the appropriate analytical methods.

8.0 CALIBRATION PROCEDURES AND FREQUENCY

Calibration of instrumentation is required to ensure that the analytical system is operating correctly and functioning at the proper sensitivity to meet established reporting limits. Each instrument is calibrated with standard solutions appropriate to the type of instrument and the linear range established for the analytical method. The frequency of calibration and the concentration of calibration standards is determined by the manufacturers guidelines, the analytical method, or the requirements of special contracts.

A bound notebook will be kept with each instrument requiring calibration in which the activities associated with QA monitoring and repairs program will be recorded. These records will be checked during periodic equipment review and internal and external QA/QC audits.

8.1 INSTRUMENTATION FOR INORGANIC ANALYSES

Inductively coupled argon plasma (ICAP) instrumentation will be calibrated using a minimum of a blank and one standard. Mercury and cyanide instrumentation will be calibrated using a blank and a minimum of three calibration standards (four for mercury), with a correlation coefficient requirement of ≥0.995. All remaining method-specified calibration procedures will be performed and acceptance criteria will be met prior to sample analyses.

9.0 DATA REDUCTION, VALIDATION, ASSESSMENT, AND REPORTING

9.1 GENERAL

The contract laboratory will perform analytical data reduction and validation in-house under the direction of the Laboratory QA/QC Officer. The Laboratory QA/QC Officer will be responsible for assessing data quality and advising of any data which were rated "preliminary" or "unacceptable" or other qualifications based on the QC criteria outlined in the relevant methods, which would caution the data user of possible unreliability. Data reduction, validation and reporting by the laboratory will be conducted as detailed in the following:

i) raw data produced and checked by the responsible analysts is turned over for independent review by another analyst;

ii) the area supervisor reviews the data for attainment of quality control criteria presented in the referenced analytical methods;

iii) upon completion of all reviews and acceptance of the raw data by the laboratory operations manager, a computerized report will be generated and sent to the Laboratory QA/QC Officer;

iv) the Laboratory QA/QC Officer will complete a thorough inspection of all reports;

v) the Laboratory QA/QC Officer and area supervisor will decide whether any sample reanalysis is required; and

vi) upon acceptance of the preliminary reports by the Laboratory QA/QC Officer, final reports will be generated and signed by the Laboratory Project Manager.

Validation of the analytical data will be performed by the QA/QC Officer - Sampling and Analytical Activities. The data validation will be performed in accordance with the document entitled "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review" (1994).

Assessment of analytical and in-house data will include checks on data consistency by looking for comparability of duplicate analyses, comparability to previous data from the same sampling location (if available), adherence to accuracy and precision control criteria detailed in this QAPP and anomalously high or low parameter values. The results of these data validations will be reported to the Project Manager and the contract laboratory, noting any discrepancies and their effect upon acceptability of the data.

Raw data from field measurements and sample collection activities that are used in project reports will be appropriately identified and appended to the report. Where data have been reduced or summarized, the method of reduction will be documented in the report. Field data will be audited for anomalously high or low values that may appear to be inconsistent with other data.

9.2 LABORATORY REPORTING, DATA PRESENTATION, AND FINAL REPORT

Reporting and deliverables shall include, but not be limited to, all items listed in Table B.9.1.

All sample data and corresponding QA/QC data as specified in the analytical methods, shall be maintained accessible either in hard copy or on magnetic tape or disk (computer data files).

The laboratory will submit a copy of the final analytical report and electronic deliverables within 21 calendar days of receipt of the final sample included in the sample delivery group (SDG).

9.3 DOCUMENT CONTROL SYSTEM

A document control system ensures that all documents are accounted for when the project is complete.

A project number will be assigned to the project. This number will appear on sample identification tags, log books, data sheets, control charts, project memos and analytical reports, document control logs, corrective action forms and logs, QA plans, and other project analytical records.

9.4 QC CHECK POINTS AND DATA FLOW

The following specific QC check points will be common to all metals, GC, and GC/MS analyses. They are presented with the decision points:

Chemist - bench level checks:

i) systems check: sensitivity, linearity, and reproducibility within specified limits;
ii) duplicate analyses within control limits;
iii) matrix spike results within control limits;
iv) surrogate spike results within control limits (organics only); and
v) calculation/data reduction checks: calculations cross-checked, any discrepancies between forms and results evident, results tabulated sequentially on the correct forms.

Laboratory Project Manager:

i) systems operating within limits;
ii) data transcription correct;
iii) data complete; and
iv) data acceptable.

Sample Control:

i) samples returned to sample control following analysis.

Laboratory QA/QC Officer:

i) QA objectives met;
ii) QC checks are completed; and
iii) final data and report package is complete.

10.0 INTERNAL QUALITY CONTROL CHECKS AND FREQUENCY

10.1 QC FOR LABORATORY ANALYSES

Specific procedures related to internal laboratory QC samples are described in the following subsections.

10.1.1 REAGENT BLANKS

A reagent blank will be analyzed by the laboratory at a frequency of one blank per analytical batch. The reagent blank, an aliquot of analyte-free water or solvent, will be carried through the entire analytical procedure.

10.1.2 MATRIX SPIKE (MS) AND DUPLICATE ANALYSES

A duplicate and MS will be analyzed for inorganic parameters at a minimum frequency of one per analytical batch. Acceptable criteria and analytes that will be used for MS are identified in the methods. Where method specified limits were not available, general control limits were used. Percent spike recoveries will be used to evaluate analytical accuracy while the RPD between duplicate analyses will be used to assess analytical precision.

10.2 QC FOR FIELD SAMPLING

To assess the quality of data resulting from the field sampling program, field duplicate and field blank samples will be collected (where appropriate) and submitted to the analytical laboratory as samples.

10.2.1 FIELD BLANKS

Rinse blanks will be used during the sampling programs to detect contamination introduced through sample collection procedures and equipment, external field conditions, sample transport, sample container preparation, sample storage, and/or the analytical process.

10.2.2 FIELD DUPLICATE SAMPLES

Field duplicate samples will be collected and used to assess the aggregate precision of sampling techniques and laboratory analysis. For every 20 investigative samples, a field duplicate sample will be collected using standard sampling procedures. This duplicate will be packed and shipped to the laboratory for analysis.

11.0 PERFORMANCE AND SYSTEM AUDITS

For the purpose of external evaluation, performance evaluation check samples are analyzed periodically by the laboratory. Internally, the evaluation of data from these samples is done on a continuing basis over the duration of a given project.

The QA/QC Officer - Sampling and Analytical Activities may carry out performance and/or systems audits to insure that data of known and defensible quality are consistently produced during this program.

Systems audits are qualitative evaluations of all components of field and laboratory quality control measurement systems. They determine if the measurement systems are being used appropriately. The audits may be carried out before all systems are operational, during the program, or after completion of the program. Such audits typically involve a comparison of the activities given in the QA/QC plan described herein, with activities actually scheduled or performed. A special type of systems audit is the data management audit. This audit addresses only data collection and management activities.

The performance audit is a quantitative evaluation of the measurement systems used for a monitoring program. It requires testing the measurement systems with samples of known composition or behavior to quantitatively evaluate precision and accuracy. A performance audit may be carried out by or under the auspices of the QA/QC Officer - Sampling and Analytical Activities without the knowledge of the analyst during each sampling event for this program.

It should be noted, however, that any additional external QA audits will only be performed if deemed necessary.

12.0 PREVENTATIVE MAINTENANCE

This section applies to both field and laboratory equipment. Specific preventive maintenance procedures for field equipment will be consistent with the manufacturer's guidelines. Specific preventive maintenance protocols for laboratory equipment will be consistent with the contract laboratory's standard operating procedures.

All analytical instruments to be used in this project will be serviced by laboratory personnel at regularly scheduled intervals in accordance with the manufacturers' recommendations. Instruments may also be serviced at other times due to failure. Requisite servicing beyond the abilities of laboratory personnel will be performed by the equipment manufacturer or their designated representative.

Routine maintenance of the instruments will be performed as per manufacturers' recommendations. The Laboratory Project Manager is responsible for the preventive maintenance of the instruments.

13.0 SPECIFIC ROUTINE PROCEDURES USES TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

13.1 QA MEASUREMENT QUALITY INDICATORS

13.1.1 PRECISION

Precision will be assessed by comparing the analytical results between duplicate spike analyses. Precision as percent relative difference will be calculated as follows for values significantly greater than the associated detection limit:

$$\text{Precision} = \left| \frac{(D_2 - D_1)}{(D_1 + D_2)/2} \right| \times 100$$

D_1 = matrix spike recovery

D_2 = matrix spike duplicate spike recovery

For results near the associated detection limits, precision will be assessed based on the following criteria:

$$\text{Precision} = \left| \text{Original result - duplicate result} \right| < \text{CRDL}$$

13.1.2 ACCURACY

Accuracy will be assessed by comparing a set of analytical results to the accepted or "true" values that would be expected. In general, MS/MSD and check sample recoveries will be used to assess accuracy. Accuracy as percent recovery will be calculated as follows:

$$\text{Accuracy} = \frac{A - B}{C} \times 100$$

A = The analyte determined experimentally from the spike sample.

B = The background level determined by a separate analysis of the unspiked sample.

C = The amount of spike added.

In some cases, MS and/or MSD recoveries may not be available due to elevated levels of the spiked analyte in the investigative sample. In such cases, accuracy will be assessed based on surrogate spike recoveries and/or laboratory control samples.

13.1.3 COMPLETENESS

Completeness is a measure of the amount of valid data obtained from a measurement system compared with the amount that was expected to be obtained under normal conditions.

To be considered complete, the data set must contain all QC check analyses verifying precision and accuracy for the analytical protocol. In addition, all data are reviewed in terms of stated goals in order to determine if the database is sufficient.

When possible, the percent completeness for each set of samples will be calculated as follows:

$$\text{Completeness} = \frac{\text{usable data obtained}}{\text{total data planned}} \times 100 \text{ percent}$$

13.1.4 OUTLIERS

Procedures discussed previously will be followed for documenting deviations. In the event that a result deviates significantly from method established control limits, this deviation will be noted and its effect on the quality of the remaining data assessed and documented.

14.0 CORRECTIVE ACTION

The need for corrective action may be identified by system or performance audits or by standard QC procedures. The essential steps in the corrective actions system will be:

i) checking the predetermined limits for data acceptability beyond which corrective action is required;

ii) identifying and defining problems;

iii) assigning responsibility for investigating the problem;

iv) investigating and determining the cause of the problem;

v) determination of a corrective action to eliminate the problem (this may include reanalysis or resampling and analyses);

vi) assigning and accepting responsibility for implementing the corrective action;

vii) implementing the corrective action and evaluating the effectiveness;

viii) verifying that the corrective action has eliminated the problem; and

ix) documenting the corrective action taken.

For each measurement system, the laboratory QA/QC Officer will be responsible for initiating the corrective action and the Laboratory Project Manager will be responsible for implementing the corrective action.

15.0 QUALITY ASSURANCE REPORTS

Final reports will contain a discussion on QA/QC summarizing the quality of the data collected and/or used as appropriate for each phase of the project. The Project Manager who has responsibility for these summaries, will rely on written reports/memoranda documenting the data assessment activities, performance and systems audits and footnotes identifying qualifications to the data, if any.

Each summary of sampling activities will include a tabulation of the data including:

i) field blank and field duplicate sample results;
ii) maps showing well locations; and
iii) an explanation of any sampling conditions or quality assurance problems and their effect on data quality.

QA reports will be prepared by the QA/QC Officer - Sampling and Analytical Activities following receipt of all analytical data. These reports will include discussions of the following and their effects on the quality of the data reported:

i) sample holding times,
ii) laboratory/reagent blank data
iii) surrogate spike, matrix spike and matrix spike duplicate data;
iv) field QA/QC data;
v) pertinent instrument performance per method protocols; and
vi) audit results (if performed).

In addition, the QA reports will summarize all QA problems, and give a general assessment of QA results versus control criteria for such parameters as accuracy, precision, etc.

The QA reports will be forwarded to the Project Manager.

TABLE B.4.1

TARGET QUANTITATION LIMITS (1)
QUALITY ASSURANCE PROJECT PLAN
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

ameters	*Soil/Sediment (mg/Kg)*	*Water (µg/L)*
Aluminum	20	200
Antimony	6	60
Arsenic	1	10
Barium	20	200
Beryllium	0.5	5
Cadmium	0.5	5
Calcium	500	5000
Chromium	1	10
Cobalt	5	50
Copper	2.5	25
Iron	10	100
Lead	0.3	3
Magnesium	500	5000
Manganese	1.5	15
Mercury	0.1	0.2
Nickel	4	40
Potassium	500	5000
Selenium	0.5	5
Silver	1	10
Sodium	500	5000
Thallium	1	10
Vanadium	5	50
Zinc	2	20
Cyanide	0.25	10
Hexavalent Chromium	0.50	5.0

Note:

(1) Specific quantitation limits are highly matrix dependent. The quantitation limits listed here are provided for guidance and may not always be achievable.

TABLE B.4.2

SAMPLING AND ANALYSIS SUMMARY
QUALITY ASSURANCE PROJECT PLAN
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Sample Matrix	*Analytical Parameters*	*Analytical Methods*	*Estimated Number of Samples*	*Field Duplicates*	*Rinse Blanks*	*MS/Dup.*
Soil	TAL Metals	SW-846 6010B/7471A (1)	45	4	2	2
	Cyanide	SW-846 9012A (1)	45	4	2	2
	Hexavalent Chromium	SW-846 7196A (1)	45	4	2	2
Surface Soil	TAL Metals	SW-846 6010B/7471A (1)	30	3	2	1
	Cyanide	SW-846 9012A (1)	30	3	2	1
	Hexavalent Chromium	SW-846 7196A (1)	30	3	2	1
Groundwater/ Surface Water	TAL Metals*	SW-846 6010B/7470A (1)	31	2	2	2
	Cyanide	SW-846 9010B (1)	31	2	2	2
	Hexavalent Chromium*	SW-846 7195 (1)	31	2	2	2

Notes:

(1) - Methods referenced from "Test Methods for Evaluating Solid Waste-Physical/Chemical Methods", SW-846, Third Edition, 1986 (rev. 9/94).
* - Some may be analyzed for dissolved metals and hexavalent chromium.
MS/Dup. - Matrix Spike/Duplicate.
TAL - Target Analyte List.

TAB. 3.5.1

SAMPLE CONTAINER, PRESERVATION, AND HOLDING TIME PERIODS
QUALITY ASSURANCE PROJECT PLAN
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Analyses	*Sample Containers*	*Preservation*	*Maximum Holding Time*	*Notes*
Water				
TAL Metals	One 1 liter plastic bottle	HNO3 pH <2 Cool 4°C	6 months from collection to analysis 28 days from collection to analysis	Fill to shoulder of bottle
Mercury	One 250 mL plastic bottle	HNO3 pH <2 Cool 4°C	14 days from collection to analysis	Fill to shoulder of bottle
Cyanide	One 500 mL plastic bottle	NaOH to pH >12	14 days from collection to analysis	Fill to shoulder of bottle
Hexavalent Chromium	One 500 mL plastic bottle	Cool 4°C	24 hours from collection to analysis	Fill to shoulder of bottle
Solids				
TAL Metals	One 8 ounce glass jar	Cool 4°C	6 months from collection to analysis	Fill to neck of bottle
Mercury	One 8 ounce glass jar	Cool 4°C	28 days from collection to analysis	Fill to neck of bottle
Cyanide	One 8 ounce glass jar	Cool 4°C	14 days from collection to analysis	Fill to neck of bottle
Hexavalent Chromium	One 8 ounce glass jar	Cool 4°C	24 hours from collection to analysis	Fill to shoulder of bottle

Note:

TAL - Target Analyte List

TABLE B.9.1

LABORATORY REPORTING DELIVERABLES - FULL DATA PACKAGE
QUALITY ASSURANCE PROJECT PLAN
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

A detailed report narrative should accompany each submission, summarizing the contents and results.

A. Chain of Custody Documentation and Detailed Narrative. (1)

B. Sample Information.
  - i) date collected
  - ii) date extracted or digested
  - iii) date analyzed
  - iv) analytical method and reference.

C. Data (including all raw data and CLP-like summary forms)
  - i) samples
  - ii) method blanks
  - iii) spikes; spike duplicates (2) (3)
  - iv) surrogate recoveries (2)
  - v) calibration

D. Miscellaneous
  - i) method detection limits and/or instrument detection limits
  - ii) percent solids (where applicable)
  - iii) run logs
  - iv) standard preparation logs
  - v) sample preparation logs

All sample data and its corresponding QA/QC data shall be maintained accessible to CRA either in hard copy or on magnetic tape or disc (computer data files).

Notes:

(1) Any quality control outliers must be addressed and corrective action taken must be specified.
(2) Laboratory must specify applicable control limits for all quality control sample results.
(3) A blank spike must be prepared and analyzed with each sample batch.

APPENDIX C

HEALTH AND SAFETY PLAN

TABLE OF CONTENTS

Page

1.0 INTRODUCTION C1
1.1 PROJECT ORGANIZATION C2

2.0 SITE CHARACTERIZATION AND POTENTIALLY HAZARDOUS COMPOUNDS C-3

3.0 BASIS FOR DESIGN C-4

4.0 ROLES AND RESPONSIBILITIES C-5
4.1 ALL PERSONNEL C-5
4.2 INDUSTRIAL HYGIENIST/SAFETY SPECIALIST C-5
4.3 HEALTH AND SAFETY OFFICER (HSO) C-5
4.4 SITE ENGINEER C-6
4.6 SUBCONTRACTORS C-6

5.0 EMPLOYEE TRAINING C-8
5.1 GENERAL C-8
5.2 SITE-SPECIFIC TRAINING C-8
5.3 DAILY SAFETY MEETINGS C-8
5.4 FIRST AID AND CPR C-8

6.0 PERSONAL PROTECTIVE EQUIPMENT C-9
6.1 LEVELS OF PROTECTION C-9
6.1.1 LEVEL D PROTECTION C-9
6.1.2 MODIFIED LEVEL D PROTECTION C-9
6.1.3 LEVEL C PROTECTION C-10
6.1.4 SELECTION OF PPE C-10
6.2 SITE RESPIRATORY PROTECTION PROGRAM C-11
6.3 USING PPE C-12
6.3.1 DONNING PROCEDURES C-12
6.3.2 DOFFING PROCEDURES C-12
6.4 SELECTION MATRIX C-13
6.5 DURATION OF WORK TASKS C-13
6.6 LIMITATIONS OF PROTECTIVE CLOTHING C-14

7.0 SITE CONTROL C-15
7.1 AUTHORIZATION TO ENTER C-15
7.2 SITE ORIENTATION AND HAZARD BRIEFING C-15
7.3 CERTIFICATION DOCUMENTS C-15
7.4 ENTRY LOG C-16
7.5 ENTRY REQUIREMENTS C-16
7.6 EMERGENCY ENTRY AND EXIT C-16
7.7 CONTAMINATION CONTROL ZONES C-16

TABLE OF CONTENTS

Page

7.7.1 EXCLUSION ZONE (EZ) C-16
7.7.2 CONTAMINATION REDUCTION ZONE (CRZ) C-17
7.7.3 SUPPORT ZONE (SZ) C-17

8.0 ACTIVITY HAZARD/RISK ANALYSIS AND GENERAL SAFETY PRACTICES C-18
8.1 CHEMICAL EXPOSURE C-18
8.2 GENERAL PRACTICES C-20
8.2.1 BUDDY SYSTEM C-20
8.3 HEAT STRESS C-21
8.4 SANITATION C-25
8.4.1 BREAK AREA C-25
8.4.2 POTABLE WATER C-25
8.4.3 SANITARY FACILITIES C-26
8.4.4 LAVATORY C-26
8.4.5 TRASH COLLECTION C-26
8.5 LIFTING HAZARDS C-26

9.0 DUST MONITORING C-28

10.0 DECONTAMINATION PROCEDURES C-29
10.1 EQUIPMENT DECONTAMINATION PROCEDURES C-29

11.0 MEDICAL SURVEILLANCE C-30

12.0 EMERGENCY CONTINGENCIES C-31
12.1 EMERGENCY CONTACTS C-31
12.2 EMERGENCY AND FIRST AID EQUIPMENT C-32
12.3 PROJECT PERSONNEL RESPONSIBILITIES DURING EMERGENCIES C-33
12..4 MEDICAL EMERGENCIES C-33
12.5 FIRE OR EXPLOSION C-34
12.6 SPILLS C-34

13.0 RECORDKEEPING C-36

LIST OF FIGURES
(Following Text)

FIGURE C.12.1 EMERGENCY HOSPITAL ROUTE

LIST OF TABLES
(Following Text)

TABLE C.2.1 MAXIMUM DETECTED CONCENTRATIONS OF CHEMICALS OF CONCERN IN SITE SOILS AND GROUNDWATER

TABLE C.2.2 EXPOSURE ROUTES AND EXPOSURE LEVELS FOR THE CHEMICALS OF CONCERN

TABLE C.6.1 SPECIFIC PERSONAL PROTECTION LEVELS

TABLE C.8.1 ANTICIPATED HAZARDS/RISKS AND HAZARD CONTROLS

LIST OF ATTACHMENTS

ATTACHMENT C-1 TRAINING ACKNOWLEDGMENT FORM

ATTACHMENT C-2 DAILY SAFETY MEETING LOG

1.0 INTRODUCTION

The Health and Safety Plan (HASP) presented herein describes the health and safety procedures and emergency response guidelines to be implemented during the Phase 1 Investigation at the Vanadium Corporation of America Site (Site) located in Niagara Falls, Niagara County, New York. Figure 1.1 of the Phase 1 Work Plan presents the Site Location, and Figure 1.2 of the Phase 1 Work Plan presents the Site Layout.

The Phase 1 scope of work includes the following activities:

i) mobilization and demobilization of labor, materials, and equipment to and from the Site;
ii) surveying activities;
iii) Site setup activities including construction of a temporary decontamination pad;
iv) drilling boreholes;
v) installing groundwater monitoring wells and developing newly installed monitoring wells;
vi) test pit excavations;
vii) obtaining water level measurements and collecting soil and groundwater samples;
viii) collecting surface water and sediment samples; and
ix) decontamination activities.

During completion of the Phase 1 activities, personnel may come in contact with soils, sediments, groundwater, and slag materials which potentially contain hazardous substances. This HASP has been developed to ensure the following:

i) that Site personnel are not adversely exposed to the compounds of concern;
ii) compliance with applicable governmental and non-governmental (American Conference of Governmental Industrial Hygienists [ACGIH]) regulations and guidelines. In particular, the amended rules of the Occupational Safety and Health Administration (OSHA) for Subpart D of Part 1926 (Title 29 Code of Federal Regulations [CFR] Part 1926.65) will be implemented for Site work where there is a potential to come in contact with hazardous substances; and
iii) initiation of proper emergency response procedures to minimize the potential for any adverse impact to Site workers, the general public, or the environment.

For the purpose of this HASP, work activity items iv), v), vi), vii), viii), and ix) are activities where compliance with 1926.65 will be required including the use of 40-hour hazardous waste trained Site personnel. The preparation of a written HASP will only be required of contractors who are conducting these work activities. All contractors, including those who are not required to provide a written HASP are required to comply with the applicable OSHA standards found in Parts 1910 and 1926.

The applicability of this HASP extends to all personnel who will be on Site, including contractors, subcontractors, and visitors to the Site. Contractors performing work identified in items iv), v), vi), vii), viii), and ix) at the Site will be required to prepare a HASP for their portion of the project. The contractor's HASP must minimally meet the requirements of this HASP.

All Phase 1 activities at the Site will be conducted in accordance with applicable standards, the provisions of the selected contractor's approved Site-specific HASP (if required), and employer-specific Standard Operating Procedures (SOPs). A copy of any required HASPs will be maintained on Site whenever Phase 1 activities are in progress.

1.1 PROJECT ORGANIZATION

There is a potential for several contractors to be working on Site. The selected contractor(s) will be responsible for providing a Health and Safety Officer (HSO) to direct their activities. A Site supervisor, if qualified, may fulfill the duties of the HSO. These individuals will be responsible for ensuring that all contract specifications are met, including those related to Site health and safety. The names of these individuals will be presented in the HASPs of each contractor.

2.0 SITE CHARACTERIZATION AND POTENTIALLY HAZARDOUS COMPOUNDS

Section 4.0 of the Phase 1 Work Plan provides a discussion on the characterization of the Site. Table C.2.1 presents the maximum detected concentration of chemicals of potential concern in Site soils. Table C.2.2 presents the time weighted average (TWA) acceptable exposure levels for the chemicals of concern. These levels are set to protect the health of workers who may be exposed to these substances.

3.0 BASIS FOR DESIGN

Regulations set forth by OSHA in Title 29, CFR, Parts 1910 and 1926 (29 CFR 1910 and 1926) form the basis of this HASP. Emphasis is placed on Section 1926.65 (Hazardous Waste Operations and Emergency Response), 1910 Subpart I (Personal Protective Equipment), 1910 Subpart Z (Toxic and Hazardous Substances), 1926 Subpart O (Motor Vehicles, Mechanized Equipment, and Marine Operations), and 1926 Subpart F (Excavations). Some of the specifications within this section are in addition to the OSHA regulations, and reflect the positions of the United States Environmental Protection Agency (USEPA) and the National Institute for Occupational Safety and Health (NIOSH) regarding safe operating procedures at hazardous waste sites.

This HASP follows the guidelines established in the following documents:

i) *Standard Operating Safety Guides*, USEPA (Publications 9285.1-03, June 1992);

ii) *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, NIOSH, OSHA, USCG, USEPA (86-116), October 1985);

iii) Title 29 of the CFR, Part 1926.65;

iv) Title 29 of the CFR, Part 1926;

v) *Pocket Guide to Chemical Hazards*, DHHS, PHS, CDC, NIOSH (#99-115);

vi) *Threshold Limit Values*, ACGIH (2002); and

vii) *Quick Selection Guide to Chemical Protective Clothing*, Forsberg, K. and S.Z. Mandsorf, 2nd Ed. (1993).

The health and safety of the public and Site personnel and the protection of the environment will take precedence over cost and scheduling considerations for all project work.

4.0 ROLES AND RESPONSIBILITIES

4.1 ALL PERSONNEL

All contractor and subcontractor personnel must adhere to the health and safety procedures during the performance of their work. Each person is responsible for completing tasks safely, and reporting any unsafe acts or conditions to his or her immediate supervisor or to the Site Engineer. No person may work in a manner that conflicts with the safety and environmental precautions expressed in these procedures. After due warning, the Site Engineer will dismiss from the Site any person who violates safety procedures.

Required personnel shall have received training in accordance with 29 CFR 1926.65 and be familiar with the requirements and procedures contained in this document prior to the beginning of project operations.

4.2 INDUSTRIAL HYGIENIST/SAFETY SPECIALIST

The Industrial Hygienist or Safety Specialist is responsible for technical health and safety aspects of the project, including review of contractor HASPs. Inquiries regarding project procedures, and other technical or regulatory issues should be addressed to this individual. Any changes or addenda to this HASP must be approved by the Industrial Hygienist.

4.3 HEALTH AND SAFETY OFFICER (HSO)

The Site HSO is responsible for coordinating Site health and safety issues. The HSO will advise the Site Engineer on health and safety issues, and will establish and oversee the project air monitoring program. The HSO is the primary Site contact on occupational health and safety matters.

It is the responsibility of the HSO or designated alternate to:

i) verify that all on-Site personnel are made aware of the provisions of the HASP and have been informed of the nature of any physical, chemical, and biological hazards associated with the Site activities;

ii) maintain a daily logbook for recording all significant health and safety activities and incidents;

iii) verify that on-Site personnel and visitors have received the required training including instructions for safety equipment and personal protective equipment (PPE) use;

iv) suspend work if health and/or safety-related concerns arise;

v) provide on-Site technical assistance;

vi) conduct Site safety orientation training session;

vii) maintain the on-Site Hazard Communication Program including copies of Material Safety Data Sheets (MSDSs);

viii) conduct brief daily safety meetings;

ix) verify that on-Site personnel have received the required physical examinations and medical certifications;

x) maintain all Site Exclusion Zones (EZs), Contaminant Reduction Zones (CRZs), and the Support Zone (SZ);

xi) communicate on a daily basis the proper evacuation routes and places of safe refuge based upon the working location at the Site;

xii) review Site activities with respect to compliance with the HASP; and

xiii) maintain required health and safety documents and records on Site.

4.4 SITE ENGINEER

The Site Engineer is ultimately responsible for verifying that all Phase 1 activities are completed in accordance with the requirements and procedures in this plan.

It is the responsibility of the Site Engineer to:

i) report all accidents and incidents to the HSO and thoroughly investigate all such occurrences on the project;

ii) approve, in writing, addenda or modifications of this HASP; and

iii) suspend work if health and safety-related concerns arise.

4.6 SUBCONTRACTORS

On-Site subcontractors and their personnel must understand and comply with the Site requirements established in their respective HASP. Subcontractors may prepare their own task-specific HASPs, which must be consistent with the requirements of this HASP. Subcontractor personnel must attend and participate in Site safety meetings.

5.0 EMPLOYEE TRAINING

5.1 GENERAL

Required project personnel as discussed in Section 1.0 must have completed hazardous waste operations-related training, as required by the OSHA Standard 29 CFR 1926.65. Field employees must also receive a minimum of 3 days of actual field experience under the direct supervision of a trained, experienced supervisor. Personnel who completed their training more than 12 months prior to the start of the project must have completed an 8-hour refresher course within the past 12 months.

5.2 SITE-SPECIFIC TRAINING

Site-specific training will be accomplished by each Site worker reading this HASP, or through a Site briefing by the Site Engineer or HSO on the contents of this HASP before work begins. The review must include a discussion of the chemical, physical, and biological hazards, the protective equipment and safety procedures, and emergency procedures. Attachment A provides the Training Acknowledgment Form.

5.3 DAILY SAFETY MEETINGS

Daily Safety Meetings will be held to cover the work to be accomplished, the hazards anticipated, the protective clothing and procedures required to minimize Site hazards and emergency procedures. These meetings should be presented by the Site Engineer or HSO prior to beginning the day's field work. No work will be performed in an EZ before the daily safety meeting has been held. The daily safety meeting must also be held prior to new tasks, and repeated if new hazards are encountered. Attachment B provides the form for documenting the daily safety meetings.

5.4 FIRST AID AND CPR

At least one employee current in first aid/CPR will be assigned to the work crew and will be on the Site during operations. Refresher training in first aid (triennially) and CPR (annually) is required to keep the certificate current. These individuals must also receive training regarding the precautions and protective equipment necessary to protect against exposure to blood-borne pathogens.

6.0 PERSONAL PROTECTIVE EQUIPMENT

PPE is required to safeguard Site personnel from various hazards. Varying levels of protection may be required depending on the level of contaminants and the degree of physical hazard. This section presents the various levels of protection and defines the conditions of use for each level.

6.1 LEVELS OF PROTECTION

Protection levels are determined based upon contaminants present in the work area. The specific protection levels to be employed at the Site for each work task are presented in Table C.6.1.

6.1.1 LEVEL D PROTECTION

The minimum level of protection that will be required for all Site personnel will be Level D. The following equipment will be used:

i) work clothing as prescribed by the weather;

ii) steel toe work boots (except for liner installation personnel), meeting American National Standard Institute (ANSI) Z41;

iii) safety glasses or goggles, meeting ANSI Z87;

iv) hard hat, meeting ANSI Z89; and

v) hearing protection (if noise levels exceed 85 dBA, then hearing protection with a USEPA NRR of at least 20 dBA must be used).

6.1.2 MODIFIED LEVEL D PROTECTION

Modified Level D will be used when airborne contaminants are not present at levels of concern, but Site activities present an increased potential for skin contact with chemicals of concern. Modified Level D consists of:

i) Tyvek® coveralls;

ii) safety toe work boots;

iii) vinyl or latex boots, or polyvinyl chloride (PVC) overboots;

iv) safety glasses or goggles;

v) hard hat;

vi) face shield in addition to safety glasses or goggles when projectiles pose a hazard;

vii) nitrile gloves; and

viii) hearing protection (if necessary).

6.1.3 LEVEL C PROTECTION

Level C protection will be required when visible dust levels are sustained in the worker breathing zone.

The following equipment will be used for Level C protection:

i) full-face air purifying respirator (APR) with organic vapor/acid gas cartridges in combination with particulate filters (P-100) which are NIOSH approved;

ii) polyethylene coated Tyvek® suit, ankles, and cuffs taped to boots and gloves;

iii) nitrile gloves over nitrile sample gloves;

iv) safety toe work boots, ANSI approved;

v) chemical resistant neoprene boots with steel toes, or latex/PVC booties over safety toe shoes;

vi) hard hat, ANSI approved; and

vii) hearing protection (if necessary).

Note: It is not anticipated that Level C protection will be required for any of the proposed Phase 1 tasks.

6.1.4 SELECTION OF PPE

Equipment for personal protection will be selected based on the potential for contact, Site conditions, ambient air quality, and the judgement of supervising HSO. The PPE used will be chosen to be effective against the compound(s) present on the Site.

6.2 SITE RESPIRATORY PROTECTION PROGRAM

Respiratory protection is an integral part of employee health and safety at sites with potential airborne contamination. Due to the limited amount of intrusive activities proposed for the Phase 1 and the general lack of VOCs at the Site, it is not anticipated that respiratory protection will be necessary. However, in the event that respiratory protection is deemed to be necessary, the following Site respiratory protection program will be implemented:

i) all Site personnel who may use respiratory protection will have an assigned respirator;

ii) all Site personnel who may use respiratory protection will have been fit tested and trained in the use of a full-facepiece APR within the past 12 months;

iii) all Site personnel who may use respiratory protection must, within the past year, have been medically certified as being capable of wearing a respirator. Documentation of the medical certification must be provided to the HSO prior to commencement of Site work;

iv) only cleaned, maintained, NIOSH-approved respirators are to be used on this Site;

v) if respirators are used, the respirator cartridge is to be properly disposed of at the end of each work shift, prior to expected breakthrough or when filter load-up occurs;

vi) contact lenses are not to be worn when a respirator is worn;

vii) all Site personnel who may use respiratory protection must be clean shaven. Mustaches and sideburns are permitted, but they must not touch the sealing surface of the respirator;

viii) respirators will be inspected and a negative pressure test performed prior to each use; and

ix) after each use, the respirator will be wiped with a disinfectant, cleansing wipe. When used, the respirator will be thoroughly cleaned at the end of the work shift. The respirator will be stored in a clean plastic bag, away from direct sunlight in a clean, dry location, in a manner that will not distort the facepiece.

6.3 USING PPE

Depending upon the level of protection selected for this project, specific donning and doffing procedures may be required. The procedures presented in this section are mandatory if Level C PPE is used.

All personnel entering the EZ must put on the required PPE in accordance with the requirements of this plan. When leaving the EZ, PPE will be removed in accordance with the procedures listed, to minimize the spread of contamination.

6.3.1 DONNING PROCEDURES

These procedures are mandatory only if Level C PPE is used on the project:

i) remove bulky outerwear. Remove street clothes and store in clean location;
ii) put on work clothes or coveralls;
iii) put on the required chemical protective coveralls or rain gear;
iv) put on the required chemical protective boots or boot covers;
v) tape the legs of the coveralls to the boots with duct tape;
vi) put on the required chemical protective gloves;
vi) tape the wrists of the protective coveralls to the gloves;
vii) don the required respirator and perform appropriate fit check;
viii) put hood or head covering over head and respirator straps and tape hood to facepiece; and
ix) don remaining PPE, such as hard hat.

When these procedures are instituted, one person must remain outside the work area to ensure that each person entering has the proper protective equipment.

6.3.2 DOFFING PROCEDURES

The following procedures are only mandatory if Modified Level D or Level C PPE is required for this project. Whenever a person leaves a Modified Level D or Level C work site, the following decontamination sequence will be followed:

i) upon entering the CRZ, rinse contaminated materials from the boots or remove contaminated boot covers;

ii) clean reusable protective equipment;

iii) remove protective garments, equipment, and respirator. All disposable clothing should be placed in a covered container which is labeled;

iv) wash hands, face, and neck or shower (if necessary);

v) proceed to clean area and dress in clean clothing; and

vi) clean and disinfect respirator for next use.

All disposable equipment, garments, and PPE must be placed in covered containers and labeled for disposal. See Section 10.0 for detailed information on decontamination procedures.

6.4 SELECTION MATRIX

The level of personal protection selected will be based upon an assessment by the Site Engineer and HSO of the potential for skin contact with contaminated materials. The PPE selection matrix is given in Table C.6.1. This matrix is based upon information available at the time this plan was written. The exposure levels presented in Table C.2.2 should be used to verify that the PPE prescribed is appropriate.

6.5 DURATION OF WORK TASKS

The duration of activities involving the usage of PPE will be established by the HSO based upon ambient temperature and weather conditions, the capacity of personnel to work in the designated level of PPE (heat stress, see Section 8.3) and limitations of the protective equipment (i.e., ensemble permeation rates, life expectancy of APR cartridges, etc.). As a minimum, rest breaks will be observed at the following intervals:

i) 15 minutes midway between shift startup and lunch;

ii) 1/2 to 1 hour for lunch; and

iii) 15 minutes in the afternoon, between lunch and shift end.

All rest breaks will be taken in a clean area (e.g., SZ) after full decontamination and PPE removal. Additional rest breaks will be observed, based upon the heat stress monitoring guidelines presented in Section 8.3.

6.6 LIMITATIONS OF PROTECTIVE CLOTHING

PPE ensembles have been selected to provide protection against contaminants at anticipated concentrations. However, no protective garment, glove, or boot is chemical-proof, nor will it afford protection against all chemical types. Permeation of a given chemical through PPE is a complex process governed by contaminant concentrations, environmental conditions, physical condition of the protection garment, and the resistance of a garment to a specific contaminant; chemical permeation may continue even after the source of contamination has been removed from the garment.

In order to obtain optimum usage from PPE, the following procedures are to be followed by all Site personnel using PPE:

i) when using disposable coveralls, don a clean, new garment after each rest break or at the beginning of each shift;
ii) inspect all clothing, gloves, and boots both prior to and during use for:
   a) imperfect seams,
   b) non-uniform coatings,
   c) tears, and
   d) poorly functioning closures; and
iii) inspect reusable garments, boots, and gloves both prior to and during use for:
   a) visible signs of chemical permeation,
   b) swelling,
   c) discoloration,
   d) stiffness,
   e) brittleness,
   f) cracks,
   g) any sign of puncture, and
   h) any sign of abrasion.

Reusable gloves, boots, or coveralls exhibiting any of the characteristics listed above will be discarded. PPE used in areas known or suspected to exhibit elevated concentrations of contaminants will not be reused.

7.0 SITE CONTROL

7.1 AUTHORIZATION TO ENTER

All personnel working in EZs must have completed hazardous waste operations initial training as defined under OSHA Regulation 29 CFR 1926.65; have completed their training or refresher training within the past 12 months, and have been certified by a physician as fit for hazardous waste operations in order to enter a Site area designated as an EZ or CRZ. Personnel without such training or medical certification may enter the designated SZ only. The HSO will maintain a list of authorized persons; only personnel on the authorized persons list will be allowed within the EZ or CRZ.

7.2 SITE ORIENTATION AND HAZARD BRIEFING

No person will be allowed in the general work area during Site operations without first being given a Site orientation and hazard briefing. This orientation will be presented by the HSO, and will consist of a review of this HASP. This review must cover the chemical, physical, and biological hazards, protective equipment, safe work procedures, and emergency procedures for the project. Attachment A provides a Training Acknowledgment Form for documentation purposes. In addition to this meeting, Daily Safety Meetings will be held each day before work begins. All people on the Site, including visitors, must document their attendance to this briefing as well as the Daily Safety Meetings on the forms included with this HASP. Attachment B presents the Daily Safety Meeting Log.

7.3 CERTIFICATION DOCUMENTS

A training and medical file may be established for the project and kept on Site during all Site operations. The 40-hour training, update, and specialty training (first aid/ cardiopulmonary resuscitation [CPR]) certificates, as well as current medical clearance for all project field personnel, will be maintained within that file. Contractor and subcontractor personnel must provide their training and medical documentation to the HSO prior to the start of field work.

7.4 ENTRY LOG

A log-in/log-out sheet must be maintained at the Site by the HSO. Personnel may sign in and out on a log sheet as they enter and leave the CRZ, or the HSO may document entry and exit in the field notebook.

7.5 ENTRY REQUIREMENTS

In addition to the authorization, hazard briefing and certification requirements listed above, no person will be allowed to enter the Site unless he or she is wearing the minimum support zone PPE as described in Section 6.0. Personnel entering the EZ or CRZ must wear the required PPE for those locations.

7.6 EMERGENCY ENTRY AND EXIT

People who must enter the Site on an emergency basis will be briefed of the hazards by the HSO. All hazardous activities will cease in the event of an emergency and any sources of emissions will be controlled, if possible.

People exiting the Site because of an emergency will gather in a safe area for a head count. The HSO is responsible for ensuring that all people who entered the work area have exited in the event of an emergency.

7.7 CONTAMINATION CONTROL ZONES

Contamination control zones are maintained to prevent the spread of contamination and to prevent unauthorized people from entering hazardous areas.

7.7.1 EXCLUSION ZONE (EZ)

The EZ consists of the specific work area, or may be the entire area of suspected contamination. All employees entering the EZ must use the required PPE, and must have the appropriate training and medical clearance for hazardous waste work. The EZ is the defined area where there is a possible respiratory and/or contact health hazard. The location of each EZ will be identified by cones, caution tape, or other appropriate means.

7.7.2 CONTAMINATION REDUCTION ZONE (CRZ)

The CRZ or transition area will be established, if necessary, to perform decontamination of personnel and equipment. All personnel entering or leaving the EZ will pass through this area to prevent any cross-contamination. Tools, equipment, and machinery will be decontaminated in a specific location. The decontamination of all personnel will be performed on Site adjacent to the EZ. Personal protective outer garments and respiratory protection will be removed in the CRZ and prepared for cleaning or disposal. This zone is the only appropriate corridor between the EZ and the SZ.

7.7.3 SUPPORT ZONE (SZ)

The SZ is a clean area outside the CRZ located to prevent employee exposure to hazardous substances. Eating and drinking will be permitted in the support area only after proper decontamination. Smoking only will be permitted in the SZ if the SZ is off Site, and subject to Site requirements.

8.0 ACTIVITY HAZARD/RISK ANALYSIS AND GENERAL SAFETY PRACTICES

This section identifies the general hazards associated with specific Phase 1 activities and presents the documented or potential health and safety hazards that exist at the Site. Every effort will be made to reduce or eliminate these hazards. Those which cannot be eliminated must be guarded against by use of engineering controls and/or PPE. Table C.8.1 presents the anticipated hazards/risks and appropriate precautions.

In addition to the chemical hazards presented in Section 2.0 of this HASP, physical and biological hazards including poison ivy, poison oak, mosquitoes, bees, wasps, uneven terrain, slippery surfaces, hazards presented by the use of heavy equipment, overhead and underground utility hazards, the use of decontamination equipment, and potential heat and cold stress exist at the Site. It will be the responsibility of each contractor and their personnel to identify the physical hazards posed by the various Site activities and implement preventative and corrective action.

8.1 CHEMICAL EXPOSURE

Preventing exposure to toxic chemicals is a primary concern. Chemical substances can enter the unprotected body by inhalation, skin absorption, ingestion, or through a puncture wound (injection). A contaminant can cause damage at the point of contact or can act systematically, causing a toxic effect at a part of the body distant from the point of initial contact.

Chemical exposures are generally divided into two categories: acute and chronic. Symptoms resulting from acute exposures usually occur during or shortly after exposure to a sufficiently high concentration of a contaminant. The concentration required to produce such effects varies widely from chemical to chemical. The term "chronic exposure" generally refers to exposures to "low" concentrations of a contaminant over a long period of time. The "low" concentrations required to produce symptoms of chronic exposure depend upon the chemical, the duration of each exposure, and the number of exposures. For a given contaminant, the symptoms of an acute exposure may be completely different from those resulting from chronic exposure.

For either chronic or acute exposure, the toxic effect may be temporary and reversible, or may be permanent (disability or death). Some chemicals may cause obvious symptoms such as burning, coughing, nausea, tearing eyes, or rashes. Other chemicals may cause health damage without any such warning signs (this is a particular concern for chronic exposures to low concentrations). Health effects such as cancer or respiratory disease may not become evident for several years or decades after exposure. In addition, some toxic chemicals may be colorless and/or odorless, may dull the sense of smell, or may not produce any immediate or obvious physiological sensations. Thus, a worker's senses or feelings cannot be relied upon in all cases to warn of potential toxic exposure.

The effects of exposure not only depend on the chemical, its concentration, route of entry, and duration of exposure, but may also be influenced by personal factors such as the individual's smoking habits, alcohol consumption, medication use, nutrition, age, and sex.

An important exposure route of concern at the Site is inhalation. The lungs are extremely vulnerable to chemical agents. Even substances that do not directly affect the lungs may pass through lung tissue into the bloodstream, where they are transported to other vulnerable areas of the body. Some toxic chemicals present in the atmosphere may not be detected by human senses (i.e., they may be colorless, odorless, and their toxic effects may not produce any immediate symptoms). Respiratory protection is therefore extremely important if there is a possibility that the work site atmosphere may contain such hazardous substances. Chemicals can also enter the respiratory tract through punctured eardrums. Where this is a hazard, individuals with punctured eardrums should be medically evaluated specifically to determine if such a condition would place them at an unacceptable risk and preclude their working at the task in question.

Direct contact of the skin and eyes by hazardous substances is another important route of exposure. Some chemicals directly injure the skin. Some pass through the skin into the bloodstream where they are transported to vulnerable organs. Skin absorption is enhanced by abrasions, cuts, heat, and moisture. The eye is particularly vulnerable because airborne chemicals can dissolve in its moist surface and be carried to the rest of the body through the bloodstream (capillaries are very close to the surface of the eye). Wearing protective equipment, not using contact lenses in contaminated atmospheres (since they may trap chemicals against the eye surface), keeping hands away from the face, and minimizing contact with liquid and solid chemicals can help protect against skin and eye contact.

Although ingestion should be the least significant route of exposure at the Site, it is important to be aware of how this type of exposure can occur. Deliberate ingestion of chemicals is unlikely, however, personal habits such as chewing gum or tobacco, drinking, eating, smoking cigarettes, and applying cosmetics at the Site may provide a route of entry for chemicals.

The last primary route of chemical exposure is injection, whereby chemicals are introduced into the body through puncture wounds (i.e., by stepping or tripping and falling onto contaminated sharp objects). Wearing safety shoes, avoiding physical hazards, and taking common sense precautions are important protective measures against injection.

8.2 GENERAL PRACTICES

Additional general safety practices to be implemented are as follows:

i) at least one copy of this HASP must be at the project Site, in a location readily available to all personnel, and reviewed by all project personnel prior to starting work;

ii) all Site personnel must use the buddy system (working in pairs or teams);

iii) food, beverages, or tobacco products must not be present or consumed in the EZ and CRZ. Cosmetics must not be applied within these zones;

iv) emergency equipment such as eyewash, fire extinguishers, etc., must be removed from storage areas and staged in readily accessible locations;

v) contaminated waste, debris, and clothing must be properly contained and legible and understandable precautionary labels must be affixed to the containers;

vi) removing contaminated soil from protective clothing or equipment with compressed air, shaking, or any other means that disperses contaminants into the air is prohibited;

vii) containers must be moved only with the proper equipment, and must be secured to prevent dropping or loss of control during transport; and

viii) visitors to the Site must be instructed to stay outside the EZ and CRZ and remain within the SZ during the extent of their stay. Visitors must be cautioned to avoid skin contact with surfaces which are contaminated or suspected to be contaminated.

8.2.1 BUDDY SYSTEM

All on-Site personnel must use the buddy system. Visual contact must be maintained between crew members at all times, and crew members must observe each other for signs of chemical exposure, heat, or cold stress. Indications of adverse effects include, but are not limited to:

i) changes in complexion and skin coloration;
ii) changes in coordination;
iii) excessive salivation and pupillary response; and
iv) changes in speech pattern.

Team members must also be aware of potential exposure to possible safety hazards, unsafe acts, or noncompliance with safety procedures. Employees must inform their partners or fellow team members of non-visible effects of exposure to toxic materials. The symptoms of such exposure may include:

i) headaches;
ii) dizziness;
iii) nausea;
iv) blurred vision;
v) cramps; and
vi) irritation of eyes, skin, or respiratory tract.

If protective equipment or noise levels impair communications, prearranged hand signals must be used for communication. Personnel must stay within line of sight of another team member.

8.3 HEAT STRESS

Heat stress is caused by a number of interacting factors including environmental conditions, clothing, workload, etc., as well as the physical and conditioning characteristics of the individual. Since heat stress is one of the most common illnesses associated with heavy outdoor work conducted with direct solar load and, in particular, because wearing PPE can increase the risk of developing heat stress, workers must be capable of recognizing the signs and symptoms of heat-related illnesses. Personnel must be aware of the types and causes of heat-related illnesses and be able to recognize the signs and symptoms of these illnesses in both themselves and their co-workers.

Heat Rashes: Are the one of the most common problems in hot work environments. Commonly known as prickly heat , a heat rash is manifested as red papules and usually appears in areas where the clothing is restrictive. As sweating increases, these papules give rise to a prickling sensation. Prickly heat occurs in skin that is persistently wetted by unevaporated sweat, and heat rash papules may become infected if they are not treated. In most cases, heat rashes will disappear when the affected individual returns to a cool environment.

Heat Cramps: Are usually caused by performing hard physical labor in a hot environment. These cramps have been attributed to an electrolyte imbalance caused by sweating. It is important to understand that cramps can be caused both by too much and too little salt.

Cramps appear to be caused by the lack of water replenishment. Because sweat is a hypotonic solution (plus or minus 0.3 percent NaCl), excess salt can build up in the body if the water lost through sweating is not replaced. Thirst cannot be relied on as a guide to the need for water; instead, water must be taken every 15 to 20 minutes in hot environments.

Under extreme conditions, such as working for 6 to 8 hours in heavy protective gear, a loss of sodium may occur. Drinking commercially available carbohydrate-electrolyte replacement liquids is effective in minimizing physiological disturbances during recovery.

Heat Exhaustion: Occurs from increased stress on various body organs due to inadequate blood circulation, cardiovascular insufficiency, or dehydration. Signs and symptoms include pale, cool, moist skin; heavy sweating; dizziness; nausea; headache, vertigo, weakness, thirst, and giddiness. Fortunately, this condition responds readily to prompt treatment.

Heat exhaustion should not be dismissed lightly, however, for several reasons. One is that the fainting associated with heat exhaustion can be dangerous because the victim may be operating machinery or controlling an operation that should not be left unattended; moreover, the victim may be injured when he or she faints. Also, the signs and symptoms seen in heat exhaustion are similar to those of heat stroke, which is a medical emergency.

Workers suffering from heat exhaustion should be removed from the hot environment, be given fluid replacement, and be encouraged to get adequate rest.

Heat Stroke: Is the most serious form of heat stress. Heat stroke occurs when the body's system of temperature regulation fails and the body's temperature rises to critical levels. This condition is caused by a combination of highly variable factors, and its occurrence is difficult to predict.

Heat stroke is a medical emergency. The primary signs and symptoms of heat stroke are confusion; irrational behavior; loss of consciousness; convulsions; a lack of sweating (usually); hot, dry skin; and an abnormally high body temperature, e.g., a rectal temperature of 41°C (105.8°F). If body temperature is too high, it causes death. The elevated metabolic temperatures caused by a combination of work load and environmental heat load, both of which contribute to heat stroke, are also highly variable and difficult to predict.

If a worker shows signs of possible heat stroke, professional medical treatment should be obtained immediately. The worker should be placed in a shady area and the outer clothing should be removed. The worker's skin should be wetted and air movement around the worker should be increased to improve evaporative cooling until professional methods of cooling are initiated and the seriousness of the condition can be assessed. Fluids should be replaced as soon as possible. The medical outcome of an episode of heat stroke depends on the victim's physical fitness and the timing and effectiveness of first aid treatment.

Regardless of the worker's protestations, no employee suspected of being ill from heat stroke should not be sent home or left unattended unless a physician has specifically approved such an order.

Proper training and preventive measures will help avert serious illness and loss of work productivity. Preventing heat stress is particularly important because once someone suffers from heat stroke or exhaustion, that person may be predisposed to additional heat injuries.

Heat Stress Safety Precautions: Heat stress monitoring and work rest cycle implementation should commence when the ambient adjusted temperature exceeds 72°F. A minimum work rest regimen and procedures for calculating ambient adjusted temperature are described below.

Adjusted Temperature(1)	*Work-Rest Regimen Normal Work Ensemble*(2)	*Work-Rest Regimen Impermeable Ensemble*
90°F (32.°C) or above	After each 45 minutes of work	After each 15 minutes of work
87.5° to 90°F (30.8°C to 32.2°C)	After each 60 minutes of work	After each 30 minutes of work
82.5° to 87.5°F (28.1° to 30.8°C)	After each 90 minutes of work	After each 60 minutes of work

Adjusted Temperature[1]	*Work-Rest Regimen Normal Work Ensemble*[2]	*Work-Rest Regimen Impermeable Ensemble*
77.5° to 82.5°F (25.3° to 28.1°C)	After each 120 minutes of work	After each 90 minutes of work
72.5° to 77.5°F (30.8° to 32.2°C)	After each 150 minutes of work	After each 120 minutes of work

Notes:

(1) Calculate the adjusted air temperature (ta adj) by using this equation: ta adj °F=ta °F + (13 x percent sunshine). Measure air temperature (ta) with a standard mercury-in-glass thermometer, with the bulk shielded from radiant heat. Estimate percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow (100 percent sunshine = no cloud cover and a sharp, distinct shadow; 0 percent sunshine = no shadows).

(2) A normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.

In order to determine if the work rest cycles are adequate for the personnel and specific Site conditions, additional monitoring of individuals heart rates will be conducted during the rest cycle. To check the heart rate, count the radial pulse for 30 seconds at the beginning of the rest period. If the heart rate exceeds 110 beats per minute, shorten the next work period by one-third and maintain the same rest period.

Additional one or more of the following control measures can be used to help control heat stress and are mandatory if any Site worker has a heart rate (measure immediately prior to rest period) exceeding 115 beats per minute:

i) Site workers will be encouraged to drink plenty of water and electrolyte replacement fluids throughout the day;

ii) on-Site drinking water will be kept cool (50 to 60°F);

iii) a work regimen that will provide adequate rest periods for cooling down will be established, as required;

iv) all personnel will be advised of the dangers and symptoms of heat stroke, heat exhaustion, and heat cramps;

v) cooling devices such as vortex tubes or cooling vests should be used when personnel must wear impermeable clothing in conditions of extreme heat;

vi) employees should be instructed to monitor themselves and co-workers for signs of heat stress and to take additional breaks as necessary;

vii) a shaded rest area must be provided. All breaks should take place in the shaded rest area;

viii) employees must not be assigned to other tasks during breaks;

ix) employees must remove impermeable garments during rest periods. This includes Tyvek® garments; and

x) all employees must be informed of the importance of adequate rest, acclimation, and proper diet in the prevention of heat stress disorders.

8.4 SANITATION

Site sanitation will be maintained according to OSHA and Department of Health requirements.

8.4.1 BREAK AREA

Breaks must be taken in the SZ, away from the active work area after Site personnel go through decontamination procedures. There will be no smoking, eating, drinking, or chewing gum or tobacco in the area other than the SZ.

8.4.2 POTABLE WATER

The following rules apply for all project field operations:

i) an adequate supply of potable water will be provided at each work Site. Potable water must be kept away from hazardous materials, contaminated clothing, and contaminated equipment;

ii) portable containers used to dispense drinking water must be capable of being tightly closed, and must be equipped with a tap dispenser. Water must not be drunk directly from the container, nor dipped from the container;

iii) containers used for drinking water must be clearly marked and not used for any other purpose; and

iv) disposable cups must be supplied, and both a sanitary container for unused cups and a receptacle for disposing of used cups must be provided.

8.4.3 SANITARY FACILITIES

Access to facilities for washing before eating, drinking, or smoking will be provided.

8.4.4 LAVATORY

An adequate number of portable chemical toilets will be provided.

8.4.5 TRASH COLLECTION

Trash collected from the CRZ will be separated as potentially contaminated waste. Trash collected in the support and break areas will be disposed of as non-hazardous waste. Trash receptacles will be set up in the CRZ and in the SZ.

8.5 LIFTING HAZARDS

Back strain or injury may be prevented by using proper lifting techniques. The fundamentals of proper lifting include:

i) consider the size, shape, and weight of the object to be lifted. A mechanical lifting device or additional persons must be used to lift an object if it cannot be lifted safely alone;

ii) the hands and the object should be free of dirt or grease that could prevent a firm grip;

iii) gloves must be used, and the object inspected for metal slivers, jagged edges, burrs, or rough or slippery surfaces;

iv) fingers must be kept away from points which could crush or pinch them, especially when putting an object down;

v) feet must be placed far enough apart for balance. The footing should be solid and the intended pathway should be clear;

vi) the load should be kept as low as possible, close to the body with the knees bent;

vii) to lift the load, grip firmly and lift with the legs, keeping the back as straight as possible;

viii) a worker should not carry a load that he or she cannot see around or over; and

ix) when putting an object down, the stance and position are identical to that for lifting; the legs are bent at the knees, and the back is straight as the object is lowered.

9.0 DUST MONITORING

During the progress of field activities, periodic measurements (hourly or more frequently in the case of visible dust emissions as determined by the Site Representative) will be taken by the Site Representative. Measurements will be collected for particulates. Particulate data will be extrapolated to determine metals levels. This monitoring will be conducted at an upwind location, in worker breathing zones and at the downwind perimeter of the EZ. In addition, this air monitoring will be conducted continuously at the downwind perimeter of the EZ whenever intrusive field activities are in active progress. The continuous monitoring will assure that the New York State Department of Environmental Conservation (NYSDEC) action levels for particulates are not exceeded. If an action level (Table C.2.2) is exceeded, all ongoing Site work will be stopped and proper corrective actions will be implemented. Work will not resume until airborne contaminants can be maintained below action levels.

The following air monitoring instrumentation will be used:

i) a real time digital particulate monitor such as a Sibata P-5 or equivalent.

Measurements will be recorded in a bound field logbook. This logbook will be kept on Site during all active field work.

10.0 DECONTAMINATION PROCEDURES

In general, everything that enters the EZ at this Site must either be decontaminated or properly discarded upon exit from the EZ. All personnel, including any State and local officials must enter and exit the EZ through the CRZ. Prior to demobilization, potentially contaminated equipment will be decontaminated on a wash pad (decontamination pad) which has a built in sump and the equipment will be inspected by the HSO before it is moved into the clean zone. Any material that is generated by decontamination procedures will be stored in a designated area in the EZ until disposal arrangements are made.

The type of decontamination solution to be used is dependent on the type of chemical hazards. The decontamination solution for heavy equipment and for any reusable PPE is Liqui-nox soap. The Material Safety Data Sheets (MSDSs) for Liqui-nox and any other chemical containing products brought to the Site will be maintained on Site by the HSO.

10.1 EQUIPMENT DECONTAMINATION PROCEDURES

All equipment that comes in contact with waste material must be decontaminated within the CRZ by a pressure water cleaner upon exit from the EZ. Decontamination procedures should include: knocking soil/mud from machines; water brush scrubbing using a solution of water and Liqui-nox; and a final water rinse. Personnel shall wear Level C or Modified Level D protection, as determined by the HSO, when decontaminating equipment. Runoff will be collected and stored until proper disposal arrangements have been made. Following decontamination and prior to exit from the EZ, the HSO shall be responsible for ensuring that the item has been sufficiently decontaminated. This inspection shall be included in the Site log.

11.0 MEDICAL SURVEILLANCE

In accordance with the requirements detailed in 29 CFR 1926.65 and 29 CFR 1910.134, all Site personnel who will come in contact with potentially contaminated materials will have received, within 1 year prior to starting field activities, medical surveillance by a licensed physician or physician's group.

Medical records for all on-Site personnel will be maintained by their respective employers. The medical records will detail the tests that were taken and will include a copy of the consulting physician's statement regarding the tests and the employee's suitability for work.

The medical records will be available to the employee or his designated representative upon written request, as outlined in 29 CFR 1910.1020.

Each employer will provide certifications to the HSO that their personnel involved in Site activities will have all necessary medical examinations prior to commencing work which requires respiratory protection or potential exposure to hazardous materials. Personnel not obtaining medical certification will not perform work within contaminated areas.

Interim medical surveillance will be completed if an individual exhibits poor health or high stress responses due to any Site activity or when accidental exposure to elevated concentrations of contaminants occur.

12.0 EMERGENCY CONTINGENCIES

It is essential that Site personnel be prepared in the event of an emergency. Emergencies can take many forms; illnesses or injuries, chemical exposure, fires, explosions, spills, leaks, releases of harmful contaminants, or sudden changes in the weather. Prior to works at the Site, the Site Engineer and/or HSO will notify and coordinate with plant personnel.

12.1 EMERGENCY CONTACTS

Agency/Facility/Individual			*Phone*
Police Department			911
Fire Department			911
Paramedics (Ambulance)			911/278-4000
Hospital (Niagara Falls Memorial Medical Center)			278-4000
National Response Center (24 Hours)			(800) 424-8802
Project Manager (Jamie Puskas)			(519) 884-0510
Project Industrial Hygienist (Craig Gebhardt)			(716) 297-2160
NYSDEC (Pollution, Health)	Buffalo		851-7000
	Albany	Water	(518) 457-6674
		Air	(518) 457-7230
		Solids and Hazardous Waste	(518) 457-5861

Directions from the Site to the hospital, as shown on Figure C.12.1, are as follows:

i) Turn left on Witmer Road;
ii) Turn right on College Avenue;
iii) Turn left on Highland Avenue;
iv) Continue on 11th Street;
v) Bear left on Portage Road;
vi) Turn right on Cedar Avenue; and
vii) Turn left on 10th Street.

Communication between work areas and the command post, located within the CZ, will be via verbal communication, auto horn, or two-way radio. The HSO will use the nearest telephone on Site or may be in the possession of a mobile telephone to communicate with outside emergency and medical facilities.

The following signals shall be established for use with auto or compressed air-type horns:

i) 1 Long Blast (2-Second Duration): evacuate exclusion area, meet at CRZ or designated area;
ii) 1 Long Blast with 2 Short Blasts: prepare for removal of injured personnel, evacuate work area; and
iii) 3 Short Blasts: all clear.

The following hand signals will be used by downrange field teams in conjunction with the "buddy" system. These signals are very important when working with heavy equipment. They shall be known by the entire field team before operations commence.

Signal	*Meaning*
• Hand Gripping Throat	Out of Air; Can't Breathe
• Grip Partner's Wrist	Leave Area Immediately
• Hands on Top of Head	Need Assistance
• Thumbs Up	Ok, I'm All Right, I Understand
• Thumbs Down	No, Negative

12.2 EMERGENCY AND FIRST AID EQUIPMENT

Emergency safety equipment will be available for use by Site personnel and will be located and maintained on Site. The safety equipment will include, but is not limited to, the following:

i) portable emergency eye wash;
ii) one 20-pound ABC type dry chemical fire extinguishers; and
iii) approved first-aid kit for a minimum of ten personnel;

12.3 PROJECT PERSONNEL RESPONSIBILITIES DURING EMERGENCIES

Note: All emergencies require notification and coordination with plant S&H/ Security personnel.

HEALTH AND SAFETY OFFICER (HSO)

As the administrator of the HASP, the HSO has primary responsibility for responding to and correcting emergency situations. The HSO will:

i) take appropriate measures to protect personnel including: withdrawal from the EZ, total evacuation and securing of the Site or upgrading or downgrading the level of protective clothing and respiratory protection;

ii) take appropriate measures to protect the public and the environment including isolating and securing the Site, preventing runoff to surface waters, and ending or controlling the emergency to the extent possible;

iii) ensure that appropriate Federal, State, and local agencies are informed, and emergency response plans are coordinated. In the event of fire or explosion, the local fire department should be summoned immediately. In the event of an air release of toxic materials, the local authorities should be informed in order to assess the need for evacuation. In the event of a spill, sanitary districts and drinking water systems may need to be alerted;

iv) ensure that appropriate decontamination treatment or testing for exposed or injured personnel is obtained;

v) determine the cause of the incident and make recommendations to prevent the reoccurrence; and

vi) ensure that all required reports have been prepared.

12..4 MEDICAL EMERGENCIES

Any person who becomes ill or injured in the EZ must be decontaminated to the maximum extent possible. If the injury or illness is minor, full decontamination should be completed and first aid administered prior to transport. If the patient's condition is serious, at least partial decontamination should be completed as much as possible without causing further harm to the patient. First aid should be administered while awaiting an ambulance or paramedics. All injuries and illnesses must immediately be reported to the HSO, and Site Engineer.

Any person transporting an injured/exposed person to a clinic or hospital for treatment should take with them directions to the hospital and a copy of the identified chemicals on Site to which they may have been exposed.

Any vehicle used to transport contaminated personnel, will be cleaned or decontaminated as necessary.

12.5 FIRE OR EXPLOSION

In the event of a fire or explosion, the local fire department should be summoned immediately. Upon their arrival, the HSO or designated alternate will advise the fire commander of the location, nature, and identification of the hazardous materials on Site.

If it is safe to do so, Site personnel should:

i) report to the Site Engineer;
ii) use fire fighting equipment available on Site; or
iii) remove or isolate flammable or other hazardous materials which may contribute to the fire.

12.6 SPILLS

On-Site

If a spill occurs, the following procedure will be followed:

i) notify the HSO, and Site Engineer;
ii) evacuate immediate area of spill;
iii) determine the needed level of PPE;
iv) don required level of PPE and prepare to make entry to apply spill containment and control procedures;
v) no entry will be made until atmosphere is less than 10 percent of the LEL; and
vi) absorb or otherwise clean up the spill and containerize the material, sorbent, and affected soils.

The Site Engineer and HSO have the authority to commit resources as needed to contain and control released material and to prevent its spread to off-Site areas.

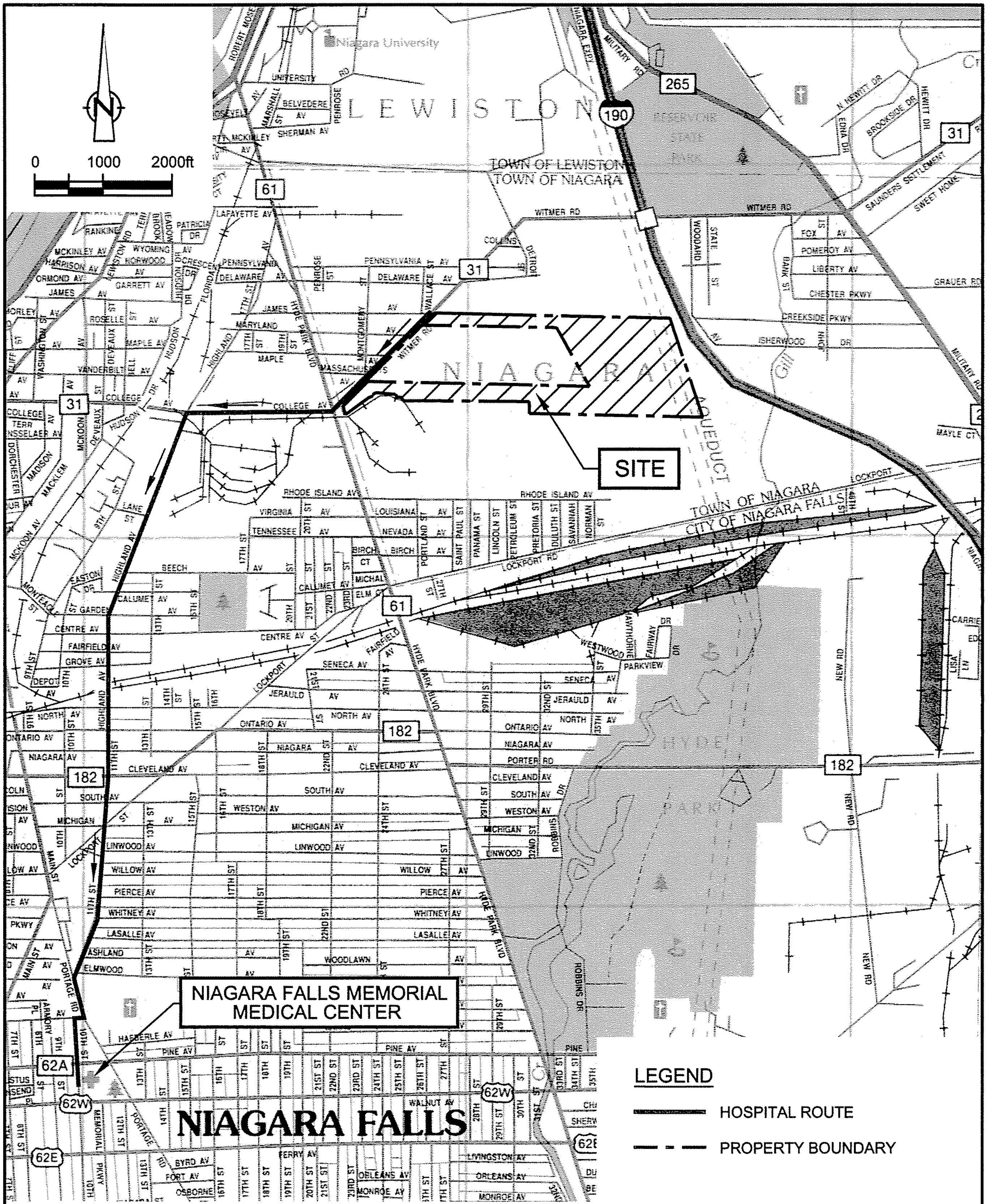
Releases from drums containing solid wastes will be placed into approved containers and covered. Each container will be labeled as to its contents. Solid spills from haulage units will be placed back into haulage units.

In the event that a drum or container of liquid is spilled on Site outside of the EZ, a drum handling team will immediately respond to the spill. The spilled liquids will be confined to the immediate area of the spill and the liquids will be pumped, with the use of a portable hand pump, into a repack drum. The spilled liquids will be confined by diking around the spill with native material or with an inert absorbent. Any residual liquids which cannot be pumped will be absorbed with a sufficient quantity of inert absorbent to ensure that no free liquids remain. If the spill occurred on soil, the visibly affected soil will be excavated. The absorbent and excavated material will be drummed or otherwise appropriately contained.

13.0 RECORDKEEPING

The HSO shall establish and maintain records of all necessary and prudent monitoring activities as described below:

i) name and job classification of the employees involved on specific tasks;
ii) records of fit testing and medical surveillance results for Site personnel;
iii) records of all OSHA training certification for Site personnel;
iv) records of training acknowledgment forms and daily safety meetings;
v) emergency report sheets describing any incidents or accidents;
vi) air monitoring equipment calibrations; and
vii) air monitoring data.



LEGEND

▬ HOSPITAL ROUTE

— - — PROPERTY BOUNDARY

SOURCE: DELORME MAPPING ATLAS,
UPSTATE NEW YORK, CITY STREET MAPS

figure C.12.1

HOSPITAL ROUTE
VANADIUM CORPORATION OF AMERICA SITE
Niagara Falls, NY

19867-00(001)GN-WA007 SEP 19/2002

TABLE C.2.1

DETECTED CONCENTRATION OF CHEMICALS OF CONCERN IN SITE SOILS, GROUNDWATER, AND SURFACE WATER
PHASE 1 WORK PLAN
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Compounds in Soils	*Maximum Detected Concentrations During Historical Investigations (mg/kg)*
Metals	
Aluminum	113,000
Arsenic	24.2
Cadmium	141
Chromium	11,800
Chromium (hexavalent)	99.2
Cobalt	536
Copper	5,420
Lead	1,760
Manganese	78,300
Nickel	5,160
Selenium	40.4
Zinc	1,400
Other Parameters	
pH	12.3 Std. Units

Compounds in Groundwater/Surface Water	*Maximum Detected Concentrations During Historical Investigations (mg/L)*
Metals	
Antimony	0.0357
Barium	6.3
Chromium	2.64
Chromium (hexavalent)	1.56
Lead	39.9
Manganese	1.62
Nickel	1.85
Other Parameters	
Ammonia	16
Cyanide (total)	0.54
pH	13.6 Std. Units

TABLE C.2.2

EXPOSURE ROUTES, EXPOSURE LEVELS AND ACTION LEVELS FOR THE CHEMICALS OF CONCERN
PHASE 1 WORK PLAN
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Chemical Compound	*Ionization Potential (1)*	*Exposure Routes (1)*	*Acceptable Exposure Levels in Air**	*Action Level for Dust Emissions*
Manganese	NA	Inhalation, Ingestion	0.2 mg/m^3 (2) 5 mg/m^3 C (7)	0.1 mg/m^3
Lead	NA	Inhalation, Ingestion Skin Contact, Eye Contact	0.05 mg/m^3 (2) 0.05 mg/m^3 (8)	5 mg/m^3
Arsenic	NA	Inhalation, Ingestion Skin Contact, Eye Contact	0.01 mg/m^3 (2) 0.5 mg/m^3 (7) 0.01 mg/m^3 (9)	5 mg/m^3
Cadmium	NA	Inhalation, Ingestion	0.01 mg/m^3 (2) 0.005 mg/m^3 (10)	5 mg/m^3
Copper (dust)	NA	Inhalation, Ingestion Skin Contact, Eye Contact	1 mg/m^3 (2) 1 mg/m^3 (7)	5 mg/m^3
Aluminum (metal dust)	NA	Inhalation	10 mg/m^3 (2) 15 mg/m^3 (OSHA)	5 mg/m^3
Chromium	NA	Inhalation, Ingestion Skin Contact, Eye Contact	0.5 mg/m^3 (2) 0.5 mg/m^3 (OSHA) PEL (7)	5 mg/m^3
Chromium (hexavalent)	NA	Inhalation, Ingestion Skin Contact, Eye Contact	0.05 mg/m^3 (2) 0.1 mg/m^3 (OSHA) (7)	5 mg/m^3
Cobalt	NA	Inhalation, Ingestion Skin Contact, Eye Contact	0.02 mg/m^3 (2) 0.1 mg/m^3 (OSHA) PEL (7)	5 mg/m^3
Nickel (elemental)	NA	Inhalation, Ingestion Skin Contact, Eye Contact	1.5 mg/m^3 (2) 1.0 mg/m^3 (OSHA) PEL (7)	5 mg/m^3
Selenium	NA	Inhalation, Ingestion Skin Contact, Eye Contact	0.2 mg/m^3 (2) 0.2 mg/m^3 (OSHA) (7)	5 mg/m^3
Zinc (dust)	NA	Inhalation	10 mg/m^3 (2) 15 mg/m^3 (OSHA) (7)	5 mg/m^3

TABLE C.2.2

EXPOSURE ROUTES, EXPOSURE LEVELS AND ACTION LEVELS FOR THE CHEMICALS OF CONCERN
PHASE 1 WORK PLAN
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Chemical Compound	*Ionization Potential (1)*	*Exposure Routes (1)*	*Acceptable Exposure Levels in Air**	*Action Level for Dust Emissions*
Ammonia	NA	Inhalation, Skin Contact	17 mg/m^3 (2) 35 mg/m^3 (OSHA) PEL (7)	NA
Vanadium	NA	Inhalation, Ingestion Skin Contact	0.05 mg/m^3 0.5 mg/m^3 (OSHA) (7)	5 mg/m^3
Cyanide (total)	NA	Inhalation, Ingestion Skin Contact	5 mg/m^3 (OSHA) (7)	NA
pH	NA	Skin Contact, Eye Contact	NA	NA

Notes:

(1)	NIOSH Pocket Guide To Chemical Hazards (99-115). National Institute for Occupational Safety and Health (NIOSH).
(2)	2002 TLVs and BEIs, Threshold Limit Values for Chemical Substances and Physical Agents/ Biological Exposure Indices. American Conference of Govenrmental Industrial Hygienists.
(3)	29 CFR 1910.1028 - Permissible Exposure Limit
(4)	29 CFR 1910.1028 - Permissible Exposure Limit - 15-minute STEL
(5)	29 CFR 1910.1017 - Permissible Exposure Limit
(6)	29 CFR 1910.1017 - Permissible Exposure Limit - 15-minute C
(7)	29 CFR 1910.1001 - Permissible Exposure Limit
(8)	29 CFR 1910.1025 - Permissible Exposure Limit
(9)	29 CFR 1910.1018 - Permissible Exposure Limit
(10)	29 CFR 1910.1027 - Permissible Exposure Limit
mg/m^3	Milligrams per Cubic Meter.
NA	Not Applicable.
NE	Not Established.
ppm	Parts Per Million.
TWA	Time-Weighted Average Limit
STEL	Short-Term Exposure Limit
*	8-hour TWA exposure limits/guidelines for exposure to total dust unless other wise noted
C	Ceiling Exposure Limit

TABLE C.6.1

SPECIFIC PERSONAL PROTECTION LEVELS
PHASE 1 WORK PLAN
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Work Task	*Maximum Protection Level* [(1)]	*Anticipated Protection Level*
Mobilization and Demobilization of Labor, Materials, and Equipment to and from the Site	Modified D	D
Surveying Activities	Modified D	D
Site Setup Activities Including Construction of Temporary Decontamination Pad	Modified D	D
Drilling Boreholes, Test Pit Excavations	Level C	Modified D
Installing Monitoring Wells	Level C	Modified D
Collecting Soil, Sediment, Groundwater, Surface Water, and Water Level Samples	Level C	Modified D
Decontamination Activities	Level C	Modified D
Site Restoration Activities	Modified D	D

Notes:

Specific requirements of protection levels are detailed in Section 6.0.

(1) Level C: To be worn when the criterion for using air-purifying respirators (APRs) are met.
Modified D: To be worn when dermal protection is required, however, no respiratory hazards are present.

TABI .1

ANTICIPATED HAZARDS/RISKS AND HAZARD CONTROLS
PHASE 1 WORK PLAN
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

	Activity(ies)	*Anticipated Hazards/Risks*	*Appropriate Precautions*
1.	Drilling Boreholes, Installing Monitoring Wells; Test Pit Excavations; Collecting Soil, Sediment, Groundwater, Surface Water, and Water Level Measurements; and Decontamination Activities.	• Metals in soil may become airborne	• Employ dust suppression techniques (e.g., wetting soil surface) as necessary.
2.	All Activities: Mobilization and Demobilization of Labour, Materials and Equipment to and from the Site; Surveying Activities; Site Setup Activities Including Construction of Temporary Decontamination Pad; Drilling Boreholes, Installing Monitoring Wells; Test Pit Excavations; Collecting Soil, Sediment, Groundwater, Surface Water, and Water Level Measurements; Decontamination Activities; and Site Restoration	• Slips, Trips and Falls	• Good housekeeping will be maintained at all work sites. Trip hazards will be removed, marked, or guarded. Extreme caution shall be used when working on or around slippery surfaces, and fall protection will be worn at elevations greater than 3 feet. All necessary precautions will be taken to prevent personnel from injuries caused by slick surfaces.
		• Back Strain/Ergonomics	• Proper lifting techniques shall be used when handling heavy or bulky loads, such as sampling equipment or sample coolers. Personnel shall lift with legs, keeping backs straight, and loads close to their bodies. Avoid twisting at the waist during lifting. Personnel shall receive help from others when loads appear to be too heavy. Mechanical means of lifting is the preferred method and will be used
		• Buried Utilities	• All buried utilities shall be identified prior to any intrusive work in the work area. Buried utilities will never be located by mechanically powered excavating equipment. Buried utilities shall be located by hand excavation. QS Form Number QSF-019 (Property Access/Utility Clearance Data Sheet) will be completed and distributed as indicated.

TABLE C.8.1

ANTICIPATED HAZARDS/RISKS AND HAZARD CONTROLS
PHASE 1 WORK PLAN
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Activity(ies)	*Anticipated Hazards/Risks*	*Appropriate Precautions*
	• Electrical	• Only qualified personnel are authorized to work on electrical circuits. CRA Lock Out -- Tag Out SOPs shall be used before any maintenance on electrical circuits or equipment is to take place. Extension cords will be inspected daily. Damaged extension cords will be taken out of service immediately. Electrical cords not specifically made for water submersion will be kept out of wet areas. Ground fault circuit interrupters (GFCI) will be used on all temporary electrical circuits (including generators), unless an assured ground fault inspection program has been implemented.
	• Small Quantity Flammable and Combustible Materials	• Small quantities of flammable/combustible materials shall be stored in "safety" cans with appropriate flame arrestors, self-closing lids, and labeled according to their contents.
	• Overhead Hazards	• Investigation of a work area must be conducted before any work is to begin. Proper clearances must be maintained at all times. Equipment shall not deviate from established roadways or work areas where clearances are unknown or insufficient. Hard hats are to be worn on all construction sites where there is any potential of overhead hazard or if heavy machinery is in use.
	• Heat/Cold Stress	• CRA personnel have the potential to be exposed to climatic extremes of both heat and cold. Because of these conditions, SOPs were developed so that the hazards associated with these temperature extremes on the body can be recognized and avoided. During extreme weather, the SOP for heat and cold stress must be followed.
	• Animals/Insects/Vegetation	• Rodents, stray animals, stinging insects, and poison ivy, sumac and oak are all environmental hazards that may be encountered during daily site operations. Site investigation to identify the hazards prior to work related activities is essential. The information obtained can then be passed on to site personnel. Site-specific procedures shall be instituted should there be a reasonable potential for these hazard

ATTACHMENT C-1

TRAINING ACKNOWLEDGMENT FORM

TRAINING ACKNOWLEDGEMENT FORM

I have been instructed in and understand and have received instruction with the Site Safety Plan. I have been informed who to contact if I have any questions and know where to report any additional health and safety hazards. I agree to work to the Safety Plan guidelines and understand that failure to do so could result in removal from the Site.

Date	*Printed Name*	*Signature*	*Company*

ATTACHMENT C-2

DAILY SAFETY MEETING LOG

DAILY SAFETY MEETING LOG

PROJECT: ____________________ LOCATION: ____________________

DATE/TIME: ____________________

1. Safety Issues or Topics Discussed:

2. Work Summary and Physical/Chemical Hazards of Concern:

3. Protective Equipment/Procedures:

4. Emergency Procedure:

5. Signatures of Attendees:

APPENDIX D

COMMUNITY AIR MONITORING PLAN

TABLE OF CONTENTS

Page

1.0 INTRODUCTION....D-1

2.0 OBJECTIVE....D-2

3.0 RESPONSIBILITIES AND ADMINISTRATION....D-3

4.0 MONITORING PARAMETERS AND ACTION LEVELS....D-4
- 4.1 MONITORING PARAMETERS....D-4
- 4.2 MAXIMUM ALLOWABLE PM-10 CONCENTRATION AT SITE BOUNDARY....D-5
- 4.3 MAXIMUM ALLOWABLE PM-10 CONCENTRATION AT WORK ZONE....D-5

5.0 AIR MONITORING PROCEDURES....D-7
- 5.1 BACKGROUND AIR MONITORING....D-7
- 5.2 PERIMETER AIR SAMPLING....D-7
- 5.3 REAL-TIME WORK ZONE AIR MONITORING....D-7
- 5.4 METEOROLOGICAL MONITORING....D-8
- 5.5 FIELD DATA RECORDING....D-8

6.0 MITIGATIVE ACTIONS....D-9
- 6.1 EXCEEDANCE OF REAL-TIME WORK ZONE AIR MONITORING ACTION LEVEL....D-9

LIST OF FIGURES
(Following Text)

FIGURE D.1.1 SITE LOCATION

FIGURE D.1.2 SITE LAYOUT

LIST OF TABLES
(Following Text)

TABLE D.4.1 DEVELOPMENT OF INTERIM SGC VALUES FOR CHEMICALS OF CONCERN IN SITE SOILS AND COMPARISON TO MAXIMUM ALLOWABLE PM-10 CONCENTRATION

TABLE D.4.2 PM-10 CONCENTRATIONS MEETING AMBIENT AIR QUALITY STANDARDS AT VARIOUS MONITORING DISTANCES FROM PROPERTY BOUNDARY DEVELOPED USING SCREEN3 MODELING DATA

LIST OF ATTACHMENTS

ATTACHMENT D-1 SCREEN3 MODELING RESULTS

1.0 INTRODUCTION

This Community Air Monitoring Plan (CAMP) has been prepared by Conestoga-Rovers & Associates (CRA) for the Phase 1 Investigation at the Vanadium Corporation of America Site (Site) located in the Town of Niagara, Niagara County, New York. Figure 1.1 of the CAMP presents the Site Location, and Figure 1.2 of the CAMP presents the Site Layout. This CAMP describes the air monitoring which will be performed during all ground intrusive Phase 1 activities at the Site. Potential air contaminants of concern at the Site are particulate matter, aluminum, arsenic, cadmium, chromium, chromium (hexavalent), cobalt, copper, lead, manganese, nickel, selenium, and zinc.

Historical site investigations and soil sampling programs have shown that volatile organic compounds (VOCs) are not a contaminant of concern for the Site. Therefore, air monitoring for VOCs is not included in this CAMP.

The real-time work zone air monitoring will monitor the potential release of suspended particulate and the other potential air contaminants of concern due to ground intrusive Phase 1 Site activities. This plan includes:

- the objective of the monitoring program;
- responsibilities and administration;
- rationale for monitoring parameters;
- real-time air monitoring procedures; and
- mitigative actions.

2.0 OBJECTIVE

The objective of the air monitoring program is to ensure and document compliance with applicable Federal National Ambient Air Quality Standards (NAAQS), and New York State Department of Environmental Conservation (NYSDEC) air quality criteria and standards. This program was developed to address concerns regarding the release of excess dust and/or other potential air contaminants of concern during ground intrusive Phase 1 activities at the Site. Real-time work zone area monitoring will be used to measure releases of respirable dust less than 10 microns (PM-10) on an ongoing basis and to modify field operations, if necessary.

3.0 RESPONSIBILITIES AND ADMINISTRATION

CRA will designate an on-Site individual to act as the Air Monitoring Specialist (AMS). The AMS will be responsible for implementing the air monitoring program.

The responsibilities of the AMS are as follows:

i) determining monitoring locations in the field;
ii) conducting real-time measurements;
iii) comparing real-time measurements to maximum allowable concentrations listed in Table D.4.2; and
iv) coordination with the Site Health and Safety officer.

The personnel assigned the responsibility of air monitoring will be trained in the operation of the air monitoring equipment and be familiar with the surrounding community that may be affected by on-Site activities.

Personnel operating the air monitoring equipment will be trained in the use, maintenance, and calibration procedures as required by the manufacturer(s) of the equipment. The personnel will also have a full understanding of the requirements of this CAMP.

Air monitoring personnel will have a key role in the contingency planning for the Site. Air monitoring personnel will ensure that potential impacts to adjacent commercial/ industrial properties are evaluated and applicable appropriate contingency plans are implemented to eliminate potential adverse effects on such properties.

The AMS will report to the Project Manager.

The organization of staff for this project and CAMP is provided below:

Name	*Association*	*Phone Number*	*Role*
Jamie Puskas	CRA	519-884-0510	Project Manager
Mitch Bergner	CRA	612-639-0913	Corporate Certified Industrial Hygienist
To Be Determined	CRA	--	QA/QC Officer
To Be Determined	CRA	--	Health and Safety Officer
To Be Determined	CRA	--	Air Monitoring Specialist
To Be Determined	CRA	--	Field Technician

4.0 MONITORING PARAMETERS AND ACTION LEVELS

This CAMP is designed to provide an indication of the release of dust and measurements of total suspended particulate for particle sizes less than 10 microns (PM-10) and other potential air contaminants of concern at the perimeter of the Site boundary. The development of monitoring parameters is presented in this section. The air quality criteria for site-related air contaminants are summarized in Table D.4.1.

4.1 MONITORING PARAMETERS

The NYSDEC has established maximum allowable concentrations for air contaminates generated from "total" Site emissions. These maximum allowable concentrations, called Short-term Guideline Concentrations (SGCs), in addition to a protocol for calculating interim SGC values, are published in NYSDEC's documents *DAR-1 AGC/SGC Tables* and *NYS DAR-1 Guidelines for the Control of Toxic Ambient Air Contaminants*. For Site air contaminants of concern that do not have a published SGC, CRA calculated the proposed interim SGC values listed in Table D.4.1. Depending upon the toxicity of the chemical compound, the ceiling limit or the most restrictive of the occupational exposure values (REL, PEL, TLV) was divided by the appropriate uncertainty factor (10 for high toxicity compounds, 4.2 for all other compounds) to calculate the proposed Interim SGC value. In addition, National Ambient Air Quality Standards (NAAQS) exist for particulate less than 10 microns (PM-10) and lead. The air quality criteria for all air contaminants of concern are summarized in Table D.4.1. The criteria is converted to 1-hour criteria using USEPA time averaging conversion factors as summarized in Section 4.2.

The concentration of potential air contaminants of concern in airborne PM-10 emissions from the Site has been estimated based on historical soil sampling data. Past investigations of the Site, that include analytical data for soil samples, were reviewed by CRA to determine the maximum detected concentration of potential air contaminants of concern in the Site soil. The use of maximum detected concentrations of contaminants of concern found during previous investigations is deemed both appropriate and conservative in that this data represents an anticipated "worst-case" scenario for Site contamination. PM-10 enrichment factors were applied to the part per million concentration of PM-10 in accordance with the USEPA document entitled, "Estimation of Air Impacts from Area Sources of Particulate Matter Emissions at Superfund Sites", April 1993.

The maximum detected concentration of each compound of concern was used to back-calculate the percent of the applicable ambient air quality standard limit for each compound of concern, when PM-10 concentrations are at the PM-10 limit of 150 μg/m³.

4.2 MAXIMUM ALLOWABLE PM-10 CONCENTRATION AT SITE BOUNDARY

The maximum allowable 1-hour average PM-10 concentration that will not result in an exceedance of the applicable air quality criteria at the Site boundaries is 150 μg/m³. The percent of ambient air quality standard limit calculated in Table D.4.1 is based on the assumption that the compounds of concern, which will potentially be present in the suspended particulate during soil excavation and handling activities, are represented by the maximum soil sample data. The NAAQs values are representative of different exposure time periods as noted in Table D.4.1. To establish the maximum allowable 1-hour particulate concentrations the following USEPA time averaging conversion factors were used:

- to convert 24-hour data to hourly divide by 0.4; and
- to convert 3-month data to hourly, divide by 0.3.

The USEPA time averaging factors were obtained from United States Environmental Protection Agency (USEPA) Air Superfund National Technical Guidance Documents.

As shown in Table D.4.1, the proposed ambient air quality standards for all compounds of concern are demonstrated to be in compliance (below the corresponding 1-hour concentration limit) at the lowest maximum allowable particulate concentration of PM-10. Therefore, it is concluded that PM-10 criteria of 150 μg/m³ (1-hour average) at the site property boundary would be protective with regard to the potential off-Site exposure of individuals to the compounds of concern in suspended PM-10.

4.3 MAXIMUM ALLOWABLE PM-10 CONCENTRATION AT WORK ZONE

The concentration of PM-10 monitored within 1 to 10 meters (m) of the edge of the work zone (ground intrusive activity area) will be diluted, due to dispersion, at the nearest property boundary/off-Site receptor.

To approximate an excavation scenario for the Phase 1 ground intrusive work, it is estimated that the maximum source area will have the dimensions of 4.0 m by 1.5 m. The maximum source area and the maximum anticipated distance to the Site property boundary (including 10 m increments) were used as input to the SCREEN3 area source model. The maximum anticipated distance to the Site property boundary from the source area used in the model was 300 m. A copy of the model output is provided in Attachment D-1.

The SCREEN3 air dispersion model was utilized to determine a dilution factor for suspended particulate emitted from the Site. The dilution factors calculated in Table D.4.2 are the maximum PM-10 concentration at 1 m (1.801E+07) divided by the concentration of PM-10 at the monitoring point of interest. Each dilution factor was then multiplied by the maximum allowable PM-10 concentration at the property boundary of 150 μg/m³ to calculate a maximum allowable PM-10 concentration at the work zone. Ground intrusive Phase 1 Site activities will occur throughout the Site at various distances from the property boundaries, ranging from 1 to 300 m. Table D.4.2 summarizes PM-10 concentrations for any distance between 1 and 300 m (in 10 m increments) from the property boundary that will result in a property boundary PM-10 concentration of 150 μg/m³.

Should real-time work zone air monitoring indicate an exceedance of the 1-hour average concentrations, mitigative measures as specified in Section 6.1 will be implemented.

5.0 AIR MONITORING PROCEDURES

5.1 BACKGROUND AIR MONITORING

Background air monitoring for PM-10 will only be conducted if real-time work zone air monitoring for Phase 1 ground intrusive Site activities indicate an exceedance of the 1-hour average concentration after mitigative measures have been implemented. The background monitoring locations will be situated upwind, near the boundaries of the work zone. The actual locations will depend on Site conditions in the immediate area. Good professional judgment will be used in selecting the background sampling locations. In accordance with standard siting requirements, the sampling locations will be as far as possible from the interference of trees, buildings, and roads, but in reasonable locations to obtain valid samples. The sample locations will be selected in such a way that the most representative samples can be collected.

If the background monitoring shows that background PM-10 levels are significant (greater than 25 percent of the maximum PM-10 concentration allowable at the specific monitoring distance per Table D.4.2) then the background PM-10 level will be subtracted from the subsequent work zone readings for that particular area source.

5.2 PERIMETER AIR SAMPLING

Perimeter air sampling activities are not proposed for the Site during Phase 1 activities.

5.3 REAL-TIME WORK ZONE AIR MONITORING

Real-time monitoring of respirable dust less than 10 microns (PM-10) during all Phase 1 ground intrusive activities will be conducted. PM-10 levels will be measured with a hand-held Dataram digital dust meter at a distance of approximately 1 to 10 m from the ground intrusive activity. The Dataram can measure to a detection limit of 1 $\mu g/m^3$.

Actual monitoring locations will depend on Site conditions in the immediate area. Good professional judgment will be used in selecting monitoring locations. Monitoring will be performed continuously during all Phase 1 ground intrusive activities downwind of the work area during each workday that such activities occur.

5.4 METEOROLOGICAL MONITORING

Meteorological monitoring is not proposed for the Site during Phase 1 activities.

5.5 FIELD DATA RECORDING

An air monitoring field log book will be maintained by the AMS. The following information will be recorded in the log book for each ground intrusive Phase 1 Site activity requiring work zone area PM-10 monitoring:

1. monitoring location distance to the work zone (1 to 10 m preferred) and the Site boundary;
2. date and time interval of monitoring activity;
3. general weather conditions at the time of monitoring, including approximate temperature, and wind direction;
4. real time monitoring results;
5. any relevant remarks; and
6. name of sampler.

The field log book will be made available to NYSDEC and NYSDOH personnel for review.

6.0 MITIGATIVE ACTIONS

Exceedances of the maximum PM-10 concentration allowable at the specific monitoring distance from the Site boundary per Table D.4.2 at the work zone, will result in modifications to work activities to mitigate potential particulate releases to the air. In addition to the mitigative action levels presented, there shall be no visible dust at the Site perimeter.

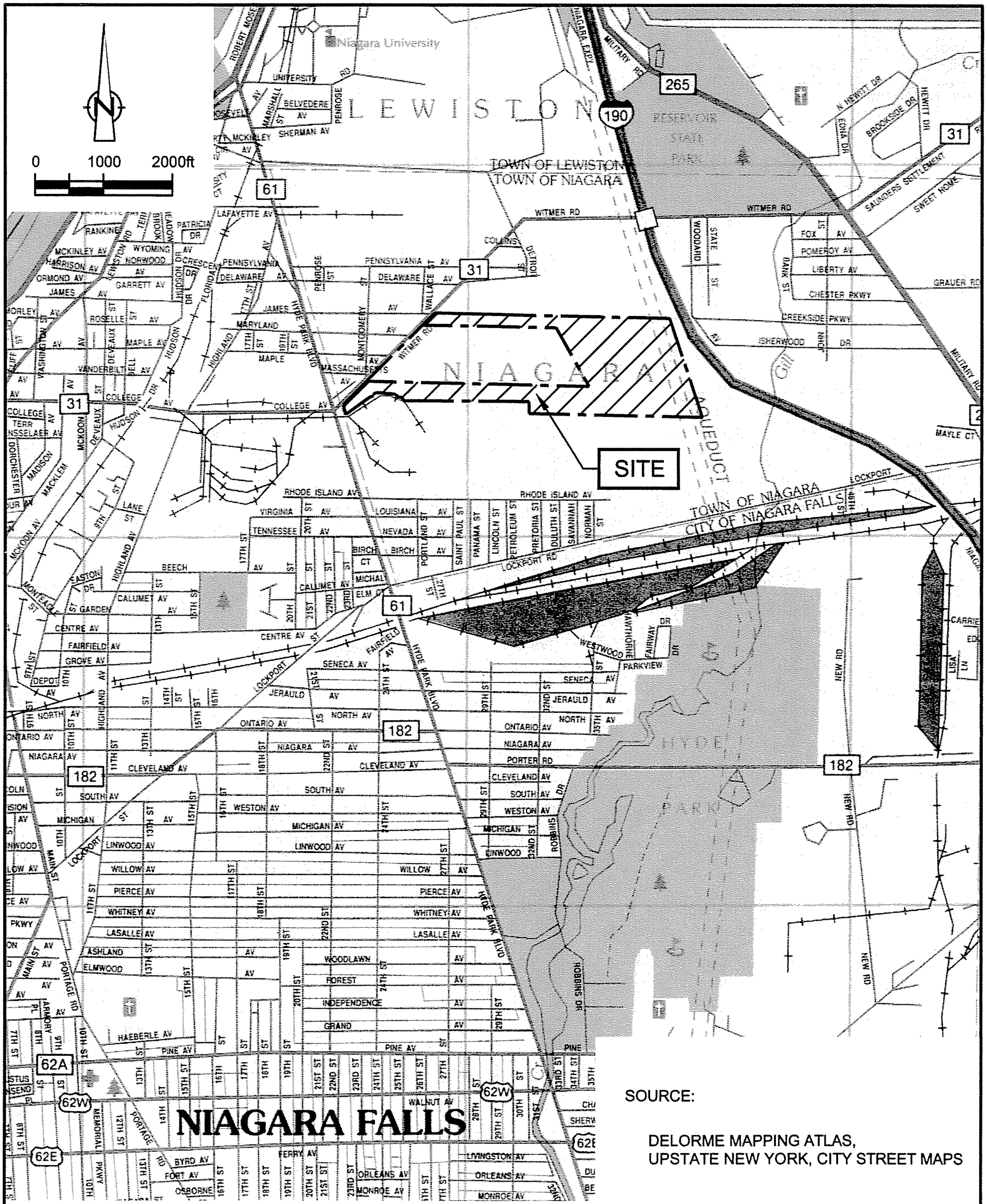
Mitigative actions are specified in the following.

6.1 EXCEEDANCE OF REAL-TIME WORK ZONE AIR MONITORING ACTION LEVEL

In the event real-time work zone air monitoring results indicate an exceedance of the maximum allowable particulate concentration at the specific work zone area, then construction activities will cease until mitigative measures are implemented. The decision on which mitigative action(s) will be implemented will be made by the AMS and Project Manager based on Site conditions.

Mitigative actions to reduce the potential exposure of off-Site receptors would include one, several, or all of the following:

- use of a water misting system for dust and particulate control;
- a reduction in excavation rates;
- use of wind screens around the excavation areas; and
- use of foam for dust and particulate control.



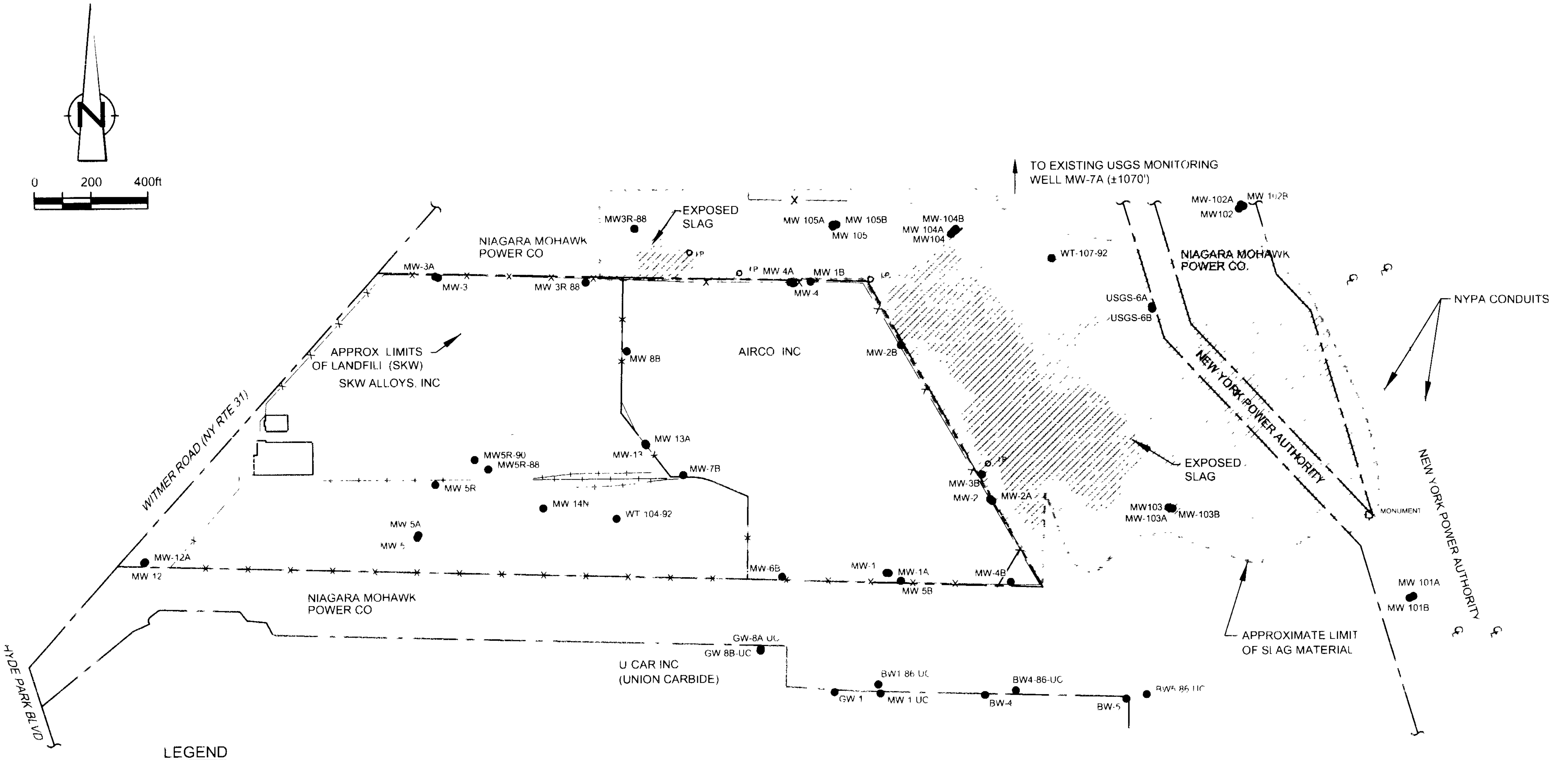
SOURCE:

DELORME MAPPING ATLAS,
UPSTATE NEW YORK, CITY STREET MAPS

figure D.1.1

SITE LOCATION
VANADIUM CORPORATION OF AMERICA SITE
Niagara Falls, NY

19867-00(001)GN-WA023 SEP 27/2002



LEGEND

— · —	PROPERTY LINE
×	FENCE
+ +	RAILROAD
NYPA	NEW YORK POWER AUTHORITY
●	EXISTING MONITORING WELL LOCATION

NOTES

BASE MAP DIGITIZED FROM VANADIUM SITE NO 932001' PROVIDED BY LU ENGINEERS 2230 PENFIELD RD PENFIELD NY (716) 377 1450 MAP DATA DIGITIZED FROM 'SITE PLAN AND SAMPLING LOCATION' PREPARED BY ABB ENVIRONMENTAL

2 SITE FEATURES AND SAMPLE LOCATIONS ARE APPROXIMATE

SOURCE

NIAGARA MOHAWK POWER CORPORATION VANADIUM CORPORATION OF AMERICA SITE NIAGRAFALLS NY FIGURES 1 2 AND 3 BBL ENGINEERS & SCIENTISTS 1/8/2001

figure D 1.2

SITE PLAN
VANADIUM CORPORATION OF AMERICA SITE
Niagara Falls, NY

19867 00(001)GN WA022 SEP 27/2002

TABLE D.4.1

DEVELOPMENT OF INTERIM SGC VALUES FOR CHEMICALS OF CONCERN IN SITE SOILS AND COMPARISION TO MAXIMUM ALLOWABLE PM-10 CONCENTRATION

VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Compounds in Soils	*Maximum Detected Concentration in Soil* (1) (*mg/kg*)	*PM-10 Enrichment Factor* (2)	*Estimated Concentration in PM-10* (*mg/kg*)	*SGC and NAAQS Standards* (ug/m^3)	*Ceiling Limit* (mg/m^3)	*TWA Limit REL,PEL,TLV* (6) (mg/m^3)	*High Toxicity Compound*	*Proposed Interim SGC Value* (ug/m^3)	*Proportion of Compound in Soil*	*Compound in 150 ug/m^3 PM-10* (ug/m^3)	*Percent of Limit*
PM-10	-	-	1,000,000	150.0 (5)	-	-	-	-	1.0	150.000	100.00%
Aluminum	113,000	1.0	113,000	None	NA	10	No	2381.0	1.130E-01	16.950	0.71%
Arsenic	24.2	1.3	31	None	0.01	-	Yes	1.0	3.098E-05	0.005	0.46%
Cadmium	141	1.3	185	None	NA	0.005	Yes	0.5	1.847E-04	0.028	5.54%
Chromium	11,800	4.7	55,696	None	NA	0.5	Yes	50.0	5.570E-02	8.354	16.71%
Chromium (hexavalent)	99.2	4.7	468	None	0.052	-	Yes	5.2	4.682E-04	0.070	1.35%
Cobalt	536	1.0	536	None	NA	0.02	No	4.8	5.360E-04	0.080	1.69%
Copper	5,420	1.0	5,420	100.0 (3)	-	-	-	-	5.420E-03	0.813	0.81%
Lead	1,760	7.3	12,918	5.0 (4)	-	-	-	-	1.292E-02	1.938	38.76%
Manganese	78,300	1.0	78,300	None	5	-	Yes	500.0	7.830E-02	11.745	2.35%
Nickel	5,160	1.0	5,160	6.0 (3)	-	-	-	-	5.160E-03	0.774	12.90%
Selenium	40.4	2.0	81	None	NA	0.2	No	47.6	8.080E-05	0.012	0.03%
Zinc	1,400	1.0	1,400	None	NA	10	No	2381.0	1.400E-03	0.210	0.01%

Notes:

(1) Maximum concentration detected during previous soil sampling activities at the Site
(2) U.S. EPA "Estimation of Air Impacts from Area Sources of Particulate Matter Emissions at Superfund Sites"
(3) NYSDEC SGC Value taken from "DAR-1 AGC/SGC Tables"
(4) Federal NAAQS 3 month standard converted to a one hour equivalent using USEPA time averaging conversion factor 0.3
(5) Federal NAAQS 24 hour standard
(6) Values taken from CRA's Table C.2.2 "Exposure Routes, Exposure Levels And Action Levels For The Chemicals Of Concern Phase 1 Work Plan"

TABLE D.4.2

PM-10 CONCENTRATIONS MEETING AMBIENT AIR QUALITY STANDARDS AT VARIOUS MONITORING DISTANCES FROM PROPERTY BOUNDARY DEVELOPED USING SCREEN3 MODELING DATA
VANADIUM CORPORATION OF AMERICA
NIAGARA FALLS, NEW YORK

Monitoring Distance From Site Boundary (Meters)	*Monitoring Distance From Site Boundary (Feet)*	*Screen3 Output PM-10 Concentration* (ug/m^3)	*Dilution Factor* (1)	*Maximum Allowable PM-10 Concentration* (ug/m^3)
1	3.3	1.801E+07	1.0	150.0
5	16.4	1.646E+07	1.1	164.1
10	32.8	8.050E+06	2.2	335.6
20	65.6	3.028E+06	5.9	892.2
30	98.4	1.571E+06	11.5	1,719.6
40	131.2	9.697E+05	18.6	2,785.9
50	164.1	6.629E+05	27.2	4,075.3
60	196.9	4.851E+05	37.1	5,569.0
70	229.7	3.717E+05	48.5	7,268.0
80	262.5	2.952E+05	61.0	9,151.4
90	295.3	2.410E+05	74.7	11,209.5
100	328.1	2.007E+05	89.7	13,460.4
110	360.9	1.701E+05	105.9	15,881.8
120	393.7	1.462E+05	123.2	18,478.1
130	426.5	1.272E+05	141.6	21,238.2
140	459.3	1.118E+05	161.1	24,163.7
150	492.2	9.922E+04	181.5	27,227.4
160	525.0	8.871E+04	203.0	30,453.2
170	557.8	7.986E+04	225.5	33,827.9
180	590.6	7.232E+04	249.0	37,354.8
190	623.4	6.585E+04	273.5	41,025.1
200	656.2	6.025E+04	298.9	44,838.2
210	689.0	5.543E+04	324.9	48,737.1
220	721.8	5.119E+04	351.8	52,774.0
230	754.6	4.745E+04	379.6	56,933.6
240	787.4	4.413E+04	408.1	61,216.9
250	820.3	4.116E+04	437.6	65,634.1
260	853.1	3.849E+04	467.9	70,187.1
270	885.9	3.609E+04	499.0	74,854.5
280	918.7	3.392E+04	531.0	79,643.3
290	951.5	3.195E+04	563.7	84,554.0
300	984.3	3.016E+04	597.1	89,572.3

Notes:

(1) Dilution factor equals the maximum PM-10 concentration at 1 meter from the area source divided by the concentration of PM-10 at the monitoring distance from the site boundry.

ATTACHMENT D-1

SCREEN3 MODELING RESULTS

```
                                                                  08/26/02
                                                                  13:00:16
  ***   SCREEN3 MODEL RUN   ***
  *** VERSION DATED 96043 ***

 VANADIUM CORPORATION OF AMERICA SITE, TOWN OF NIAGARA, NEW YORK

 SIMPLE TERRAIN INPUTS:
    SOURCE TYPE                  =        AREA
    EMISSION RATE (G/(S-M**2))   =      1.00000
    SOURCE HEIGHT (M)            =        .0000
    LENGTH OF LARGER SIDE (M)    =       4.0000
    LENGTH OF SMALLER SIDE (M)   =       1.5000
    RECEPTOR HEIGHT (M)          =        .0000
    URBAN/RURAL OPTION           =       RURAL
 THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
 THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.

    MODEL ESTIMATES DIRECTION TO MAX CONCENTRATION


 BUOY. FLUX =     .000 M**4/S**3;  MOM. FLUX =     .000 M**4/S**2.

 *** FULL METEOROLOGY ***

 **********************************
 *** SCREEN AUTOMATED DISTANCES ***
 **********************************

 *** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

   DIST     CONC             U10M   USTK  MIX HT   PLUME  MAX DIR
    (M)   (UG/M**3)   STAB  (M/S)  (M/S)    (M)   HT (M)   (DEG)
 -------  ----------  ----  -----  -----  ------  ------  -------
      1.   .1801E+08    6     1.0    1.0 10000.0     .00     15.
    100.   .2007E+06    6     1.0    1.0 10000.0     .00      0.
    200.   .6025E+05    6     1.0    1.0 10000.0     .00      0.
    300.   .3016E+05    6     1.0    1.0 10000.0     .00      0.

 MAXIMUM 1-HR CONCENTRATION AT OR BEYOND     1. M:
      3.   .2720E+08    6     1.0    1.0 10000.0     .00     12.

 *********************************
 *** SCREEN DISCRETE DISTANCES ***
 *********************************

 *** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

   DIST     CONC             U10M   USTK  MIX HT   PLUME  MAX DIR
    (M)   (UG/M**3)   STAB  (M/S)  (M/S)    (M)   HT (M)   (DEG)
 -------  ----------  ----  -----  -----  ------  ------  -------
      1.   .1801E+08    6     1.0    1.0 10000.0     .00     15.
      5.   .1646E+08    6     1.0    1.0 10000.0     .00     10.
     10.   .8050E+07    6     1.0    1.0 10000.0     .00      0.
     20.   .3028E+07    6     1.0    1.0 10000.0     .00      0.
     30.   .1571E+07    6     1.0    1.0 10000.0     .00      0.
     40.   .9697E+06    6     1.0    1.0 10000.0     .00      0.
```

```
   50.   .6629E+06    6     1.0     1.0 10000.0     .00      0.
   60.   .4851E+06    6     1.0     1.0 10000.0     .00      0.
   70.   .3717E+06    6     1.0     1.0 10000.0     .00      0.
   80.   .2952E+06    6     1.0     1.0 10000.0     .00      0.
   90.   .2410E+06    6     1.0     1.0 10000.0     .00      0.
  100.   .2007E+06    6     1.0     1.0 10000.0     .00      0.
  110.   .1701E+06    6     1.0     1.0 10000.0     .00      0.
  120.   .1462E+06    6     1.0     1.0 10000.0     .00      0.
  130.   .1272E+06    6     1.0     1.0 10000.0     .00      0.
  140.   .1118E+06    6     1.0     1.0 10000.0     .00      0.
  150.   .9922E+05    6     1.0     1.0 10000.0     .00      0.
  160.   .8871E+05    6     1.0     1.0 10000.0     .00      0.
  170.   .7986E+05    6     1.0     1.0 10000.0     .00      0.
  180.   .7232E+05    6     1.0     1.0 10000.0     .00      0.
  190.   .6585E+05    6     1.0     1.0 10000.0     .00      0.
  200.   .6025E+05    6     1.0     1.0 10000.0     .00      0.
  210.   .5543E+05    6     1.0     1.0 10000.0     .00      0.
  220.   .5119E+05    6     1.0     1.0 10000.0     .00      0.
  230.   .4745E+05    6     1.0     1.0 10000.0     .00      0.
  240.   .4413E+05    6     1.0     1.0 10000.0     .00      0.
  250.   .4116E+05    6     1.0     1.0 10000.0     .00      0.
  260.   .3849E+05    6     1.0     1.0 10000.0     .00      0.
  270.   .3609E+05    6     1.0     1.0 10000.0     .00      0.
  280.   .3392E+05    6     1.0     1.0 10000.0     .00      0.
  290.   .3195E+05    6     1.0     1.0 10000.0     .00      0.
  300.   .3016E+05    6     1.0     1.0 10000.0     .00      0.

    ***************************************
    *** SUMMARY OF SCREEN MODEL RESULTS ***
    ***************************************

 CALCULATION         MAX CONC     DIST TO    TERRAIN
  PROCEDURE         (UG/M**3)     MAX (M)     HT (M)
--------------     -----------    -------    -------
SIMPLE TERRAIN       .2720E+08         3.         0.

***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************
```

APPENDIX E

CITIZEN PARTICIPATION PLAN

TABLE OF CONTENTS

Page

1.0 INTRODUCTION E-1

2.0 BASIC SITE INFORMATION E-3

3.0 PROJECT DESCRIPTION E-4
  3.1 PROJECT SCHEDULE E-5
  3.2 PREVIOUS INVESTIGATIVE EFFORTS E-5

4.0 COMMUNITY ISSUES AND CITIZEN PARTICIPATION ACTIVITIES E-6

5.0 PROJECT CONTACTS E-7

6.0 DOCUMENT REPOSITORIES AND LIST OF AVAILABLE DOCUMENTS E-8
  6.1 AVAILABLE DOCUMENTS E-8

7.0 POTENTIALLY AFFECTED/INTERESTED PUBLIC (CONTACT LIST) E-9

LIST OF ATTACHMENTS

ATTACHMENT E-1	CITIZEN PARTICIPATION RECORD
ATTACHMENT E-2	DRAFT SCOPING SHEETS

1.0 INTRODUCTION

The New York State Department of Environmental Conservation (NYSDEC) is committed to informing and involving the public during the upcoming Remedial Investigation/Feasibility Study for Operable Unit 3 (OU3) at the Vanadium Corporation of America Site (Site), in Niagara Falls, Niagara County, New York. The Site location and Site Plan are presented on Figures 1.1 and 1.2, respectively, in the Phase 1 Work Plan. The RI/FS will be conducted in accordance with the scope of work, as presented in the Order On Consent, and is summarized as follows:

Phase 1 - Additional Data Collection;

Phase 2 - Evaluation of Human Health Impacts;

Phase 3 - Remedial Investigation Report; and

Phase 4 - Remedial Alternatives Analysis/Feasibility Study.

Phase 1 of the RI/FS involves the collection of information concerning OU3 environmental conditions by conducting on-Site investigations, including the collection of soil, groundwater, surface water, sediment, and air samples. These data will supplement existing information for OU3 that were generated by previous investigations. Following the Phase 1 Investigation, a Phase 1 Report (letter report) will be prepared which will summarize and discuss the data. This report will be submitted to the NYSDEC for review. Following NYSDEC approval of the Phase 1 Report (letter report), all available data, including data derived from previous investigations, will be used in Phase 2: the evaluation of human health impacts. The evaluation will be presented in the Phase 2 Report. Upon NYSDEC approval of the Phase 2 Report, a Remedial Investigation (RI) Report (Phase 3) will be prepared. The RI Report will discuss and evaluate all information and data generated from Phase 1 and previous investigations, and will also discuss and evaluate information from Phase 2. Upon NYSDEC approval of the RI Report (Phase 3), a Feasibility Study (FS) Report (Phase 4) will be prepared. The FS Report will discuss and evaluate various remedial alternatives for OU3.

The public will be kept informed of and involved with the RI/FS process through the Citizen Participation Plan (CP). This CP identifies important community issues and information needs that relate to the Site. In addition, it identifies information which NYSDEC needs from the community and describes CP activities to be conducted during RI and FS. The CP activities are designed to achieve the following objectives:

- help the interested and affected public to understand the environmental conditions at the Site, and the nature and progress of NYSDEC's program to investigate and, if necessary, clean up the Site;
- ensure open communication between the public and project staff throughout the remedial process;
- create opportunities for the public to contribute information, opinions and perspectives that have potential to influence decisions about the Site's investigation and cleanup; and
- show that public input was received and considered, and how it was factored into decision making.

2.0 BASIC SITE INFORMATION

The Vanadium Corporation of America (Vanadium) site (Site) is located in the Town of Niagara, Niagara County, New York. The property is bounded on the north by an automobile depot and vacant property, to the west by Witmer Road (Route 31), on the east by Interstate 190, and on the south by vacant land and industrial facilities. The nearest water bodies are the Lower Niagara River located approximately 1.4 miles west of the property and the New York Power Authority (NYPA) reservoir, located approximately 0.8 miles north of the property. Water transfer conduits (tunnels) are located beneath the NYPA property. These conduits transfer water from the Upper Niagara River, located to the south, to the NYPA reservoir. Numerous high voltage electrical transmission lines cross the Site.

The Site consists of a 25-acre parcel owned by Airco Properties Inc. (Airco), a 37-acre parcel owned by SKW Alloys, Inc. (SKW), and right-of-way comprising approximately 88 acres owned by the Niagara Mohawk Power Corporation (NiMo) and the NYPA. The Airco parcel has been designated by NYSDEC as Operable Unit 1 (OU1), the SKW parcel has been designated as Operable Unit 2 (OU2), and the NYPA and NiMo parcel has been designated as Operable Unit 3 (OU3).

The NYSDEC has defined the Site as a Class 2 hazardous waste site and has placed it on the New York Registry of Inactive Hazardous Waste Disposal Sites.

Potential hazards identified at the Site include metals, particularly chromium and hexavalent chromium, and pH.

3.0 PROJECT DESCRIPTION

The Respondents and NYSDEC have entered into an Order On Consent, in which the Respondents will perform RI/FS activities with NYSDEC oversight. The RI/FS activities will be conducted in a phased manner, and are summarized as follows:

Phase 1: Additional Data Collection

- Installation of boreholes, and collection and analysis of subsurface soil samples;
- Installation of monitoring wells, and collection and analysis of groundwater samples;
- Excavation of test pits;
- Collection and analysis of surface water, surface soil, and sediment samples; and
- Topographic/property surveying.

Phase 2: Evaluation of Human Health Impacts

- Using data gathered from Phase 1 and previous investigations, a baseline human health risk assessment will be conducted, consistent with CERCLA guidance; and
- Components of the baseline human health risk assessment will include:
  - i) identification of contaminants of concern,
  - ii) evaluation of potential exposure pathways for contaminants to current and future receptors,
  - iii) toxicity assessment of the contaminants of concern, and
  - iv) evaluation of health risk dependent upon contaminant, concentration, toxicity, and exposure pathway.

Phase 3: RI Report

- The RI Report will discuss and evaluate information and data from the Phase 1 investigation, and all previous investigations; and
- Evaluation of human health impact from Phase 2 will also be included.

Phase 4: FS Report

- The FS Report will evaluate remedial alternatives, and propose a preferred remedy.

3.1 PROJECT SCHEDULE

The schedule for the RI activities is presented on Figure 7 in the Work Plan.

3.2 PREVIOUS INVESTIGATIVE EFFORTS

Several previous investigations have been performed at the Site. The majority of the previous investigations focussed on OU1 and OU2. In 1996, NYSDEC performed an investigation under the Immediate Investigative Work Assignment (IIWA) program to evaluate OU3. The investigation by NYSDEC included installing eight monitoring wells for groundwater sampling, 12 soil borings for soil sampling, two test pit samples to investigate the waste piles, and the collection of surface water and sediment samples. Table 2.1 in the Work Plan presents the number of samples taken for each media and the sampling parameters. Each sample was analyzed for TCL Volatile Organic Compounds (VOCs), TCL Semi-volatile Organic Compounds (SVOCs), and Total Analyte List (TAL) metals, and hexavalent chromium.

In 2001, Golder Associates performed supplemental investigations at the Site that included the collection and analyses of groundwater samples and water level measurements from the existing Site monitoring wells. Seven groundwater samples were collected and analyzed for TAL metals and hexavalent chromium. Table 2.1 in the Work Plan presents a summary of samples collected and sampling parameters.

4.0 COMMUNITY ISSUES AND CITIZEN PARTICIPATION ACTIVITIES

This section of the CP Plan describes the CP activities to be conducted during the RI/FS activities.

NYSDEC and Respondent project staff will perform these activities to inform and involve the affected and interested community during the investigation and remediation activities at the Site.

NYSDEC will utilize CP Record forms to identify the CP activities required to be conducted during the RI/FS activities. The record forms will also list additional CP activities that will be conducted for each activity. The CP record helps to document for project staff and the public the activities that will be performed during the remedial process, and task completion. The CP Records for this Site are presented in Attachment E-1.

A major emphasis of the CP program is to conduct CP activities that are responsive to significant issues of community concern, and to identify major information needs of both the community and NYSDEC. Each CP Record noted above is accompanied by a supporting document entitled Site Issues and Community Profile Scoping Sheet (Scoping Sheet). Draft Scoping Sheets for the RI/FS for this Site are presented in Attachment E-2. Finalizing these documents will help NYSDEC staff profile the structure and makeup of the community, identify key issues of community concern and public information needs and the particular groups or individuals who have those concerns and needs. In order to identify these issues and information needs, NYSDEC project staff can conduct a combination of discussions with local residents and officials, media accounts, historical knowledge, letters and telephone discussions with residents and officials, and other sources. Understanding issues of public concern and public information needs will help NYSDEC to:

- Effectively conduct the CP activities required by law, regulation and policy; and
- Choose and effectively conduct CP activities beyond the requirements that may be necessary to construct and implement an effective CP program for the Site.

The public is encouraged to review the issues and information needs of the community identified in each CP Record and corresponding Scoping Sheet. Interested persons are encouraged to contact NYSDEC project staff at any time with additional issues or information needs, to recommend how CP activities can effectively be conducted, or to suggest additional CP activities that may be needed to improve the outreach effort.

5.0 PROJECT CONTACTS

For additional information about the remedial program at the Site, the public is encouraged to contact any of the following project staff:

1. Regional Environmental Remediation Engineer, Region 9
   New York State Department of Environmental Conservation
   270 Michigan Avenue
   Buffalo, New York 14203-2999
2. Director, Division of Environmental Remediation
   New York State Department of Environmental Conservation
   625 Broadway
   Albany, New York 12233-5500
3. Matthew J. Forcucci
   Environmental Health Specialist II
   New York State Department of Health
   Western Regional Office
   Division of Environmental Health Assessment
   584 Delaware Avenue
   Buffalo, New York 14202-1295
4. Gary Litwin
   Bureau of Environmental Exposure Investigation
   New York State Department of Health
   547 River Street
   Troy, New York 12180-2216
5. Division of Environmental Enforcement
   New York State Department of Environmental Conservation
   270 Michigan Avenue
   Buffalo, New York 14203-2999

6.0 DOCUMENT REPOSITORIES AND LIST OF AVAILABLE DOCUMENTS

A document repository has been established to provide the public with convenient access to important project documents and other information. This information will include reports, data, and other information gathered and developed during the course of the project, as well as fact sheets and public meeting announcements. The document repository is as follows: **TO BE DETERMINED.**

6.1 AVAILABLE DOCUMENTS

Documents available in the document repository include the Phase 1 Work Plan, Operable Unit 3, Vanadium Corporation of America, Niagara Falls, New York. Additional documents will be placed in the repository as they are produced, including the following:

- RI Report;
- Remedial Alternatives Analysis/Feasibility Study Work Plan; and
- Feasibility Study.

7.0 POTENTIALLY AFFECTED/INTERESTED PUBLIC (CONTACT LIST)

The following contact list has been developed to help NYSDEC to keep the community informed about and involved in the RI/FS process for the Site. The list includes adjacent/nearby property owners; local, regional and state officials; local media; civic, business and environmental organizations and others. The contact list will be reviewed periodically and updated as appropriate.

Newspapers

1. Niagara Gazette
310 Niagara Street
Niagara Falls, New York 14303
(716) 282-2311

2. The Buffalo News
One News Plaza
P.O. Box 100
Buffalo, New York 14240
(716) 856-5555

Elected Officials

1. Danny W. Sklarski
Niagara County Legislature, District 6
175 Hawley Street
Lockport, New York 14094-2740
(716) 439-7000

2. Paulette M. Kline
Niagara County Public Health Director
5467 Upper Mountain Road, Suite 100
Lockport, New York 14094-1899
(716) 439-7435

3. Francine DelMonte
New York State Assembly Member, Assembly District 138
1700 Pine Avenue
Niagara Falls, New York 14301
(716) 282-6062

4. David E. Seaman
New York State Assembly Member, Assembly District 139
237 Bewley Building
Lockport, New York 14049
(716) 433-5838

5. John J. LaFalce
New York State Congressman, District 29
615 Main Street
Niagara Falls, New York 14302
(716) 854-8705

6. Byron W. Brown
New York State Senator, District 57
65 Court Street, Suite 213
Buffalo, New York 14202
(716) 854-8705

7. George D. Maziarz
New York State Senator, District 61
60 Professional Parkway
Lockport, New York 14094
(716) 438-0655

8. Honorable George Pataki
Governor
The Executive Chamber, Capitol
Albany, New York 12224
(518) 474-4801

9. Mary Donohue
Lieutenant Governor
The Executive Chamber, Capitol
Albany, New York 12224
(518) 474-4623

10. Elliot Spitzer
Attorney General
Office of the Attorney General, Capitol
Albany, New York 12236
(518) 474-7124

ATTACHMENT E-1

CITIZEN PARTICIPATION RECORD

New York State Department of Environmental Conservation
Division of Environmental Remediation

Citizen Participation Record [See Instructions]

Non-Time Critical Interim Remedial Measure
(Planning More Than Six Months)

Site Name:

Site No: Operable Unit: Region:

Municipality: County:

Part 1. Listed Below Are the CP Activities Required to Be Performed When an Interim Remedial Measure (IRM) With Planning More Than Six Months is Implemented. When an Activity is Performed, Fill in the Completion Date:

Site Citizen Participation Requirements

CP Requirement	Remedial Time Frame	Completion Date
Contact List	Before Implementation of IRM	
Fact Sheet or Other Notification	Before Implementation of IRM	
Availability Session	Before Implementation of IRM	

Part 2. Stop! Evaluate Issues Important to the Community and Information the Department and Public Need to Exchange — Complete and Attach the Site Issues and Community Profile Scoping Sheet for Non-Time Critical Interim Remedial Measure.

As a Result, Should CP Activities Beyond the CP Activities Required Above Be Conducted?

(Yes/No)

Why or Why Not?

Part 3. If Answer To **Part 2.** Is "Yes" and If There Are Sufficient Staff, Resources and Time, List Below the Additional CP Activity(ies) to Be Conducted. When an Activity is Performed, Fill in the Completion Date:

Additional Site Citizen Participation Activity(ies) for Non-Time Critical Interim Remedial Measure

CP Activity	Remedial Time Frame	Completion Date

Was input from a Citizen Participation Specialist received and reviewed during drafting of this <u>CP Record</u>?

(Yes/No)

Approved By:

NYSDEC Project Manager (Signature) Date

CP RECORD NON-TIME CRITICAL IRM.wpd

New York State Department of Environmental Conservation
Division of Environmental Remediation

Citizen Participation Record [See Instructions]

Site Remedial Investigation, Feasibility Study and Record of Decision

Site Name:

Site No: Operable Unit: Region:

Municipality: County:

Part 1. Listed Below Are the CP Activities Required to Be Performed During a Site's Remedial Investigation, Feasibility Study and Record of Decision. When an Activity is Performed, Fill in the Completion Date:

Site Citizen Participation Requirements

CP Requirement	Remedial Time Frame	Part 375 Reference	Completion Date
Citizen Participation Plan	Before Start of RI/FS	375-1.5(b)(1)	
Contact List (Residents, Government Representatives, Civic and Environmental Groups, Business Interests, Media etc.)	Before Start of RI/FS	375-1.5(b)(2)	
Document Repositories (Regional DEC Office and Local to Site)	Before Start of RI/FS	375-1.5(b)(3)	
Mailing to Contact List Describing Proposed RI Work Plan	At Start of RI	375-1.5(b)(4)	
Mailing to Contact List Describing Proposed Remedial Action Plan (PRAP) and Announcement of Comment Period	At End of FS/ Completion of PRAP	375-1.5(c)(1)	
30-Day Comment Period for PRAP	At End of FS/ Completion of PRAP	375-1.5(c)(2)	
Public Meeting to Discuss PRAP/Gather Public Comments	At End of FS/ Completion of PRAP	375-1.5(c)(2)	
Mailing to Contact List Describing the Selected Remedy and Responding to Significant Comments	During/After Completion of ROD	375-1.5(c)(3)	

Part 2. Stop! Evaluate Issues Important to the Community and Information the Department and Public Need to Exchange — Complete and Attach the Site Issues and Community Profile Scoping Sheet for Remedial Investigation, Feasibility Study and Record of Decision.

As a Result, Should CP Activities Beyond the CP Activities Required Above Be Conducted?

(Yes/No)

Why or Why Not?

Part 3. If Answer To **Part 2.** Is "Yes" and If There Are Sufficient Staff, Resources and Time, List Below the Additional CP Activity(ies) to Be Conducted. When an Activity is Performed, Fill in the Completion Date:

Additional Site Citizen Participation Activity(ies) for Remedial Investigation, Feasibility Study and Record of Decision

CP Activity	Remedial Time Frame	Completion Date

Was input from a Citizen Participation Specialist received and reviewed during drafting of this CP Record?

(Yes/No)

Approved By:

NYSDEC Project Manager (Signature) Date

ATTACHMENT E-2

DRAFT SCOPING SHEETS

New York State Department of Environmental Conservation
Division of Environmental Remediation

Site Issues and Community Profile Scoping Sheet [See Instructions]

Non-Time Critical Interim Remedial Measure

Site Name:

Site No: Operable Unit: Region:

Municipality: County:

Part 1. List Major Issues of Interest to the Community and Information the Community Wants. Where Appropriate, Identify Individuals, Organizations, Businesses or Units of Government Related to the Issue or Information. (Refer to **Part 5.** of This Scoping Sheet):

How Were These Issues and Information Identified?

Part 2. List Information Project Staff Need From the Community. Where Appropriate, Identify Individuals, Organizations, Businesses or Units of Government Related to the Issue or Information. (Refer to **Part 5.** of This Scoping Sheet):

How Were These Issues and Information Needs Identified?

Part 3. List Major Issues and Information Project Staff Need to Communicate to the Community. Where Appropriate, Identify Individuals, Organizations, Businesses or Units of Government Related to the Issue or Information. (Refer to **Part 5.** of This Scoping Sheet):

How Were These Issues and Information Needs Identified?

Part 4. Identify the following characteristics of the affected/interested community. This knowledge will help to identify and understand issues and information important to the community, and ways to effectively plan and deliver the site CP program (mark all that apply):

a. Land Use/Zoning Around Site:

☐ Residential ☐ Agricultural ☐ Recreational ☐ Commercial ☐ Industrial

b. Residential Type Around Site: ☐ Urban ☐ Suburban ☐ Rural

c. Population Density Around Site: ☐ High ☐ Medium ☐ Low

d. Community Economic Status: ☐ High ☐ Medium ☐ Low

e. Water Supply of Nearby Residences: ☐ Public ☐ Private Wells ☐ Mixed

f. Other Present/Past Environmental Problems With Significant Impact on Affected Community? (Yes/No)

☐

Explain if "Yes"

g. Special Considerations: ☐ Language ☐ Age ☐ Transportation ☐ Other

Explain Any Marked Categories:

Part 5. What Individuals and Organizations Within the Community Are Affected—Or Likely To Be Interested In—the Site, Its Investigation and/or Remediation? (Mark <u>All</u> That Apply and Adjust Site Contact List As Appropriate)

☐ Adjacent Residents/Property Owners ☐ Local Officials ☐ Media ☐ Doctors/Nurses

☐ Business/Commercial Interests ☐ Native American Nation ☐ Labor Groups/Workers

☐ Citizens Group(s) (Identify):

☐ Environmental Group(s) (Identify):

☐ Civic Group(s) (Identify):

☐ Recreational Group(s) (Identify):

☐ Other(s) (Identify):

[Attach When Completed to CP Record for Non-Time Critical Interim Remedial Measure.]

New York State Department of Environmental Conservation
Division of Environmental Remediation

Site Issues and Community Profile Scoping Sheet [See Instructions]

Site Remedial Investigation, Feasibility Study and Record of Decision

Site Name:

Site No: Operable Unit: Region:

Municipality: County:

Part 1. List Major Issues of Interest to the Community and Information the Community Wants. Where Appropriate, Identify Individuals, Organizations, Businesses or Units of Government Related to the Issue or Information. (Refer to **Part 5.** of This Scoping Sheet):

How Were These Issues and Information Identified?

Part 2. List Information Project Staff Need From the Community. Where Appropriate, Identify Individuals, Organizations, Businesses or Units of Government Related to the Issue or Information. (Refer to **Part 5.** of This Scoping Sheet):

How Were These Issues and Information Needs Identified?

Part 3. List Major Issues and Information Project Staff Need to Communicate to the Community. Where Appropriate, Identify Individuals, Organizations, Businesses or Units of Government Related to the Issue or Information. (Refer to **Part 5.** of This Scoping Sheet):

How Were These Issues and Information Needs Identified?

Part 4. Identify the following characteristics of the affected/interested community. This knowledge will help to identify and understand issues and information important to the community, and ways to effectively plan and deliver the site CP program (mark all that apply):

a. Land Use/Zoning Around Site:

☐ Residential ☐ Agricultural ☐ Recreational ☐ Commercial ☐ Industrial

b. Residential Type Around Site: ☐ Urban ☐ Suburban ☐ Rural

c. Population Density Around Site: ☐ High ☐ Medium ☐ Low

d. Community Economic Status: ☐ High ☐ Medium ☐ Low

e. Water Supply of Nearby Residences: ☐ Public ☐ Private Wells ☐ Mixed

f. Other Present/Past Environmental Problems With Significant Impact on Affected Community? (Yes/No) ☐

Explain if "Yes" ☐

g. Special Considerations: ☐ Language ☐ Age ☐ Transportation ☐ Other

Explain Any Marked Categories: ☐

Part 5. What Individuals and Organizations Within the Community Are Affected—Or Likely To Be Interested In—the Site, Its Investigation and/or Remediation? (Mark All That Apply and Adjust Site Contact List As Appropriate)

☐ Adjacent Residents/Property Owners ☐ Local Officials ☐ Media ☐ Doctors/Nurses

☐ Business/Commercial Interests ☐ Native American Nation ☐ Labor Groups/Workers

☐ Citizens Group(s) (Identify): ☐

☐ Environmental Group(s) (Identify): ☐

☐ Civic Group(s) (Identify): ☐

☐ Recreational Group(s) (Identify): ☐

☐ Other(s) (Identify): ☐

[Attach When Completed to CP Record for Remedial Investigation, Feasibility

Study and Record of Decision.]

site issues rifsrod.wpd