Post-Closure Monitoring and Facility Maintenance Plan for the Airco Parcel Niagara Falls, New York

Contract No. 12040.83

Prepared for

The BOC Group
100 Mountain Avenue
Murray Hill, New Jersey 07974

Prepared by

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February 2005
Revision: 1
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22 February 2005

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1. INTRODUCTION

1.1 STATEMENT OF PURPOSE

This revised Post-Closure Monitoring and Facility Maintenance Plan has been prepared for the Airco Parcel located on Witmer Road in the Town of Niagara Falls, New York (Figure 1). This Plan describes the tasks necessary for maintenance of the site; periodic inspections; and monitoring of groundwater, surface water, and the groundwater collection and treatment system (GCTS). The intended use for this Plan is to provide a guide to the current landfill owners for maintenance and facility monitoring for a period of 30 years.

The following is required as part of the Post-Closure Monitoring and Facility Maintenance Plan:

- Drainage structures and ditches must be maintained to prevent ponding of water and erosion of the final landfill soil cap.
- Routine inspections conducted of sediment ponds and the engineered wetland to assess the presence of mosquito larvae.
- Soil cover integrity, slopes, cover vegetation, drainage structures, and the perimeter road must be maintained during the post-closure monitoring and maintenance period.
- Environmental monitoring points must be maintained and sampled during the post-closure period. Bi-annual summary reports must be submitted to the New York State Department of Environmental Conservation (NYSDEC) Division of Solid and Hazardous Materials, Region 9; the State of New York Department of Health in Albany, New York; and the document repository located at the Town of Niagara Town Clerk's Office.
- A vegetative cover must be maintained on all exposed final cover material, and adequate measures must be taken to ensure the integrity of the final vegetated cover, topsoil layer, and underlying barrier protection layer.
- The GCTS must be operated and maintained to effectively mitigate the release of groundwater recharging to surface water in the southwest corner of the Airco Parcel.
- Records must be maintained of all sampling and analysis results.

1.2 ORGANIZATION

Section 1 outlines the purpose of this Plan, and identifies applicable regulatory provisions. Section 2 details the maintenance inspection requirements. Section 3 outlines the groundwater monitoring and GCTS monitoring program. Section 4 discusses the sampling frequency and data reporting requirements. Appendix A contains the Operation and Maintenance Manual for the GCTS. Appendix B contains the standard operating procedures for the low-flow sampling method. Appendix C contains the field forms. Appendix D contains the well construction diagrams.

2. MAINTENANCE INSPECTIONS

Bi-annual landfill inspections, and inspections after major rainfall events (5-year storms), will be performed at the facility during the minimum 30-year post-closure period, unless specific approval is given by NYSDEC to eliminate some or all of these requirements. The inspections will be performed on the facility to ensure that the final landfill cover materials, site drainage structures, and onsite monitoring wells are maintained and functioning within the design standards. Advance notification of inspections will be made to NYSDEC 72 hours prior to commencement of inspection-related activities in the event NYSDEC attendance is desired. An example of the inspection checklist is provided in Appendix C. The landfill inspection reports will be submitted to NYSDEC along with the bi-annual monitoring reports.

2.1 DRAINAGE STRUCTURES

The inspections will include visual checks of culverts, drainage swales, and berms/benches, if present, to ensure erosion problems are not occurring. Any material defects and erosion occurrences discovered at the facility will be repaired immediately and restored to "new" condition. Eroded soil or cover material will be replaced as soon as possible. Exposed or unvegetated soil will be re-seeded, fertilized, and mulched.

2.2 COVER SYSTEM

Areas of concern within the final landfill cover system could include erosion, exposure, loss of vegetative cover, settlement, gravity sliding, or cracking on the top or side slopes of the landfill. Each quarter, the cover system, including topsoil layer and barrier protection layer, the geocomposite drainage layer, and the 40-mil liner low-density polyethylene membrane, will be inspected and records will be maintained.

Minor repairs to the cover system will be performed by hand, utilizing materials from the original borough source or newly approved borough source. The areas of minor erosion, sloughing, or cracking will be excavated by hand to allow for a concise repair. Materials will be placed, compacted appropriately by hand, and re-seeded. Additional erosion control measures, such as straw or hay bales, will be used accordingly to prevent future damage to the repaired areas.

In the event that major erosion, sloughing, or slumping is noted during an inspection, NYSDEC personnel will be notified within 48 hours of the problems observed. An action plan detailing the remedial measures to be taken to rectify the problem will be developed and submitted to NYSDEC for approval, prior to implementation of the remedy. Any repairs requiring patching or seaming of the liner low-density polyethylene membrane or geocomposite drainage layer will be conducted in accordance with manufacturers' construction specifications and outlined in the action plan.

2.3 VECTORS

The original vector inspection performed in December 1999 as part of the preparation of the approved Closure Plan (EA 2000[1]) indicated that vectors do not appear to pose a threat to the proposed landfill cap section. Although the habitat has been significantly improved after closure was completed, vectors have not been observed. However, continued monitoring for vectors will be performed as part of the inspections. The presence of any vectors (e.g., rodents, flies, etc.) on the site will be determined during the quarterly inspection. If present, extermination or treatment that will remove the vecting population(s) will be implemented

2.4 GROUNDWATER COLLECTION AND TREATMENT SYSTEM

Appendix A includes a comprehensive Operation and Maintenance Manual, which details the required activities to be performed routinely to ensure proper system operation. In general, the system includes pumps, tanks, and controls to convey collected water from the southwest corner of the site, to the northwest corner for treatment. Treatment includes aeration of the water with carbon dioxide gas to lower the pH, and reduction of the hexavalent chromium utilizing a bed of shredded zero valence iron. The system also includes two settling ponds and an engineered wetland to provide removal of insoluble precipitates.

2.4.1 Mosquito Larvae Inspection

During the monthly site inspections and maintenance activities, personnel will inspect the two sediment ponds and engineered wetland for the presence of mosquito larvae. If larvae are noted, then identification of the mosquito species will be performed. Subsequent mitigation of the mosquito population, either by addition of indigenous *Fundalis* minnows, or by applying a mono-molecular film, will be employed to control the population. Within 72 hours of observing mosquito larvae, NYSDEC will be contacted to assist in the identification. A letter work plan detailing the mitigation approach will be submitted for approval prior to initiation of mosquito abatement activities.

2.5 OTHER FACILITIES AND STRUCTURES

Monitoring well casings, casing locks, concrete aprons, fences, and gates will be inspected to ensure that they are undamaged and functional. Damages will be repaired immediately and structures re-secured. Mowing of the cap system will occur annually after 1 September to allow for enhancement of avian wildlife habitat.

1. EA Engineering, P.C. and its Affiliate EA Science and Technology. 2000. Closure Plan for the Witmer Road Landfill, Niagara Falls, New York. April.

2.6 INSPECTION REPORTING

Inspection reports will be prepared and submitted to NYSDEC Division of Solid and Hazardous Materials Region 9 office as an attachment to the bi-annual monitoring event report. The inspection report will include, at a minimum, the date and time of the inspection; personnel conducting the inspection; visual observations of the inspectors; a list of items inspected; and a brief description of any repair work, if required, including the nature of the damage, repairs completed, and estimated cost of the repairs. The report will also describe any items that will need future attention or repairs not completed during the course of the inspection, along with any other pertinent comments.

2.7 BI-ANNUAL MONITORING EVENT REPORT

A summary report will be prepared bi-annually to outline the previous year's monitoring and maintenance activities. The report will describe the previous year's trends with regards to constituents of concern, inspection report findings, and associated remedies, if required.

3. ENVIRONMENTAL MONITORING PROGRAM

This section provides a summary of the field activities to be performed as part of the post-closure environmental monitoring program at the Airco Parcel. Activities to be conducted at the site include:

- Groundwater monitoring
- Surface water sampling
- GCTS sampling.

3.1 GROUNDWATER MONITORING

The monitoring wells at the site will be sampled using the low-flow sampling methods (Appendix B). Prior to sampling, each well will be monitored until the water quality parameters (temperature, pH, specific conductivity, and turbidity) have stabilized. However, if a well(s) has a limited well volume and low recharge, dedicated bailers will be used. The well(s) will be bailed dry at least once and allowed to recharge to at least 90 percent of the static (i.e., before purging) water level prior to collecting the sample. Results will be logged on the Field Record of Well Gauging, Purging, and Sampling included in Appendix C. The samples will be collected bi-annually and analyzed for a limited number of metals, water quality parameters, and field parameters. Table 1 depicts the list of analyses to be performed.

3.1.1 Groundwater Gauging

In order to evaluate the groundwater flow direction at the site, groundwater level gauging will be performed on the onsite wells prior to sample collection. An electronic water level meter will be used for this field task capable of recording water elevations to within ±0.01-in. accuracy.

3.2 SURFACE WATER MONITORING

Surface water sampling is designed to evaluate the chemical quality surface water runoff, which may collect in the drainage swales prior to exiting the site in the southwest corner. Surface water samples, if present, will be collected from the southern and western drainage swales in the southwest corner of the site. Samples will be collected using a decontaminated stainless steel or Teflon dipper. The sample will be analyzed for the same list of parameters identified in Table 1.

3.3 GROUNDWATER COLLECTION AND TREATMENT SYSTEM MONITORING

During routine visits, the GCTS will be sampled at various locations to evaluate treatment system performance and compliance with discharge criteria. Samples will be collected prior to and after treatment via the zero valence iron tanks, and after the engineered wetland. These samples will be field analyzed using a Hach DR/4000 U spectrophotometer. Hexavalent chromium will be determined using Hach Method 8083, which used 1,5-diphenylcarbohydrazide to react with the hexavalent chromium to form a purple color. Hexavalent chromium concentrations are measured spectrophotometrically at 540 nm. Total chromium will be determined using Hach Method 8084. This procedure oxidizes all chromium in the sample to hexavalent chromium using the alkaline hypobromide oxidation method, followed by analysis of hexavalent chromium using 1,5-diphenylcarbohydrazide as discussed above. The detection limit is 5 ppb for either total or hexavalent chromium.

3.3.1 State Pollutant Discharge Elimination System Permit Sampling

Pursuant to the NYSDEC-issued State Pollutant Discharge Elimination System Discharge Guidance Values (4 January 2004), the GCTS discharge will be sampled monthly until May 2004, quarterly in September and December 2004, and quarterly after December 2004. Discharge guidance values analyte list and limits are listed in Table 3. Treatment system discharge samples are collected from the effluent pipe of P7, after the engineered wetland, and sent for laboratory analysis to Life Science Laboratories, Inc., East Syracuse, New York.

3.4 FIELD QUALITY CONTROL SAMPLES

These samples are not included specifically as laboratory quality control samples but are analyzed when submitted. Data for these quality control samples are reported with associated samples.

3.4.1 Water Source Sample

Water source samples are samples of water used for field decontamination purposes. Specifically, water source samples will include laboratory-supplied, reagent-grade, de-ionized water used for decontamination activities. Water source samples will be analyzed for the parameters sampled during the field mobilization period. One water source sample will be collected from the source per sampling event. The water source sample will be collected early in the field effort to assess the quality of this source water.

3.4.2 Rinsate Blanks

A rinsate blank is a water sample collected after having been poured through or over a decontaminated piece of sampling equipment to assess and document the thoroughness of the decontamination process. At least one rinsate blank per sampling event will be collected. As noted above, laboratory-supplied, reagent-grade de-ionized water will be used.

3.4.3 Field Duplicates

Field duplicates are two samples of the same matrix that are collected, to the extent possible, from the same location at the same time using the same techniques. Field duplicates provide information on the precision of the sampling and analysis process. Field duplicates will be collected at a frequency of 1 duplicate per 20 sample media. Quality control samples will be filled from the same discrete sample or composite mixture as the field samples.

3.4.4 Sample Labels

Field samples collected will each be assigned a unique sample tracking number. Sample designation will be an alpha-numeric code which will identify each sample by site and location.

Sample Codes:

AP	=	Airco Parcel
MW	=	Monitoring well
SP1	=	Sediment Pond No. 1
SP2	=	Sediment Pond No. 2
EWE	=	Engineered wetland effluent
SS	=	Surface water
RB	=	Rinsate blank
TB	=	Trip blank
DUP	=	Duplicate
SWB	=	Source water blank.

For example, the groundwater sample from MW-1B is labeled AP-MW-1B. Quality control samples are labeled by the type of sample followed by a sequential numerical identification. For example, the first source water blank was named SWB-01. In order to ensure blind laboratory analysis of duplicate samples from specific matrixes, "DUP" is replaced by the sample identification number. This ensures that the laboratory cannot identify the location of the duplicate sample. For example, the first groundwater duplicate sample collected was identified as DUP-01.

3.5 SAMPLE KITS AND HANDLING

Sample kits, which are coolers containing chain-of-custody forms, custody seals, sample containers (with preservatives), and packing material, are prepared by the laboratory. The chain-of-custody procedure begins with the preparation of sample containers and preservatives to be used in sample collection. Unless superseded by specific project requirements, the contracted laboratory purchases and distributes pre-cleaned sample containers. Vendors are required to provide documentation of analysis for each lot of containers, and the documentation is kept on file.

For the analyses specified for this project, Table 2 shows general guidelines for the type of sample container required, preservation techniques, and holding times for analytical samples collected. Preservatives will be added to the sample containers in the laboratory prior to shipment.

After the samples are collected, they are split as necessary among containers and preservatives appropriate to the parameters to be determined. Each container is provided with a sample label that is filled out at the time of collection. At this time, a chain-of-custody form is initiated. The collected samples are cooled, if necessary, and returned to the laboratory by the most expedient means to ensure that holding times will be met. The chain-of-custody form is signed and dated as necessary as the samples pass from the collectors to those persons responsible for their transportation.

3.6 SAMPLE DOCUMENTATION IN THE FIELD

Field personnel are issued serialized weatherproof logbooks. Field personnel are responsible for recording all pertinent project information including, but not limited to, field work documentation; field instrumentation readings; calculations; calibration records; work plan distributions; photograph references; sample tag/label numbers; meeting information; and important times and dates of telephone conversations, correspondence, or deliverables. The field logbook also contains an abbreviated version of notes listed in the team or individual field logbooks. The sample team or individual performing a particular sampling activity is required to maintain a field logbook that is filled out at the location of sample collection immediately after sampling. It contains sample particulars including sample number, sample collection time, sample location, sample descriptions, sampling methods used, daily weather conditions, field measurements, name of sampler, and other site-specific observations. The field logbook also addresses deviations from this Plan or the Health and Safety Plan, including authorization obtained and the rationale for the deviation, visitor's names or community contacts during sampling, and geologic and other site-specific information determined by field personnel as noteworthy. A sample log sheet is filled out for each sample from the information recorded in the field logbook. In addition, field personnel use appropriate forms applicable to field activities. These include Field Record of Well Gauging, Purging, and Sampling; Landfill Cap Inspection; and GCTS checklists.

3.7 DECONTAMINATION PROCEDURES

To minimize the potential for cross-contamination between sample locations, reusable sampling equipment (stainless steel pumps and water level/interface probes) is cleaned as follows:

- Wash with potable water and laboratory-grade detergent (e.g., Alconox® detergent)
- Rinse with potable water
- Rinse with deionized water
- Rinse with methanol
- Rinse with deionized water
- Air dry and wrap in aluminum foil if equipment will be stored.

All monitoring wells have a dedicated bailer assigned to the sampling location. The dedicated bailers will be stored onsite. The water level/interface probe and stainless steel pumps are non-dedicated and will be decontaminated prior to and after sampling at all monitoring well locations.

4. SAMPLING FREQUENCY AND DATA REPORTING

4.1 SAMPLING FREQUENCY

During 2003, BOC requested a reduction in the frequency of sampling and testing of the monitoring wells and the designated surface water locations. NYSDEC granted this request by reducing the frequency from quarterly to bi-annual.

4.1.1 Groundwater Sampling

Due to extensive sampling that has been performed at this site, beginning in 2004, the groundwater monitoring wells at the site (MW-1B through MW-8B) will be sampled and analyzed for two rounds of modified routine parameters (Table 1). Monitoring wells will be sampled from least contaminated to most contaminated (MW-2B, MW-4B, MW-8B, MW-7B, MW-1B, MW-3B, MW-6B, and MW5B). A sampling location map is provided in Figure 2. Bi-annual modified routine parameter sampling will be conducted in April and October of each calendar year.

4.1.2 Surface Water Sampling

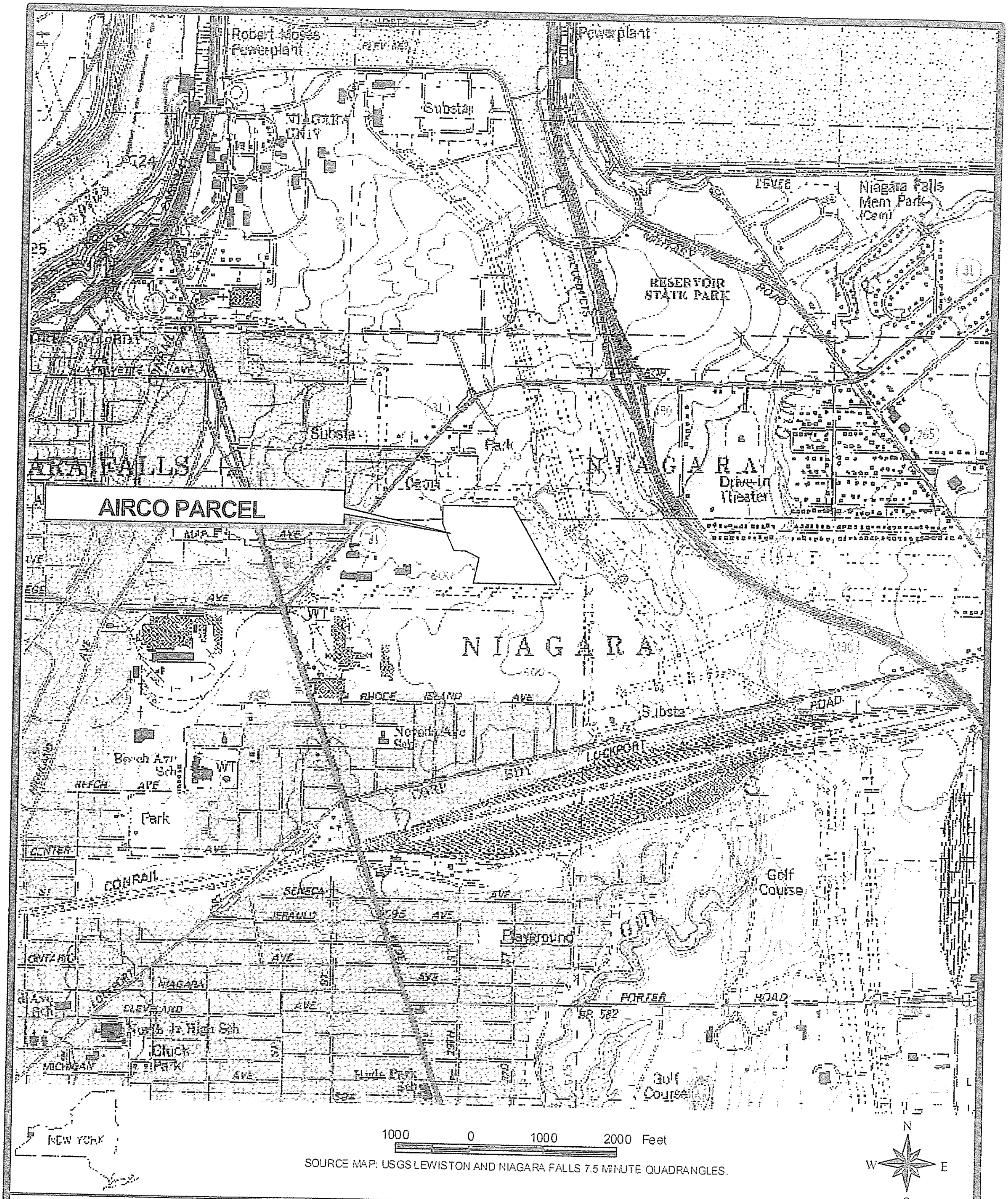
The designated surface water sampling point (SS-1) will be sampled on a bi-annual basis at the site. During the sampling event, the surface water sample is collected from the wetland adjacent to monitoring well MW-6B. As noted above, bi-annual modified routine parameter sampling will be conducted in April and October of each calendar year.

4.1.3 Groundwater Collection and Treatment System Sampling

The GCTS was sampled weekly for the first 8 weeks of operation, monthly for the ensuing 4 months, and quarterly thereafter. The first compliance sample was collected on 20 November 2003. Weekly sampling continued through the week ending 9 January 2004. Monthly compliance sampling will then occur from February to May, with 2 quarterly sampling events in September and December 2004. The sampling frequency after December 2004 will be quarterly. However, in the event of system modifications or upgrades, or periods of downtime greater than 2 weeks, weekly sampling using the Hach DR/4000 U spectrophotometer will be performed for 1 month after system restart.

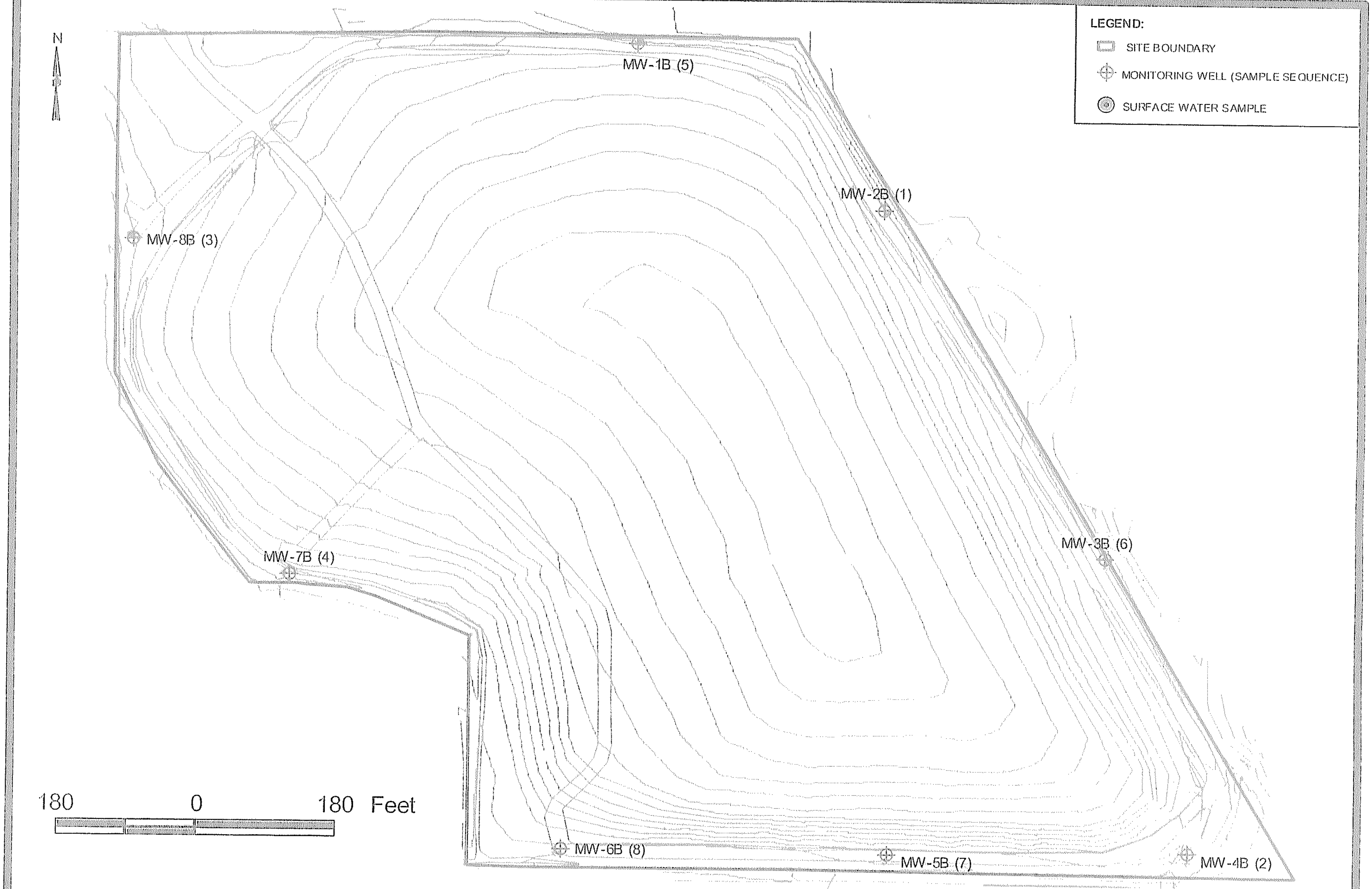
4.2 DATA REPORTING

The results of the two rounds of groundwater and surface water sampling, and the routine GCTS sampling, will consist of the field data sheets, chain-of-custody forms, and laboratory analysis results. A New York State-certified laboratory (Life Science Laboratory, Syracuse, New York) has been retained to analyze the water samples. Data collected in 2004 will be summarized in the bi-annual reports submitted after each groundwater sampling event.



SOURCE MAP: USGS LEWISTON AND NIAGARA FALLS 7.5 MINUTE QUADRANGLES.

EA	AIRCO PARCEL NIAGARA FALLS, NEW YORK					FIGURE 1 SITE LOCATION MAP	
PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT No	FILE No
CEM	RSC	RSC	CEM	AS SHOWN	10 SEP 2003	12040.69	I:\BOC-NIAGARA\FINAL.APR



AIRCO PARCEL
NIAGARA FALLS, NEW YORK

FIGURE 2
MONITORING WELL SITE MAP

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT No	FILE No
CEM	RSC	RSC	SLG	AS SHOWN	04 FEBURARY 2005	12040.09	I:\BOC-NIAGARA-GIS\ FINAL.APR

TABLE 1 SUMMARY OF ANALYTES LIST AND ANALYTICAL METHODS FOR MONITORING WELL SAMPLES

Analyte List	Laboratory Analytical Method
Silicon	EPA 200.7 Total Metals
Cadmium	EPA 200.7 Total Metals
Chromium	EPA 200.7 Total Metals
Iron	EPA 200.7 Total Metals
Lead	EPA 200.7 Total Metals
Magnesium	EPA 200.7 Total Metals
Manganese	EPA 200.7 Total Metals
Selenium	EPA 200.7 Total Metals
Sodium	EPA 200.7 Total Metals
Thallium	EPA 200.7 Total Metals
Zinc	EPA 200.7 Total Metals
Ammonia as N	EPA 350.1, Ammonia
Phenolics, Total Recoverable	EPA 420.1, Recoverable Phenolics ML
Sulfate	EPA Method 300.0 A
Chromium, Hexavalent	SM 18 3500Cr-D, Hexavalent Chromium
pH	Field parameter recorded in the field
Conductivity	Field parameter recorded in the field
Turbidity	Field parameter recorded in the field
Dissolved Oxygen	Field parameter recorded in the field
Temperature	Field parameter recorded in the field
Oxidation Reduction Potential	Field parameter recorded in the field
NOTE: EPA = U.S. Environmental Protection Agency.	

TABLE 2 SUMMARY OF SAMPLE BOTTLES, PRESERVATIVE, AND HOLDING TIMES FOR MONITORING WELL AND GROUNDWATER COLLECTION AND TREATMENT SYSTEM SAMPLES

Monitoring Well Samples		
Sample Bottle and Analysis	Preservative	Holding Time
1 Amber liter (Total Phenolics)	H_2SO_4	28 days
1 Plastic 500 mL (Cr+6, SO4)	None	24 hours
1 Plastic 250 mL (Ammonia)	H_2SO_4	28 days
1 Plastic 250 mL (Metals)	HNO_3	6 months
Groundwater Collection and Treatment System Samples		
1 Amber liter (Total Phenolics)	H_2SO_4	28 days
1 Plastic 500 mL (Cr+6, BOD, TSS, pH, NO3, NO2, TDS)	None	24 hours
1 Plastic 500 mL (TKN, NH3, COD)	H_2SO_4	28 days
1 Plastic 500 mL (Ba, Cr, Cu, Fe, Ni, Se, Tl, Zn)	HNO_3	6 months
2 Volatile Organic Analytes 40 mL (601/602)	HCL	14 days

TABLE 3 SUMMARY OF STATE POLLUTANT DISCHARGE ELIMINATION SYSTEM DISCHARGE GUIDANCE VALUES

Analyte List	Discharge Limitations
Flow Rate	21,600 gal per day
pH	6.5-8.5 standard unit
Total Kjeldahl Nitrogen	Monitor
Nitrate (expressed as N)	Monitor
Nitrite (expressed as N)	Monitor
Ammonia as N	5.0 (1 JUN – 31 OCT) mg/L 9.2 (1 NOV – 31 MAY) mg/L
Biological Oxygen Demand (BOD5)	5.0 mg/L
COD	40 mg/L
Total Suspended Solids	10 mg/L
Dissolved Oxygen	7 mg/L (minimum)
Total Dissolved Solids	Monitor
Chromium, total	100 µg/L
Iron, total	300 µg/L
Barium	2,000 µg/L
Copper, total	14.7 µg/L
Nickel, total	70 µg/L
Selenium, total	4.6 µg/L
Thallium	4 µg/L
Zinc, total	115 µg/L
Chromium, Hexavalent	11 µg/L
Phenolics	8 µg/L
1,1 Dichloroethane	5 µg/L
Trichloroethene	5 µg/L

Appendix A

Operation and Maintenance Manual Groundwater Collection and Treatment System

Operation and Maintenance Manual
Groundwater Collection and Treatment System
Airco Parcel
Niagara Falls, New York

Contract No. 12040.83

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1. INTRODUCTION

EA Engineering, P.C. and its affiliate EA Science and Technology have prepared this Operation and Maintenance (O&M) Manual for the groundwater collection and treatment system (GCTS) located at the Airco Parcel, Niagara Falls, New York. This Manual describes the O&M of the GCTS and is intended to serve as a general guide to operating personnel. The information contained within this Manual should be used in conjunction with manufacturer's information and recommendations included in the attachments. In addition, O&M functions should only be performed by authorized personnel. As such, this Manual does not describe specific O&M functions in detail. This Manual identifies normal operating procedures. The GCTS was installed during Summer and Fall of 2003, and officially began operation on 20 November 2003 when the first compliance sample was collected for offsite laboratory analysis.

During the first 6 months of the GCTS operation, it was observed that the groundwater collection system was yielding a significantly higher flow rate than was initially recorded during the design phase. To compensate for the higher flow rate, the GCTS was retrofitted to meet the collection system capacities. The modifications and upgrades were completed during the period June-July 2004. The GCTS was re-started on 29 July 2004, and the first compliance sample was collected for offsite laboratory analysis at that time.

1.1 SITE LOCATION AND HISTORY

The GCTS is part of the Interim Remedial Measures implemented at Airco Parcel located near Witmer Road in Niagara Falls, New York. The location of the site is presented on Figure 1. The Airco Parcel is the middle of three parcels that comprised the Vanadium Corporation of America site. The Airco Parcel was owned and used by the Vanadium Corporation of America from 1920 to 1964 for disposal of industrial slag and dust and other construction debris. A full description of the background, site use, and physical conditions of the site can be found in the Feasibility Study (EA 2003[1]).

The Airco Parcel was completed as a capped landfill in 2000. During construction of the capping system, a relief pipe system was installed to allow perched water to exit from under the cap without causing slope instability. Flow monitoring and quarterly sampling were initiated as part of post-closure operations and facility maintenance. The data collected since December 2000 indicated that the leachate was actually shallow groundwater recharging to surface water. The data also indicated that the recharge of groundwater at the site would continue to flow seasonally. The data further indicated that elevated hexavalent chromium (Cr^{6+}) concentrations and pH in groundwater, upon mixing with surface water, remained in excess of the ambient water quality criteria.

1. EA Engineering, P.C. and its Affiliate EA Science and Technology. 2003. Focused Groundwater Feasibility Study for the Airco Parcel, Niagara Falls, New York. March.

The GCTS is designed to implement additional remedial actions which have been deemed necessary to meet the goals of the Interim Remedial Measures Program. The main portion of the GCTS is located on the northwest corner of the site and contains the main control panel, carbon dioxide storage tank, carbon dioxide aeration system, two sediment ponds, duplex pump house, zero valence iron (ZVI) reaction tanks, engineered wetland, and an effluent pump station. At the southwest corner of the site, there is an influent wetwell pump station. The GCTS located at the site is presented on Figure 2.

1.2 PERSONNEL REQUIREMENTS AND EMERGENCY CONTACTS

Full-time operating personnel are not required for operation of the GCTS. For O&M requirements, it is anticipated that site visits will be conducted on a monthly basis by a technician in order to collect monitoring data and perform preventive maintenance. Additional site visits may be necessary based on operational or maintenance requirements.

Prior to performing work onsite, operating personnel should thoroughly review and be familiar with emergency procedures outlined in the Site Health and Safety Plan (EA 1999[2]).

1.3 MANUAL ORGANIZATION

This O&M Manual describes the function and O&M of each major component of the GCTS system. This O&M Manual is organized into the following sections:

- Section 1—Introduction
- Section 2—Process and Equipment Description
- Section 3—Process Controls and Instrumentation
- Section 4—System Startup and Shutdown Procedures
- Section 5—Maintenance.

Attachments A, B, and C include cut sheets and detailed O&M information for the GCTS system. The GCTS modification and upgrade drawings are provided in Attachment D.

2. EA Engineering, P.C. and its Affiliate EA Science and Technology. 1999. Pre-Design Investigation Site Health and Safety Plan, Witmer Road Landfill, Niagara Falls, New York. December.

2. PROCESS AND EQUIPMENT DESCRIPTION

2.1 PROCESS DESCRIPTION

To address the high pH (>12) and the elevated Cr^{6+} concentrations, the GCTS has been conceived. The general process flow includes collection of untreated water at the southwest corner of the site via a 6-in. high density polyethylene (HDPE) collection system. Conveyance of this water from the collection area is through the use of a wetwell pump station and 3-in. discharge line. The water flows to the northwest treatment area where initial pH adjustment occurs using carbon dioxide aeration. Primary settling of hardness precipitate occurs in the baffle system in Sediment Pond No. 1, prior to treatment for Cr^{6+} via contact reaction with ZVI. Secondary settling of iron and chromate precipitates occurs in Sediment Pond No 2, with final settling/clarification occurring in the engineered wetland. Discharged treated water flows from the wetland through a 2-in.discharge return line back to the initial collection area which outlets into an offsite wetland area. The following sections will detail each of these components, including design approach and process descriptions.

2.1.1 Groundwater Collection and Conveyance System

A 6-in. HDPE perforated collection pipe conveys water from the waste to the influent wetwell. There are three clean-outs along this line to facilitate cleaning, if required. The collection line is connected to a 30-in. diameter sump at the termination point of the collection system, which will allow for suspended sediments to be collected and removed. Routine maintenance is not anticipated to be required, although routine cleaning every few years is recommended.

2.1.2 Treatment Water pH Adjustment

To reduce the pH, the treatment process utilizes carbon dioxide aeration through a series of aerating disc diffusers installed in Sediment Pond No. 1. The process generates carbonic acid, which reacts to neutralize the water. A pH probe is installed in Sediment Pond No. 1 to monitor pH. If the observed pH is not below 8.0, then the programmable logic controller (PLC) will send an alarm signal and shut the system down. The settling pond is sized such that when collection water enters Sediment Pond No. 1 at a higher than desired pH, the volume of water per cycle, as compared to the volume of water in the settling pond, will not result in a pH value in excess of the allowable range due to dilution within the settling pond.

2.1.3 Primary Settling

The water that is to be treated exhibits a high hardness value, which results in the formation of a white calcium carbonate precipitate upon pH reduction. This white precipitate is not aesthetically desirable and is one of the treatment considerations. The Sediment Pond No. 1 baffle system was incorporated into the design to provide adequate settling time for the calcium carbonate prior to reaction with ZVI for Cr^{6+} reduction. The sediment pond is constructed with a 40-mil HDPE liner. The pond has a working volume of approximately 15,000 gal and has a designed retention time of 4 hours based on a maximum flow rate of 60 gpm. The pond is designed to maintain the minimum retention time of 4 hours, while allowing for the storage of precipitate generated during the neutralization process.

2.1.4 Hexavalent Chromium Reduction

The reduction of Cr^{6+} occurs within a series of four vessels containing ZVI. The iron acts as an electron donor during the oxidation-reduction process. The Cr^{6+} will accept three electrons during the process to convert to trivalent chromium, and ultimately precipitate out as an insoluble compound. The ZVI vessels are configured to allow the required contact time at the maximum flow rate of 60 gpm, or 15 gpm per tank. The vessels, four separate concrete tanks with a minimum ZVI working volume of 120 ft^3 per tank, are designed with a 4-in. influent line which distributes water into a 12- to16-in. bed of pea stone to reduce the potential for short-circuiting through the vessel by inclusion of horizontal channels. The water then flows hydraulically up through 12-16 in. of ZVI, where the reaction occurs, then is gravity fed to a collection manhole equipped with a float-activated submersible pump. The ZVI vessels also contain a piezometer, which are used to check the Cr^{6+} concentrations within each vessel. This allows the operator to track breakthrough of the ZVI and calculate when ZVI replacement will be required. Based on the bench-scale studies, and proper selection of the ZVI source material, additional filtration is not anticipated to be required given the settling capacity of Sediment Pond No. 2 and the engineered wetland downstream of the ZVI process.

2.1.5 Secondary Settling

Sediment Pond No. 2 was incorporated into the design to provide adequate settling time for the iron and chromate precipitates which form after the water has been processed through the ZVI. The sediment pond is constructed with a 40-mil HDPE liner. The pond has an approximate volume of 25,000 gal and has a designed retention time of 4 hours based on a maximum flow rate of 60 gpm. During system upgrades in June 2004, an additional pH meter was installed in Sediment Pond No. 2 to ensure that the treated water is within the 6.0-8.0 compliance range for pH prior to entering the engineered wetland.

2.1.6 Engineered Wetland

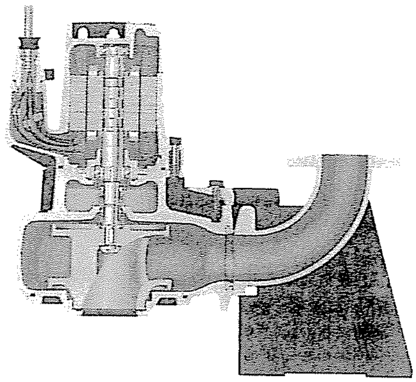
The final treatment step includes processing the water through an engineered wetland of approximately 4,019 ft^2. The water depth in this wetland varies based on pump cycles to convey the treated water from the wetland to the discharge area for release into the environment. The volume within the wetland ranges from a low of 23,162.5 gal to approximately 46,325 gal. The wetland is designed with a total retention time of approximately 1 day (based on average flow rate of 30 gpm), while maintaining sufficient capacity to control the 24-hour duration, 100-year return frequency storm event.

2.1.7 Treatment Water Discharge Conveyance System

The treated water exiting the engineered secondary wetland is conveyed, by pumping, back to the discharge area via a 2-in. line. The 2-in. HDPE line is installed in the same trench as the untreated influent line from the wetwell to the aeration chamber. Both lines are installed to a depth not less than 48 in. below ground surface.

2.2 EQUIPMENT DESCRIPTION

2.2.1 Influent Wetwell Pump Station



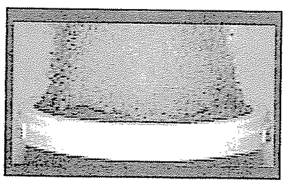
The pump station includes a KSB Model No. KRTF40-160/22X heavy duty submersible non-clog pump with a 3-h.p. explosion-proof motor rated for 3-phase, 60-hertz, 460-volt power. The pump (designated as P-1) is rated for 50 gpm at 40 ft of total discharge head. The KSB pump is contained in a 60-in. diameter, 84-in. deep reinforced fiberglass pump station (designated T-1) with aluminum hinged access hatch.

2.2.2 Carbon Dioxide Storage Tank

A 6-ton vertical carbon dioxide storage tank, and associated controls (supplied by BOC), is used to store the carbon dioxide for pH neutralization. The vaporizer maintains an operating pressure in the tank of 220-235 psi. If the tank pressure exceeds 300 psi, the pressure relief valves will activate to maintain the tank pressure at a safe level. Continued venting through the relief valve will result in a buildup of ice on the valve which could result in system shutdown if the valve freezes.

During startup and proveout of the GCTS, the system typically consumed approximately 3,000 lb of carbon dioxide per week, maintaining a 3-week (20-24 days) carbon dioxide storage tank refill cycle. The tank is fitted with a direct read level gauge calibrated in pounds of carbon dioxide. The tank level should be maintained above 2,000 lb to ensure availability of gas for the treatment process.

2.2.3 Carbon Dioxide Aeration System



The carbon dioxide aeration system is located in the deep portion of Sediment Pond No. 1 along the path of the first two baffle series. The aeration system consists of five Stamford Scientific International Model No. AFD350 12-in. disk diffusers. The collected groundwater enters Sediment Pond No. 1 into the first baffle where initial aeration occurs; following the baffle system, the water is again aerated in the second baffle, and then allowed to settle out precipitate through the remaining baffle series before entering the ZVI tanks.

The aeration system is fed via a 0.75-in. HDPE line connected to the distribution lines which supply carbon dioxide to the disc diffusers. Each line and disc diffuser is equipped with a 0.75-in. ball valve to regulate carbon dioxide flow to the pond.

2.2.4 Sediment Pond No. 1 Controls

The sediment pond (designated as T-3) is fitted with a pH probe and controller, and a pressure transducer for pump control and alarm condition status. The pH probe is installed in a 3-in. line which enters Sediment Pond No. 1 at its mid-point. This enables the controller to observe the pH of the treated water that passes by to the outlet suction line. An alarm condition includes high pH (<8.0) and low pH (<6.0). A high pH alarm condition will shut the system down. A low pH alarm condition will alert the operator that the condition exists, but the system will continue to operate. A high pH results in lower than desired reduction efficiency of the Cr^{6+} during the oxidation-reduction reaction which occurs in the ZVI tanks.

2.2.5 Zero Valence Iron Duplex Pump House

The pump house includes two Goulds Model No. SSH 1.5 × 2.5-6 closed coupled pump (designated as P-4A and P-4B) with a 1-h.p., totally enclosed fan cooled 1,750-rpm motor rated for 3-phase, 60-hertz, 460-volt power. The pump is rated for 60 gpm at 30 ft of total discharge head. The pumps are contained in a 5 ft × 5 ft × 6 ft wooden pump house. The pumps are mounted to the concrete sub-base flooring. The pumps have a 2.5-in. suction inlet and a 1.5-in. discharge outlet. Sampling ports are located in the discharge piping of each pump.

Pump 4A, which draws water from Sediment Pond No. 1 and pumps the water through the ZVI tanks to the gravity fed manhole, is controlled by a variable frequency drive located in the control panel. The pump is designed to maintain the liquid level in Sediment Pond No. 1 at an elevation of 616.0 ft mean sea level (msl). A full list of the system set points is provided in Table 1.

Pump 4B, which draws water from Sediment Pond No. 2 and pumps the water to the engineered wetland, is controlled by the PLC, and set points generated by the pressure transducer which measures the water level in Sediment Pond No. 2. A full list of the system set points is provided in Table 1.

2.2.6 Zero Valence Iron Reaction Tanks

The ZVI tanks are 7 ft wide × 13 ft long × 4 ft high and contain approximately 5.6 tons of iron per tank. The tanks are filled with 12-16 in. of pea stone and 12-16-in. of ZVI on top of the stone. It is estimated that the iron will require replacement annually.

2.2.7 Manhole Collection Sump

The treated water exiting the ZVI tanks gravity drains to the manhole collection sump. The sump is equipped with a Goulds Model 3885 submersible pump. The pump is rated for 60 gpm at 20 ft of total discharge head. The pump is controlled by an "ON" and "OFF" float switch. This pump conveys treated water from the manhole to Sediment Pond No. 2.

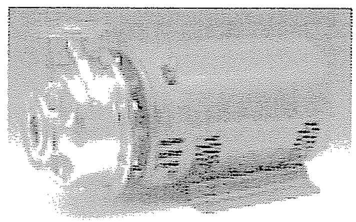
2.2.8 Sediment Pond No. 2 Controls

The sediment pond (designated as T-6) is fitted with a pressure transducer for pump control and alarm condition status. The PLC monitors the water surface elevation and activates P-4B when the water surface elevation reaches 616.5 ft msl, and shuts the pump off at an elevation of 615.0 ft msl. An additional pH meter was installed in Sediment Pond No. 2 to ensure pH discharge does not exceed 8.0.

2.2.9 Engineered Wetland Controls

The wetland (designated as T-7) is fitted with a pressure transducer for pump control and alarm condition status. The PLC monitors mean sea level, and shuts the pump off at an elevation of 614.0 ft msl. An overflow pipe will convey water from the wetland to the existing stormwater swale.

2.2.10 Engineered Wetland Effluent Pump Station



The pump station (designated T-7) includes one Goulds Model No. SSH 1.5 × 2.5-6 closed coupled pump with a 1-h.p., totally enclosed fan cooled 1,750-rpm motor rated for 3-phase, 60-hertz, 460-volt power. The pump is rated for 60 gpm at 30 ft of total discharge head. The pump is contained in a 48-in. diameter, 60-in. deep reinforced fiberglass pump station with aluminum hinged access hatch. The pump has a 2.5 -in. suction inlet and a 1.5 -in. discharge outlet.

Pump P-7 draws water from the engineered wetland and pumps the water to an outlet structure in the southwest corner of the Airco Parcel. The PLC monitors the water surface elevation and activates P-7 when the water surface elevation reaches 614.5 ft msl, and shuts the pump off at an elevation of 614.0 ft msl.

3. PROCESS CONTROLS AND INSTRUMENTATION

This section provides a description of the GCTS process instrumentation and control sequence.

3.1 ANALOG AND DISCRETE INPUTS

The GCTS utilizes one control panel with a keypad interface to allow the user to view and modify system set points. The control panel utilizes a PLC for logical control of the GCTS. Table 2 depicts the various PLC inputs.

There are no alarm indicator lights on the exterior of the control panel. Alarms are displayed at the PLC located inside the control panel and audibly available through the autodialer. If an alarm should occur in the GCTS, the following PLC output lights will indicate the cause of the shutdown:

- ***Alarm Condition No. 1*:**
  - ***CO2 Failure***—System shutdown, technician to site
  - ***P1 Failure***—System shutdown, technician to site
  - ***P4A Failure***—System shutdown, technician to site
  - ***P4B Failure***—System shutdown, technician to site
  - ***P7 Failure***—System shutdown, technician to site
  - ***Manhole Pump Failure***—System shutdown, technician to site
  - ***T1 High Level***—Acknowledge to clear, system will continue to operate
  - ***T1 Low Level***—Acknowledge to clear, system will continue to operate
  - ***T3 Low Level***—Acknowledge to clear indicates that the water level in Sediment Pond A is below 615.0 ft msl; alarm will reset when water level reaches 615.5 ft msl; system will continue to operate.
  - ***T6 Low Level***—Acknowledge to clear indicates that the water level in Sediment Pond B is below 614.5 ft msl; alarm will reset when water level reaches 615.0 ft msl; system will continue to operate

— ***T7 High Level***—Acknowledge to clear indicates that the water level in Engineered Wetland is above 615.5 ft msl; alarm will reset when water level drops below 616.0 ft msl; system will continue to operate (technician to site to pump out dry well T7)

— ***T7 Low Level***—Acknowledge to clear indicates that the water level in Engineered Wetland is below 612.3 ft msl; alarm will reset when water level reaches 612.8 ft msl; system will continue to operate

- *Alarm Condition No. 2*:

— ***T1 Pressure Transducer Low Level***—Indicates that the water table is low; system will shut down until water level resets alarm condition

- *Alarm Condition No. 3*:

— ***pH High***—System shutdown, technician to site

- *Alarm Condition No. 4:*

— ***T3 High Level***—Acknowledge to clear indicates that the water level in Sediment Pond A is above 617.0 ft msl, alarm will reset when water level drops below 616.5 ft msl; system will continue to operate.

— ***T6 High Level***—Acknowledge to clear indicates that the water level in Sediment Pond B is above 617.2 ft msl, alarm will reset when water level drops below 616.7 ft msl; system will continue to operate.

The autodial is programmed to dial out in the event of system shutdown to report the various alarm conditions and/or power failures. To acknowledge alarm calls, enter 555 after alarm message is complete.

4. SYSTEM STARTUP AND SHUTDOWN PROCEDURES

This section describes the procedures to be utilized to start up or shut down the components of the GCTS.

4.1 SYSTEM STARTUP PROCEDURES

The following steps should be performed during initial startup of the GCTS.

4.1.1 System

- *Step 1*—Turn on the main power disconnect, which is mounted on a back panel near the main control panel, and check to make sure all the breakers contained in the load center (480/240 VAC, 3-phase) in the main control panel, and the small load center (220/110 VAC, 1 Phase) in the junction box on the backside of the control panel, are in the ON position. Turn the power disconnect to P1, in the southwest corner, to the ON position.

- *Step 2*—Utilizing the keypad interface, press the status button to display the status of the process equipment. Using the touch keypad, place each piece of process equipment into to AUTO mode.

  — The system will begin to operate; monitor 2-3 treatment cycles to ensure system is operating properly

  — Monitor the cycle times of the pumps and visually observe aerator system

  — Monitor the pH in Sediment Pond No. 1 and Sediment Pond No. 2; desired pH is approximately 6.7

  — Verify heater operation (winter only).

4.2 SYSTEM SHUTDOWN PROCEDURES

In the event that the GCTS needs to be turned off for an extended period of time, the system startup procedure should be reversed. The following steps should be performed.

4.2.1 System

- *Step 1*—Utilizing the keypad interface, press the status button to display the status of the process equipment. Using the touch keypad, place each piece of process equipment into OFF mode. Check each piece of process equipment's operating status at the keypad interface to ensure that the process equipment is STOPPED.

- *Step 2*—Turn the main power disconnect to the OFF position. Turn the power disconnect to P1, in southwest corner, to the OFF position.

5. MAINTENANCE

5.1 INTRODUCTION

The GCTS contains specialized and complex process equipment. Routine maintenance is required to ensure that process equipment continues to operate properly. Disabled or improperly working equipment will reduce treatment efficiency. Repair costs for poorly maintained equipment usually exceed the cost of a regular preventative maintenance program and may increase the downtime of the treatment system. In addition to regular preventive maintenance, routine system monitoring is required to assess the effectiveness of the GCTS and identify and correct any irregular maintenance issues that arise.

The following are the basic objectives of the GCTS maintenance program:

- Reduce the overall cost of maintenance by making critical equipment more reliable and minimizing unnecessary maintenance

- Prevent sudden failure of critical equipment by systematically inspecting, servicing, and repairing operating equipment.

The following components comprise the GCTS maintenance program:

- Equipment maintenance scheduling
- Spare parts inventory and control
- Lubrication
- Housekeeping
- Monitoring.

5.2 EQUIPMENT MAINTENANCE SCHEDULING

Maintenance should be planned and scheduled to distribute tasks throughout the year. A list summarizing recommended routine maintenance tasks and frequencies is provided in Table 3. The maintenance schedule includes the component, interval of inspection or maintenance, and action required. The manufacturer's O&M Manual should be consulted before maintenance is performed.

5.3 SPARE PARTS

Certain items of equipment require spare parts to be maintained in stock to prevent prolonged equipment downtime. The recommended spare parts for equipment will include various pump seals, O-rings, and gauges that are listed in the manufacturer's information included in Attachments A, B, and C.

Spare parts should be stored in areas readily accessible to the equipment items for which they are provided. They should be stored in their original packing and containers, in accordance with manufacturer's instructions.

5.4 LUBRICATION

Lubrication frequencies for each piece of equipment are included in Table 3. For detailed information regarding lubricant specifications, the operator should refer to specific equipment manufacturer's instructions (Attachments A, B, and C).

5.5 HOUSEKEEPING

The routine housekeeping schedule should cover the GCTS, surrounding grounds, and the areas around the drywells. Poor housekeeping creates safety and health hazards and can mask or create process and mechanical problems.

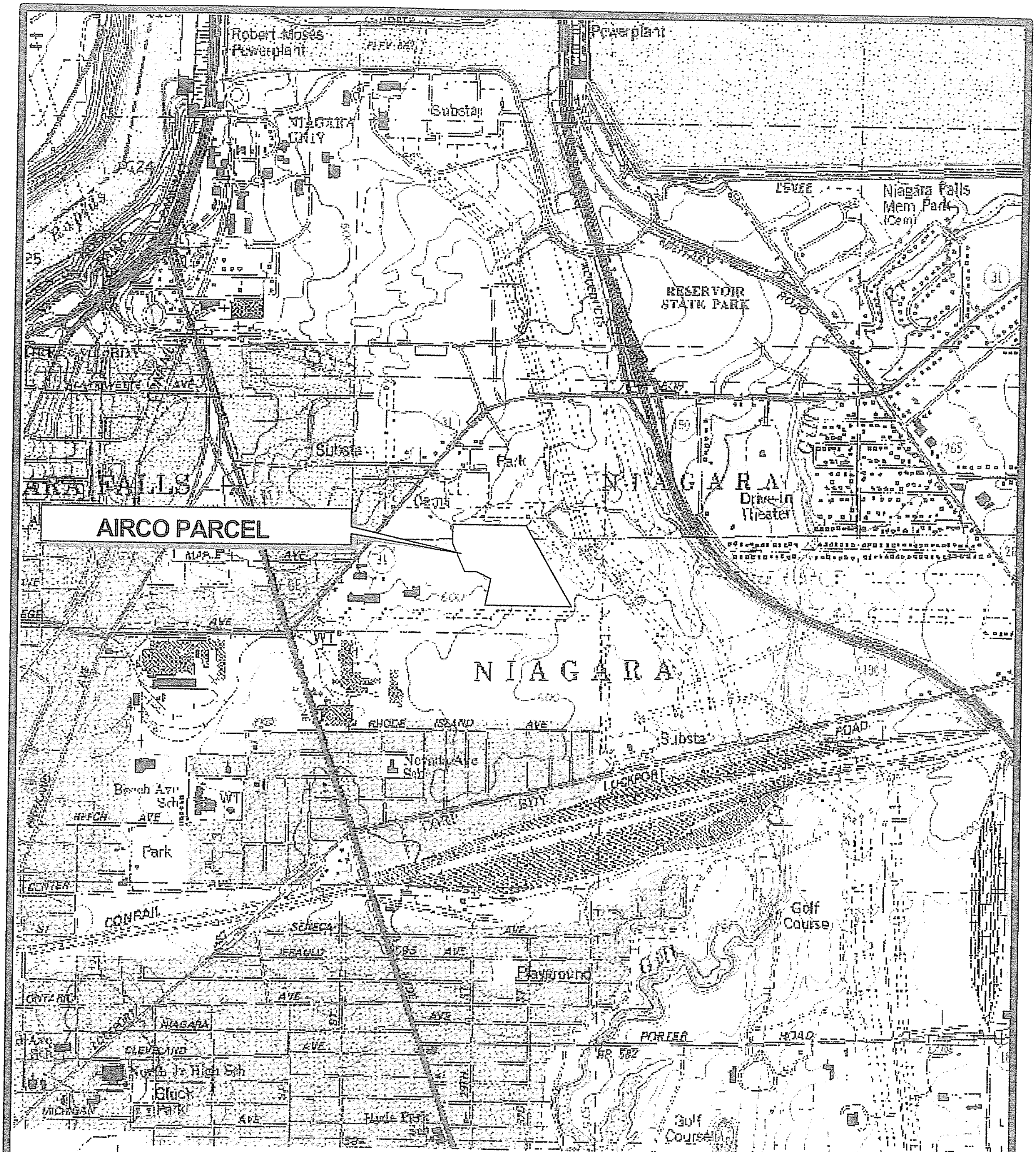
Process equipment should be cleaned and painted as required to enhance the overall appearance of the system. Building interiors and exteriors should be kept clean and in good repair. Outside maintenance work should be scheduled as required.

5.6 MONITORING

System monitoring should be performed on a regular basis to evaluate the operational parameters and influence of the GCTS and to identify potential maintenance issues. Operational parameters normally monitored include flow rates, vacuums, pressures, temperatures, and volatile organic compound concentrations. The results of each monitoring visit should be recorded and a copy of all monitoring data should be maintained onsite. A sample data recording sheet for the GCTS is included as Table 4.

The complete sampling and monitoring plan for the GCTS is detailed in the Revised Final Post-Closure Monitoring and Facility Maintenance Plan (EA 2001[3]). Groundwater samples of the system effluent are also required to meet New York State Department of Environmental Conservation issued guideline standards for the treatment system discharge. The current requirements include analysis of phenolics by U.S. Environmental Protection Agency (EPA) Method 420.1; total metals including barium, total chromium, total copper, total iron, total nickel, total selenium, thallium, and total zinc by EPA Method 200.7; pH by EPA Method 150.1; total Kjeldahl nitrogen by EPA Method 351.2; ammonia as N by EPA Method 350.1; total dissolved solids by Method SIM18-2540C; total suspended solids by EPA Method 160.2; biochemical oxygen demand by EPA Method 405.1; chemical oxygen demand by HACH Method 8000; nitrate/nitrite as N by EPA Method 300.0; hexavalent chromium by Method SM 18 3500Cr-D; and volatiles 624 by EPA Method 601/602. Analytical parameters and discharge criteria are provided in Table 5. Analytical parameters and sampling strategies will be re-evaluated yearly in order to ensure compliance with discharge regulations.

3. EA Engineering P.C. and its Affiliate EA Science and Technology. 2001. Interim Remedial Measure Report Documenting Closure of the Witmer Road Landfill, Niagara Falls, New York. Appendix A – Revised Final Post-Closure Monitoring and Facility Maintenance Plan. January.



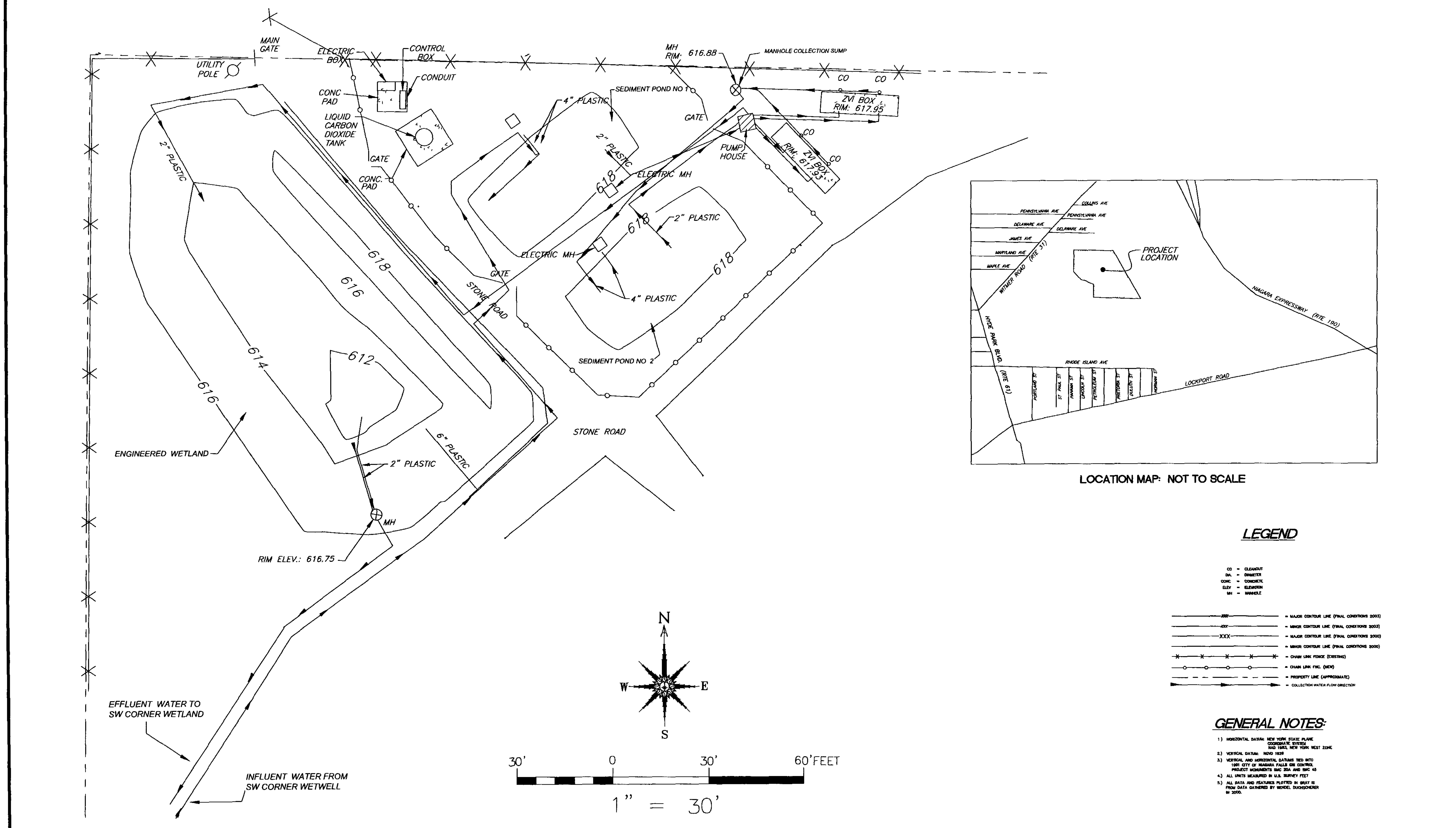
1000 0 1000 2000 Feet

SOURCE MAP: USGS LEWISTON AND NIAGARA FALLS 7.5 MINUTE QUADRANGLES.

N W E S

EA	AIRCO PARCEL NIAGARA FALLS, NEW YORK	FIGURE 1 SITE LOCATION MAP

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT No	FILE No
CEM	RSC	RSC	CEM	AS SHOWN	10 SEP 2003	12040.69	I:\BOC-NIAGARA\FINAL.APR



EA ENGINEERING, P.C.
AND ITS AFFILIATE
EA SCIENCE AND TECHNOLOGY

FIGURE 2
GROUNDWATER COLLECTION AND TREATMENT SYSTEM
SITE LOCATION MAP
AIRCO PARCEL, NIAGARA FALLS, NEW YORK

DRAWN BY: RSC
CHECKED BY: CEM
DATE: 27 SEPTEMBER 2004
FILE PATH: SYR_FP/AIRCO PARCEL/O&M MANUAL

TABLE 1 SUMMARY OF GROUNDWATER COLLECTION AND TREATMENT SYSTEM COMPONENT SET POINTS

System Component	Set Points
Carbon Dioxide Aeration System	
Sparge Time	Continuous until pH <6
Sediment Pond No. 1/Pump 4A	
Pressure Transducer Elevation	613.3 ft msl
Low Level Alarm On	615.0 ft msl
Low Level Alarm Off	615.5 ft msl
Pump Off	615.5 ft msl
Pump On	616.0 ft msl
High Level Alarm On	617.0 ft msl
High Level Alarm Off	616.5 ft msl
Pressure Gauge	10 psi
Sediment Pond No. 2/Pump 4B	
Pressure Transducer Elevation	612.2 ft msl
Low Level Alarm On	614.5 ft msl
Low Level Alarm Off	615.0 ft msl
Pump Off	615.0 ft msl
Pump On	616.5 ft msl
High Level Alarm Off	616.7 ft msl
High Level Alarm On	617.2 ft msl
Engineered Wetlands/Pump 7	
Pressure Transducer Elevation	611.3 ft msl
Low Level Alarm On	612.3 ft msl
Low Level Alarm Off	612.8 ft msl
Pump Off	614.0 ft msl
Pump On	614.5 ft msl
High Level Alarm Off	615.0 ft msl
High Level Alarm On	615.5 ft msl
Carbon Dioxide Storage Tank	
Carbon Dioxide Normal Operating Range	Low = 220 High = 235
Carbon Dioxide Feed Line	220-253 psf
Carbon Dioxide Feed Load	100 psf
Liquid Carbon Dioxide Storage Capacity (lb)	2,000-12,000 lb
Carbon Dioxide Aeration System	
Carbon Dioxide Feed Line	100 psi
Carbon Dioxide Feed Load	12 psi
Carbon Dioxide Rate	150 scfm
Sediment Ponds Aeration Lines	
Sediment Pond No. 1	10 scfh
Sediment Pond No. 2	10 scfh

NOTE: msl = Mean sea level.
psf = Pounds per square foot.
psi = Pounds per square inch.
scfm = Standard cubic feet per minute.
scfh = Standard cubic feet per hour.

TABLE 2 VARIOUS PROGRAMMABLE LOGIC CONTROLLER INPUTS

Indicator Description	Programmable Logical Controller Input/Output No.	Signal Type	Set Point	Control Function
Influent Wetwell Pressure Transducer				
LLA		4-20 mA Signal	597.0 ft msl	Places system in standby
LLA Reset		4-20 mA Signal	597.5 ft msl	Resets system to automatic
Carbon Dioxide Aeration System				
HLA		Discrete	pH > 8	Turns off P-1, alarms out
Sediment Pond No. 1 Pressure Transducer				
LLA		4-20 mA Signal	615.0 ft msl	Turns off P-4A, alarms out
LLA Reset		4-20 mA Signal	615.5 ft msl	Resets alarm condition
Pump Setpoint		4-20 mA Signal	616.0 ft msl	Water level to be maintained by variable frequency drive
HLA Reset		4-20 mA Signal	617.0 ft msl	Resets alarm condition
HLA		4-20 mA Signal	617.5 ft msl	Shuts system down
Sediment Pond No. 1 pH Controller				
Low pH Alarm		4-20 mA Signal	6.0 pH units	Alarms out
High pH Alarm		4-20 mA Signal	8.0 pH units	Shuts system down
Sediment Pond No. 2 Pressure Transducer				
LLA		4-20 mA Signal	614.5 ft msl	Turns off P-4B, alarms out
LLA Reset		4-20 mA Signal	615.0 ft msl	Resets alarm condition
Pump Off		4-20 mA Signal	615.5 ft msl	Turns P-4B off
Pump On		4-20 mA Signal	616.5 ft msl	Turns P-4B on
HLA Reset		4-20 mA Signal	616.7 ft msl	Resets alarm condition
HLA		4-20 mA Signal	617.2 ft msl	Shuts system down
Engineered Wetland Pressure Transducer				
LLA		4-20 mA Signal	612.3 ft msl	Turns off P-4B, alarms out
LLA Reset		4-20 mA Signal	612.8 ft msl	Resets alarm condition
Pump Off		4-20 mA Signal	614.0 ft msl	Turns P-4B off
Pump On		4-20 mA Signal	614.5 ft msl	Turns P-4B on
HLA Reset		4-20 mA Signal	615.0 ft msl	Resets alarm condition
HLA		4-20 mA Signal	615.5 ft msl	Alarms out

NOTE: LLA = Low Level Alarm.
mA = Milliamp.
msl = Mean sea level.
HLA = High Level Alarm.