Final Site Inspection Report for the Lewiston-Porter Central School District at the Former Lake Ontario Ordnance Works (LOOW) Niagara County, New York

March 2011

Prepared for:

U.S. Army Corps of Engineers
Buffalo District

Contract W912DR-06-D-0002
Delivery Order 0009

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11/17/10

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COMPLETION OF SENIOR TECHNICAL REVIEW

This document has been produced within the framework of the Earth Resources Technology, Inc. and EA Engineering, Science, and Technology, Inc. (EA) quality management system. As such, a senior technical review (STR) has been conducted. The STR included review of the overall design addressed within the document, proposed or utilized technologies and alternatives and their applications with respect to project objectives and framework of U.S. Army Corps of Engineers regulatory constraints under the current Defense Environmental Restoration Program-Formerly Used Defense Sites (DERP-FUDS) No. C02NY0025 project, within which this work has been completed.

Sandra M Staigerwald 3/15/11

Sandy Staigerwald (EA) Date
Senior Technical Reviewer

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LIST OF ACRONYMS

bgs	below ground surface
BTV	background threshold value
cpm	counts per minute
DERP	Defense Environmental Restoration Program
DoD	Department of Defense
EA	EA Engineering, Science and Technology, Inc.
ERT	Earth Resources Technology, Inc.
ft	foot/feet
FS	feasibility study
FSP	Field Sampling Plan
FUDS	Formerly Used Defense Site
GPS	global positioning system
LOOW	Lake Ontario Ordnance Works
L-P CSD	Lewiston-Porter Central School District
mg/kg	milligrams per kilogram
NA	not applicable
NCDOH	Niagara County Department of Health
ND	not detected
NFSS	Niagara Falls Storage Site
NM	not measured
NY	New York
NYCRR	New York Codes, Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
OCCP	Occidental Chemical Corporation Property
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyls
PEI	Panamerican Environmental Incorporated
PID	photoionization detector
ppm	parts per million
PRG	preliminary remedial goal
QAPP	Quality Assurance Project Plan
rad	radiation absorbed dose
rem	Roentgen equivalent in man
RI	remedial investigation
RSL	Regional Screening Level
SSHP	Site Safety and Health Plan
STR	senior technical review
SVOC	semivolatile organic compound
SWDD	Southwest Drainage Ditch
TAGM	Technical Administrative Guidance Memorandum
TAL	Target Analyte List
TCL	Target Compound List
TNT	trinitrotoluene
USACE	United States Army Corps of Engineers
USAGC	United States Army Geospatial Center

USATEC	United States Army Topographic Engineering Center
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
WWTP	Wastewater Treatment Plant
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
µR/hr	microRoentgens per hour
µrem/hr	microRems per hour

1.0 INTRODUCTION

Earth Resources Technology, Inc. (ERT) has been contracted by the U.S. Army Corps of Engineers (USACE) to conduct an investigation at the Lewiston-Porter Central School District (L-P CSD) in Niagara County, New York (NY) (Figure 1-1). This investigation was conducted under Contract Number W912DR-06-D-0002, Delivery Order 0009 with the USACE-Baltimore District.

The work performed at the L-P CSD addressed concerns identified by a review of historical aerial photographs thought to reflect possible Department of Defense (DoD) activities on property currently owned by L-P CSD. The work also addressed concerns with surface water drainage systems on the L-P CSD property.

In order to maintain consistency in methodology, analytical reproducibility and representativeness, this investigation utilized sampling and analytical protocols established in previously approved work plans for the Phase IV Remedial Investigation (RI)/Feasibility Study (FS) of EU-7 Wastewater Treatment Plant (WWTP) at the former Lake Ontario Ordnance Works (LOOW), Niagara County, NY (USACE, 2009a, 2009b, 2009c). Investigation activities were conducted in accordance with the following approved work plan components.

- Final Field Sampling Plan (FSP) Addendum for Occidental Chemical Corporation Property (OCCP) Data Gap and L-P CSD Investigations at the Former LOOW, Niagara County, NY (USACE, 2010a)
- Final Quality Assurance Project Plan (QAPP) Addendum for OCCP Data Gap and L-P CSD Investigations at the Former LOOW, Niagara County, NY (USACE, 2010b)
- Final Site Safety and Health Plan (SSHP) Addendum for OCCP Data Gap and L-P CSD Investigations at the Former LOOW, Niagara County, NY (USACE, 2010c)

1.1 Project Scope and Objectives

The objective of the L-P CSD investigation was to evaluate if previous DoD activities associated with historical aerial photographic "anomalies" in undeveloped portions of the L-P CSD property resulted in impacts to surface and subsurface soil, and whether there were potential impacts to surface water, sediment, and soil within the Southwest Drainage Ditch (SWDD) where it traverses the school campus. An assessment was performed through field screening, sample collection, laboratory analysis, and evaluation of detected constituents relative to U.S. Environmental Protection Agency (USEPA) Regional Screening Levels (RSLs) (USEPA, 2010), background threshold values (BTVs) and ecological screening values established for the Niagara Falls Storage Site (NFSS) (USACE, 2007a), and associated New York State Department of Environmental Conservation (NYSDEC) Part 703 Surface Water and Groundwater Quality Standards (NYSDEC, 2004). This report documents activities conducted as part of the L-P CSD investigation, presents field observations, field screening measurements and analytical results, and compares the analytical data to established criteria.

1.2 Site History

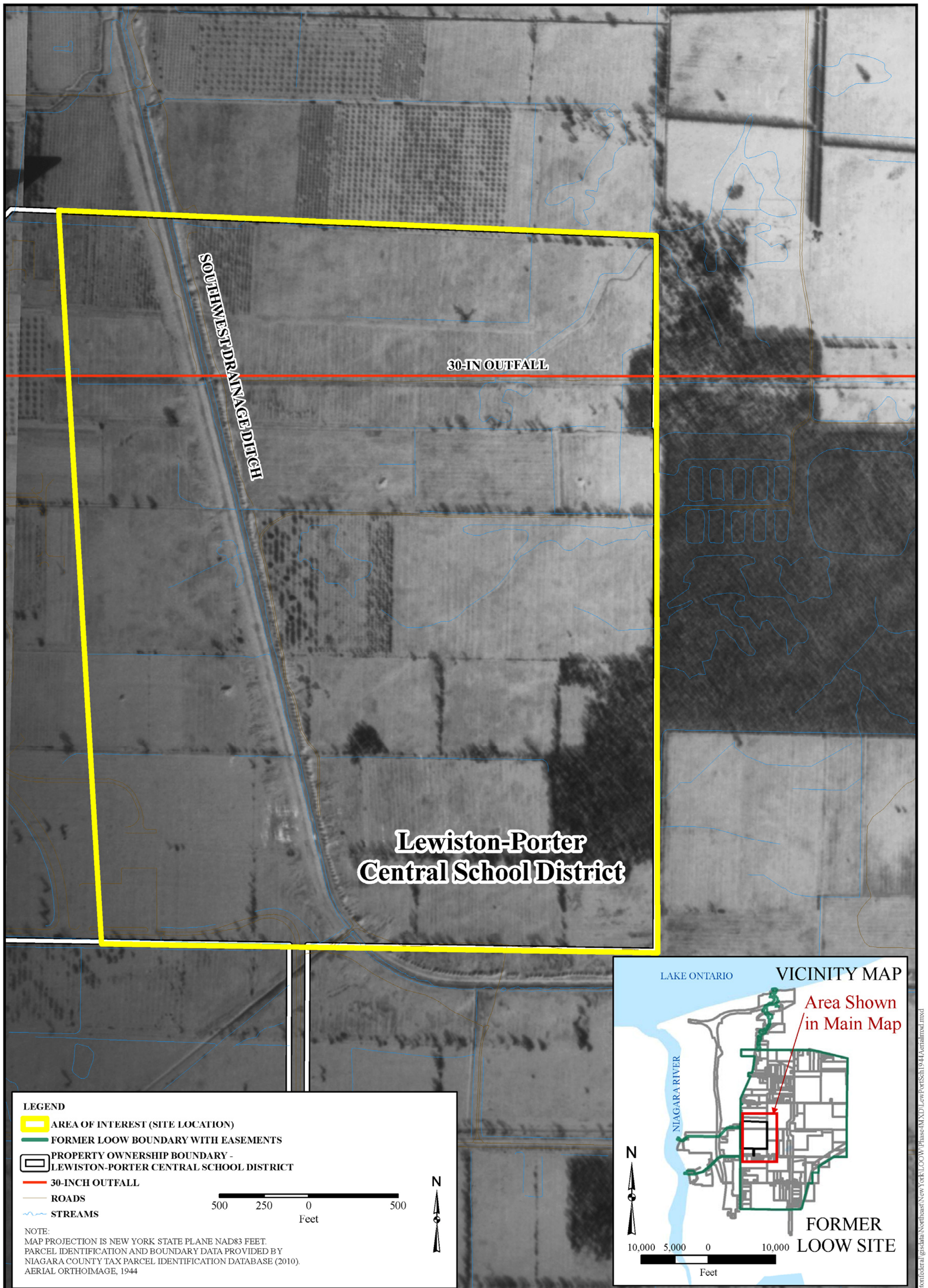
DoD owned the land parcel associated with the L-P CSD property from 1942 until 1945, when it was transferred to the General Services Administration (Figure 1-2) and thereafter sold to private landowners. The L-P CSD parcel was part of the former LOOW Buffer Zone; documented DoD activities consisted of the construction and use of a 30-inch outfall line and the SWDD. During DoD ownership the 30-inch outfall line conveyed treated trinitrotoluene (TNT) wastewater, acid neutralized wastewater and sanitary wastewater from the former LOOW WWTP to the Niagara River. After the transfer of the parcel to the L-P CSD from the private landowners in 1948, the 30-inch outfall line also accepted treated waste from the former Air Force Plant 68 and the former NF-03 Nike Missile site near Model City. The portion of the 30-inch outfall that traverses the campus is constructed with terracotta pipe that is encased in concrete and buried approximately 6 feet (ft) below ground surface (bgs) (USACE, 1999). Figure 1-3 shows land use in 1944 when DoD owned the property.

Construction of the L-P CSD campus began in the early 1950s with the North Elementary Building (USACE, 1999). The L-P CSD currently maintains a 372-acre campus consisting of an elementary school, middle school, and high school.

LAKE ONTARIO ORDNANCE WORKS LEWISTON-PORTER CENTRAL SCHOOL DISTRICT NIAGARA COUNTY, NEW YORK	FIGURE 1-1 LOCATION

LAKE ONTARIO ORDNANCE WORKS
LEWISTON-PORTER CENTRAL SCHOOL DISTRICT
NIAGARA COUNTY, NEW YORK

FIGURE 1-2
SITE LOCATION



LAKE ONTARIO ORDNANCE WORKS
LEWISTON-PORTER CENTRAL SCHOOL DISTRICT
NIAGARA COUNTY, NEW YORK

FIGURE 1-3
1944 HISTORICAL AERIAL

2.0 PREVIOUS INVESTIGATIONS

Previous investigations performed by USACE and L-P CSD have evaluated potential constituent concentrations within the school campus. The majority of these investigations have focused on the portion of the campus that has been developed by L-P CSD. L-P CSD has contracted various entities to perform environmental investigations to accommodate development of the property.

Potential constituent concentrations on the former LOOW are being evaluated by an ongoing USACE RI/FS that is assessing the nature and extent of contamination associated with former LOOW and DoD operations at areas of concern eligible for investigation within an approved Defense Environmental Restoration Program-Formerly Used Defense Sites (DERP-FUDS) Hazardous, Toxic, and Radioactive Waste project. Portions of the L-P CSD property with known DoD activity were included in previous phases of the RI, which included soil in the vicinity of the 30-inch outfall line.

2.1 Historical Aerial Photography

The U.S. Army Topographic Engineering Center (USATEC) examined historical aerial photographs of the former LOOW and identified ground anomalies, ground scars, disturbed ground, and debris piles within the undeveloped portion of the L-P CSD property (USATEC, 2002). Historical photographs from 1938, 1942, 1944, 1951, 1956, 1958, 1960, 1963, 1972, 1978, 1981, 1985, 1990, 1995, and 1997 were reviewed. Anomalies identified in the photographs were considered areas of potential previous DoD activity. Anomalies that were identified on the L-P CSD property were categorized as mounded material. However, other than the construction of the 30-inch outfall line and the SWDD, there are no other available documents that indicate DoD use of the L-P CSD property. The USATEC report stated that the mounds “may be associated with local farming” (USATEC, 2002).

In 2009, USATEC became part of the U.S. Army Geospatial Center (USAGC). USAGC expanded on the examination of the aforementioned historical aerial photographs by focusing on specific areas of LOOW property (such as L-P CSD property). USAGC identified additional anomalies including ground scars, disturbed ground, and debris piles that were not included in the previous USATEC historic aerial photograph analysis. Anomalies identified in the photographs from the time of DoD ownership were considered areas of potential previous DoD activity. Anomalies that were identified in association with the L-P CSD property were categorized as mounded material, ground scars, pits, transportation pathways and drainage ditches. USAGC stated that mounding and ground scaring “may be due to local agricultural activity” (USAGC, 2009).

2.2 Phase I Remedial Investigation

During the Phase I RI, subsurface soil samples were collected from below the 30-inch outfall line that traverses the L-P CSD property. The samples were field screened for TNT and four samples were submitted for laboratory analysis for DoD marker compounds (i.e., boron, lithium and explosives). Results of the sample analysis indicated boron and lithium concentrations below the Phase I RI project screening criteria, based on NYSDEC and USEPA guidance, and no reportable explosives concentrations. It was concluded that the data did not indicate an impact from previous DoD activities (USACE, 1999). However, the USACE performed additional sampling as part of the Phase III RI (see Section 2.9).

2.3 Lewiston-Porter Central School District Sampling

Surface soil samples were collected in 2001 at previous USACE background sampling locations where elevated concentrations of arsenic were detected, as compared to USEPA Region 9 Preliminary Remediation Goals (PRGs) (current as of 2000). These PRGs have since been updated and are now referred to as the USEPA RSLs. During three separate sampling events a total of 32 soil samples were collected and analyzed for lead and arsenic (Chopra Lee, 2001a, 2001b, and 2001c). Arsenic concentrations ranged from 3.98 milligrams per kilogram (mg/kg) to 58.5 mg/kg.

2.4 Gamma Walkover Survey

A gamma background study was performed by USACE on the L-P CSD property and used to compare background measurements obtained at the New York Army National Guard Weekend Training Site (now referred to as the Youngstown Local Training Area) located on Balmer Road. The L-P CSD property was selected due to proximity and upwind location relative to the NFSS. The study involved measuring gamma radiation levels of surface media (i.e., soil, asphalt, concrete and gravel) using detectors linked to global positioning instruments. The results of the survey were considered typical of similar local properties as well as man-made construction and development projects (USACE, 2002).

2.5 Lewiston-Porter Central School District Southwest Drainage Ditch Sampling

In 2002, three surface water samples were collected by the Niagara County Department of Health (NCDOH) from the SWDD which transects the school campus. The samples were collected from points where the SWDD enters the L-P CSD campus, exits the L-P CSD campus, and at a point centrally located along the SWDD within the L-P CSD campus. The NCDOH reviewed the analytical results and found that the levels of inorganic constituents detected in the samples were similar to background concentrations and below concentrations of concern to human health or the environment (NCDOH, 2002).

2.6 Lewiston-Porter Central School District Playground Area Sampling

L-P CSD contracted Chopra-Lee, Inc. to investigate soil associated with the construction of two playground areas on the L-P CSD campus. Concentrations of polycyclic aromatic hydrocarbons (PAHs) were detected in a mound of excavated soil that was sampled. It was determined that these levels did not present a risk to human health (Chopra-Lee, 2003).

2.7 University of Buffalo Environmental and Society Institute Study

In 2004, Dr. Joseph Gardella and four graduate assistants at the University of Buffalo Environment and Society Institute published the results of a soil investigation conducted at the L-P CSD property. Samples were collected throughout different areas of the campus and analyzed for metals, semivolatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), and DoD marker compounds (lithium and boron). Results of the sample analysis identified elevated concentrations of arsenic and PAHs in the vicinity of the Campus Community Resource Center. No other compounds, including DoD marker compounds, were detected at concentrations greater than background data and/or the NYSDEC Technical Administrative Guidance Memorandum (TAGM) 4046 recommended soil cleanup objectives (Gardella, et al, 2004).

2.8 Lewiston-Porter Central School District Soil Sampling

In 2004, the L-P CSD contracted Panamerican Environmental, Inc. (PEI) to conduct soil sampling as a follow-up to the investigation completed by the University of Buffalo. The objective of the 2004 sampling effort was to further investigate levels of arsenic, lead, and PAHs detected in the vicinity of the Campus Community Resource Center. Four soil samples were collected from each of 15 borings and analyzed for lead, arsenic and PAHs. Arsenic was not detected in any of the collected samples and lead was detected at concentrations ranging up to 140 mg/kg, which was below the 200-500 mg/kg background level cited in NYSDEC TAGM 4046 for metropolitan areas. Slightly elevated concentrations of PAHs were identified in an area of construction/demolition material (PEI, 2004).

In 2005, PEI re-sampled at 10 of the locations to evaluate differences between their 2004 findings, which did not detect arsenic, and the University of Buffalo findings that detected arsenic in each of the areas sampled. Lead concentrations were consistent with the previous PEI results and the detected concentrations of arsenic, although lower, were consistent with the analytical data presented by the University of Buffalo in 2004 (PEI, 2005).

In 2006, PEI conducted another follow-up investigation that consisted of collecting five soil samples from each of four locations at depths ranging from the ground surface to 4 ft bgs. The samples were analyzed for arsenic and lead. Lead was detected at concentrations up to 193 mg/kg, which was below the 200-500 mg/kg site background level cited in NYSDEC TAGM 4046 for metropolitan areas. Three of the four sample locations had arsenic concentrations greater than the TAGM 4046 recommended soil cleanup value of 7.5 mg/kg, and one surface soil sample contained arsenic (46.2 mg/kg) above the site background (3-12 mg/kg). In addition, it was determined that the arsenic concentrations diminished with increased depth below ground surface (PEI, 2006).

In response to the elevated metals concentrations identified adjacent to the Campus Community Resource Center and future plans to redevelop the campus, L-P CSD contracted PEI to prepare a Soils Management Plan for the campus (PEI, 2007) with the intent of managing any soils containing elevated metals concentrations during current and future redevelopment projects.

2.9 Phase III Remedial Investigation

During the Phase III RI, one sediment sample and one surface water sample were collected from the SWDD beneath the 30-inch outfall line where it traverses the ditch. Analytical results indicated that constituent concentrations were comparable to established background concentrations (USACE, 2008).

Additional soil, sludge and wastewater samples were collected from below and within the 30-inch outfall line from the point where it originated at the former LOOW WWTP to the SWDD. Samples were collected from 11 locations along the portion of the 30-inch outfall line located on L-P CSD property and analyzed for volatile organic compounds (VOCs), SVOCs, pesticides, PCBs, explosives, and metals. A human health risk screening and risk assessment were performed on the reported concentrations of VOCs, SVOCs, pesticides, metals. Results of the human health risk assessment concluded that there were no human health concerns from exposure to media associated with the 30-inch outfall line.

3.0 DATA COMPARISON METHODS

3.1 Regulatory Comparison Criteria

This investigation was performed to identify potential environmental impacts associated with previous DoD operations on undeveloped portions of the L-P CSD property and the SWDD where it traverses the L-P CSD property. The NYSDEC has been providing regulatory oversight of this and other projects associated with the former LOOW.

3.1.1 Soil and Sediment

NFSS background data (USACE, 2007b) and USEPA RSLs (USEPA, 2010) were used as a means of comparison for soil and sediment analytical data. Similar to previous investigations performed at the former LOOW, data for non-carcinogenic analytes, with the exception of lead, were compared to 1/10th of the USEPA RSLs. This procedure was followed to account for circumstances where multiple constituents were reported and to reduce the likelihood that a constituent that should have been retained for further consideration was dropped. Sediment samples obtained from the SWDD were also compared to ecological screening levels that have been updated from values that were used in the NFSS RI report (USACE, 2007a). The current recommended NYSDEC sediment screening values are taken from consensus threshold effects concentrations developed by USEPA (USEPA, 2002). The sediment consensus threshold effects concentrations were developed to represent concentrations of individual constituents below which the constituent was considered to be non-toxic in the sediment. This screening approach ensures the protection of both human health and the environment. Analytical parameters and their respective reporting limits, method detection limits, and data quality limits used for comparison are presented in Appendix A.

3.1.2 Surface Water

Analytical data from surface water samples collected in the SWDD were compared to ecological risk-based screening levels, USEPA RSLs for tap water, and NFSS background data (USACE, 2007a). The NFSS risk-based screening levels incorporated NYSDEC standards presented in New York Codes, Rules and Regulations (NYCRR) Title 6, Part 703 Surface Water and Groundwater Quality Standards for Class B water, aquatic life chronic. NYSDEC Class B water classification was utilized because the SWDD discharges into 4 Mile Creek, which is classified by New York State as a Class B water source (USACE, 1999). Tap water screening values from the EPA RSLs were used for human health-based screening. This was a conservative approach as water in the ditch is not used as a potable water supply and actual human exposure to water within the ditch is much lower. The USEPA RSLs for tap water were used since they incorporate updated toxicity criteria, especially for the DoD-marker compound, lithium. A toxicity criterion for lithium was not available at the time of the NFSS RI report publication. Furthermore, this screening approach is consistent with the previous LOOW RI phases. Evaluations presented in the NFSS RI used site-specific risk-based concentrations associated with intermittent exposure to ditch water for screening surface water concentrations on-site.

3.2 Background Data

The background data used to compare sample results against was based on a data set compiled for NFSS (USACE, 2007b). For soils, this background data set is identical to the one used in previous phases of the LOOW RI. For sediment and surface water, the data set represents ditches upstream of the NFSS (USACE, 2007b). These locations are also upstream of the developed portion of the LOOW and are appropriate to use in determining potential impacts from DoD activities on the L-P CSD property. The BTV selected for comparison to site data was either the maximum concentration reported in the background data set or the 95% upper tolerance limit of the background data set for metals and many organic constituents in surface soil, sediment, surface water and total soil (which was used for comparison to subsurface soils). The individual sample results were compared to the BTVs and were considered above background if they exceeded the BTVs. Samples results below the BTVs were considered within site background levels. A summary of the statistical evaluation results and the methodology used to select the BTV is provided in Appendix B.

4.0 INVESTIGATION ACTIVITIES

Site investigation activities consisted of: brush clearing to provide access; field screening for radiation, volatile constituents, and explosives; soil sampling at terrestrial locations that corresponded to USAGC-identified anomalies; and surface water, sediment, and soil sampling from the SWDD. All field and laboratory activities were performed in accordance with the approved FSP Addendum (USACE, 2010a), QAPP Addendum (USACE, 2010b), and SSHP Addendum (USACE, 2010c).

4.1 Brush Clearing

Brush clearing was performed to access certain sample locations throughout the investigation area. Prior to clearing, the brush was screened with a Bicron microRem dose rate meter to ensure that no radiological impacts were present above the site-specific background dose rate of 7.7 microRoentgens per hour (μR/hr), which was established during the Phase IV RI (using a Ludlum Model 19). Cleared brush was mulched and spread in place.

4.2 Sampling Activities

Soil sampling was performed at the USAGC-identified anomalies and within the SWDD. Biased sample locations were selected based on reviews of previous investigations and historical aerial photographs. The investigation was designed to target locations that may constitute a higher potential for impact.

Terrestrial soil sample locations consisted of seven suspected mounds (Anomalies A01, A02, A03, A04, A05, A07 and A08) in the northern portion of the L-P CSD property, one trench (Anomaly A06) in the northeast portion, and two pits (Anomalies A09 and A10) in the southeastern portion. Prior to intrusive operations, a field reconnaissance was performed using a global positioning system (GPS) and visual inspection to locate the sample areas.

The presence or absence and approximate size of each anomaly were determined by visual inspection. Anomalies were not observed at A03, A04, A06, and A08 (suspected mounds), and A09 (a suspected pit). Two of the anomalies (A01 and A05) were small in size (less than 200 cubic ft). Two other anomalies, A02 and A07, were larger mounds (greater than 200 cubic ft). One suspected pit (A10) indentified in the USAGC (2009) report, was found to be a large mound. Approximately 100 ft north of A10, a small depression was observed, classified as a pit, and designated as Anomaly A10A. This feature was not identified in the historical aerial photographs.

For those anomalies that were small (less than 200 cubic ft) or not found, one boring was advanced using direct-push (i.e., Geoprobe®-type) equipment at the center of the anomaly or at the GPS coordinates (determined from the aerial photographs) where no anomaly was found. At each boring two samples were collected for laboratory analysis: one surface (0-1 ft bgs) and one subsurface (greater than 1 ft bgs). The depth of the subsurface sample was selected from the interval of highest potential impact based on field observation, photoionization detector (PID) screening results, and/or the interface of the mounded material and the undisturbed native soil. Borings at these anomalies were terminated at a depth of 4 ft. Subsurface samples were taken from the transition between disturbed and undisturbed soil. In cases where disturbed soil was not encountered, the sample was taken from the transition between different soil types or from the bottom of the borehole (where no soil transition was present).

Each of the larger mounds (Anomalies A02, A07, and A10) was separated into four quadrants. Within each quadrant a single boring was advanced and field observations were made. Borings were terminated upon reaching a clear transition to the undisturbed native soil sequence. In each case, the surface soil sample was collected from the top six inches of soil. For the subsurface soil sample, the soil core determined to have the highest potential for impact were selected for laboratory analysis.

Soil boring logs for all the anomalies are provided in Appendix C. Photographs of the anomalies and sampling activities are provided in Appendix D.

Sediment and surface water samples were collected along the SWDD from six discrete locations located between where the SWDD enters the L-P CSD campus (location SWDD-06) to where the SWDD exits the campus (SWDD-01). Sample locations were roughly equidistant along the SWDD. Sample collection began at the most down-gradient location and continued sequentially up-gradient in order to avoid disturbance of the SWDD and to avoid potential cross contamination. At each location, one surface water, one sediment sample (6-12 inches below water surface), and one subsurface sample (2.5-3 ft below water surface) were collected. At each location, the surface water samples were collected first, followed by the sediment and soil samples. A disposable acetate liner or pre-cleaned hand auger was used to collect each sediment and soil sample.

Additional quality control sample volumes were collected at select locations to verify field collection methods, laboratory analytical methods, and to ensure sample chain of custody integrity. Laboratory analytical results are discussed in Section 5.

4.2.1 Field Soil Screening

Three field screening techniques were utilized during investigation:

- Soil radiation screening
- Soil PID screening
- Soil explosives screening

These techniques are described in the following subsections.

4.2.1.1 Soil Radiation Screening

Radiation screening was conducted due to the proximity of the site to the NFSS. In order to ensure the health and safety of field personnel, sample areas, terrestrial soil samples, and brush were screened for radiological constituents (general area dose rate) using field instrumentation (Bicron MicroRem dose rate meter). The Bicron microRem displays readings in units of microrem per hour (μrem/hr). It is acceptable to compare values obtained in μrem/hr to the site-specific background of 7.7 μR/hr. The most commonly used unit of exposure is the Roentgen. In human tissue, one Roentgen of gamma radiation exposure results in approximately one radiation absorbed dose (rad). The absorbed dose of specific types of radiation is multiplied by a "quality factor" to arrive at the dose equivalent. Rem is an acronym for "Roentgen equivalent in man." When exposed to gamma radiation, the quality factor is 1. Dose rate is then presented as rem over a specific measure of time. For most types of radiation, a Roentgen equals one rad and since the quality factor for x- and gamma rays is one, the Roentgen, rad, and rem can be considered equal in value (Non-destructive Testing Resource Center, 2010). Direct counts were also taken via a Ludlum 2221 meter coupled to a Ludlum Model 44-10 probe (2-inch by 2-inch sodium iodide tube) to ensure that no radiological impacts were present above the site-specific background direct count of 8,000 counts per minute (cpm), which was established during the Phase IV RI. None of the cleared brush exhibited radioactivity greater than the established background dose rate or background direct count.

General area dose rates were monitored during sampling activities for health and safety purposes. In addition, each set of soil samples for laboratory analysis was screened for dose rate and direct count after packaging in sample coolers and prior to off-site shipment. None of the sample containers exhibited radioactivity greater than the established background levels (7.7 μR/hr and 8,000 cpm). Radiation screening results are discussed in Section 5 and field data are presented in Appendix E.

4.2.1.2 Soil Photoionization Detector Screening

Each collected soil and sediment core was screened using a PID for total VOCs. Terrestrial soil cores collected with a Macrocore sampler and SWDD soil/sediment cores collected with acetate tube liners were screened by slicing a hole in the disposable acetate liner and inserting the PID probe. SWDD core samples collected via hand auger were screened by manually breaking a small section of the core and inserting the PID probe. Readings were observed for a minimum of five seconds to allow for stabilization and each highest reading was recorded by a field geologist on a sample location-specific boring log. The PID measurements are included on soil boring logs in Appendix C and discussed in Section 5.

4.2.1.3 Soil Explosives Screening

Field screening for explosives was conducted on each soil core utilizing DropEx® field screening kits. DropEx® screening procedures involved the collection of soil on a dedicated wipe and the application of a proprietary liquid resulting in a colorimetric reaction that identifies various explosive constituents. To ensure that sample preparation and field analysis techniques were consistent with the established standard operating procedure; two duplicate field screen samples were collected and analyzed. A summary of the explosives screening results is provided in Appendix F and discussed in Section 5. The results are also included on soil boring logs in Appendix C.

4.3 Soil Sampling

Twenty-two (22) terrestrial soil samples (11 surface soil samples and 11 subsurface soil samples) were collected at the anomaly locations using a Macrocore sampler with disposable acetate liners (Figure 4-1). At each location, a pneumatic hammer (i.e., direct-push sampling equipment) was used to advance the Macrocore sampler.

Six subsurface soil samples were collected in the SWDD, beneath or adjacent to the co-located surface water and sediment samples (discussed in Sections 4.4 and 4.5 below). A disposable acetate liner or hand auger was used to collect these samples.

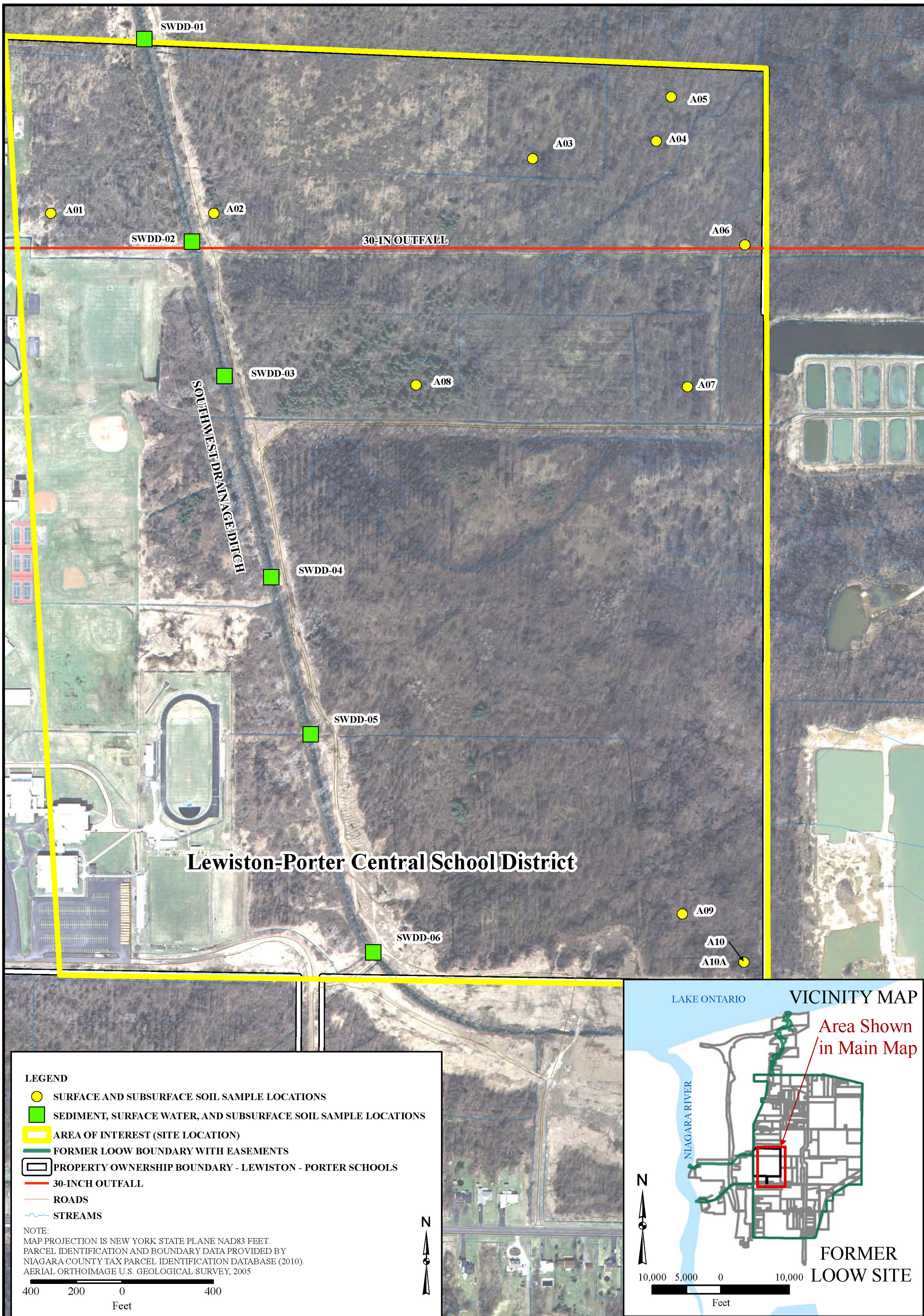
All samples were delivered to an analytical laboratory (Test America Laboratories) for analysis of Target Compound List (TCL) VOCs, TCL SVOCs, explosives, PCBs, and Target Analyte List (TAL) metals plus lithium and boron. Analytical results are discussed in Section 5 and the data is presented in Appendix G.

4.4 Sediment Sampling

Six sediment samples were collected from six discrete locations within the SWDD (Figure 4-1) utilizing disposable soil acetate Macrocore liners or a hand auger. All samples were delivered to an analytical laboratory (TestAmerica Laboratories) for analysis of TCL VOCs, TCL SVOCs, explosives, TCL PCBs, and TAL metals plus lithium and boron. Analytical results are discussed in Section 5 and the data is presented in Appendix G.

4.5 Surface Water Sampling

Six surface water samples were collected from six discrete locations within the SWDD (Figure 4-1) by directly immersing sample containers into the water. Sample collection began at the furthest downstream location and progressed sequentially to the adjacent upstream location. Dedicated unpreserved sample containers were utilized to transfer aliquots to pre-preserved sample containers. Each surface water sample was collected away from the shoreline in an undisturbed area facing upstream. Surface water samples were analyzed for TCL VOCs, TCL SVOCs, explosives, TCL PCBs, and TAL metals plus lithium and boron. Analytical results are discussed in Section 5 and the data is presented in Appendix G.



LAKE ONTARIO ORDNANCE WORKS
LEWISTON-PORTER CENTRAL SCHOOL DISTRICT
NIAGARA COUNTY, NEW YORK

FIGURE 4-1
SAMPLING LOCATIONS

5.0 RESULTS

The following subsections discuss field observations, field screening results and laboratory analytical results.

5.1 Field Observations

5.1.1 Aerial Anomalies

Anomalies were not observed at A03, A04, A06, A08 and A09. Mounds were observed at A01, A02, A05, A07, and A10. A small depression was observed at A10A. This feature was not identified in the historical aerial photographs.

Table 5-1 provides a summary of soil types encountered at each investigated location; detailed soil descriptions are provided in the boring logs (Appendix C). Information provided on this table and the logs indicates that topsoil was present over silt or clay soils at all investigated locations. These soils types appear to represent either redistributed or undisturbed native soils. Redistributed native soils were present within the mounds which might have been created by previous agricultural activities or by the construction of the SWDD and/or 30-inch outfall line. Non-native fill or waste materials were not encountered.

5.1.2 Southwest Drainage Ditch

Sediment and soil descriptions associated with the SWDD core samples are provided in the boring logs (Appendix C). Sediment within the SWDD consisted of decayed organic material (peat) or sand at five of the six locations sampled. Surficial materials at SWDD-06 consisted of gravel and cobbles, which might have been placed during construction of a culvert and bridge at this location. Clay soils were encountered beneath the sediment.

5.2 Field Soil Screening Results

PID and explosives screening was performed on all collected samples. Radiological screening was conducted on cleared brush, terrestrial sampling areas, and terrestrial samples. Table 5-1 provides a summary of the anomaly field screening measurements and observations. PID and explosives screening results for the anomaly and SWDD samples are also provided on the soil boring logs in Appendix C.

5.2.1 Photoionization Detector Screening Results

Results from the surface soil screening identified four of 23 terrestrial soil boring samples that had reportable PID readings, ranging from approximately 0.2 parts per million (ppm) to 1.2 ppm. PID readings of 1.2 ppm were recorded from subsurface samples from locations A01 (1-4 ft), A06 (1-4 ft) and A08 (1-4 ft). A PID reading of 0.2 ppm was recorded at surface soil location A01 (0-1 ft). PID readings for all other terrestrial soil cores were zero. Analytical results associated with the samples that had reportable PID readings did not identify any VOCs, indicating that the readings might have detected low levels of organic vapors associated with natural decay of vegetation or the instrument might have been affected by wind or moisture. PID readings from all soil and sediment cores taken from the SWDD were zero.

5.2.2 Radiation Screening Results

Radiological field screening of surface water, soil and sediment samples from the SWDD was not conducted, with the exception that all packaged samples were screened for radiation prior to sample shipment.

The average measured dose rate for the terrestrial soil cores was 6.4 µrem/hr and the average direct count was 7,926 cpm. None of the soil radiation screening results exceeded the established health and safety criteria, which was two times above the appropriate background value. Table 5-1 presents the measured dose rate and direct count rates for each terrestrial soil boring. Complete results of field radiation screening, as well as daily radiological instrumentation quality control check documentation, are provided in Appendix E.

5.2.3 Explosives Screening Results

None of the screened terrestrial and SWDD soil core sections resulted in positive detections for explosive constituents. Complete results of the DropEx® explosive field screen results are provided in Appendix F and on the soil boring logs in Appendix C.

5.3 Aerial Anomaly Investigation

Surface and subsurface soil analytical results from the investigated anomalies are discussed below, compared to site background and USEPA RSLs. Complete analytical data packages and summarized analytical results are provided in Appendix G.

5.3.1 Surface Soil Analytical Results

Table 5-2 provides a summary of surface soil analytical results for constituents that were detected in at least one sample in concentrations at or exceeding the USEPA RSLs and, if available, the BTVs. Figure 5-1 graphically presents the analytical results for these constituents. Dibenz[a,h]anthracene (a PAH) was detected just above the USEPA RSL of 15 micrograms per kilogram (µg/kg) at three locations, ranging from 17 µg/kg to 19 µg/kg. Dibenz[a,h]anthracene was not detected in the background surface soil data set. The USEPA RSL was established to protect against chronic, intensive exposure to soils that may occur in a residential setting (i.e., if someone were living on the school property). The potential for occasional exposure that may occur at this area of the school property is much less than what is assumed in developing the RSL. Therefore, the concentrations that are slightly above the RSL do not indicate any potential risk and should not be a concern to the school community.

The data tables presented in Appendix G include USEPA RSLs for every constituent that was detected in surface soil. As seen in those tables, no metals were detected in surface soils that were above both the BTVs and USEPA RSLs. Aluminum, arsenic, chromium, cobalt, iron, lithium, and manganese were detected in concentrations above the USEPA RSL for residential soil; however, these analytes were all detected at concentrations below site background levels. Selenium was detected at concentrations above site background levels in all samples; however these concentrations were below the USEPA RSL for residential soil.

5.3.2 Subsurface Soil Analytical Results

No constituents were detected in the subsurface soils that were above both site background and the USEPA RSLs. Therefore, a summary table is not presented for these results. All of the analytical results are presented in Appendix G along with the USEPA RSLs and background levels for constituents that were detected in at least one sample. Aluminum, arsenic, chromium, cobalt, iron, lithium, and manganese were detected at concentrations above the USEPA RSLs; however, none of these were above site background levels. Selenium was detected at concentrations above site background levels in all samples; however these concentrations were below the USEPA RSL. No organic constituents were detected at levels above site background and the USEPA RSLs.

5.4 Southwest Drainage Ditch Investigation

SWDD sediment and soil analytical results are discussed below relative to site BTVs, USEPA RSLs, and ecological screening levels. Surface water samples are discussed below relative to BTVs and screening values (human health and ecological) established for the NFSS (USACE, 2007a). Complete analytical data packages and summarized analytical results are provided in Appendix G. Figure 5-2 graphically presents analytical results for constituents that are above surface water, sediment, and soil risk-based criteria, and if available, the BTVs. If no BTV was available, concentrations that exceeded the risk-based criteria are presented.

5.4.1 Southwest Drainage Ditch Sediment Analytical Results

Table 5-3 provides a summary of sediment analytical results for constituents that were detected in at least one sample in concentrations exceeding the ecological or human health (i.e., risk-based) screening values and the BTVs. Twelve SVOCs (all PAHs) were detected in sediment samples at concentrations above their respective BTV and at least one (human health or ecological) risk-based screening value. These included: anthracene, benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene, dibenz[a,h]anthracene, flouranthene, flourene, indeno[1,2,3-c,d]pyrene, phenanthrene and pyrene. In addition, benzo[g,h,i]perylene was detected above background, although not at concentrations above a risk-based screening level (Appendix G).

Two other SVOCs, carbazole and di-n-octyl phthalate, were also detected in one or more locations. These compounds were not detected in sediments upstream of NFSS and do not have any USEPA risk-based screening values. Carbazole is used in dye manufacturing and di-n-octyl-phthalate is a component of some plastics, which indicates that their presence may not be associated with DoD activities at the former LOOW.

Appendix G provides a summary of analytical results for all SWDD samples that were analyzed. Screening levels are provided for each constituent that was detected in at least one sample. No metals were detected in the sediments at concentrations above both site background and the risk-based screening levels. Seven metals, aluminum, arsenic, chromium, cobalt, iron, lithium, and manganese were detected at concentrations above the human health screening level (USEPA RSL), but all were below site background. One PCB, Aroclor 1254, was detected at concentrations slightly above the USEPA RSL (22 µg/kg) in sediment samples from SWDD-03, SWDD-04 and SWDD-05, ranging between 25 and 27 µg/kg. These concentrations are roughly one half of the site background level of 58.3 µg/kg and are also below the ecological screening value of 60 µg/kg.

The southern (upstream) end of the SWDD did not contain PAHs above background and the USEPA RSLs. At the northern (downstream) end, two PAHs were detected above both background and the USEPA RSLs. The greatest number of PAHs and highest concentrations occur at a location (SWDD-03) that is upstream of where the 30-inch outfall line traverses the SWDD. This location is relatively isolated and approximately midway between the upstream and downstream locations. Human exposure to this location would be intermittent and neither at the duration nor intensity required for potential risk to receptors.

5.4.2 Southwest Drainage Ditch Soil Analytical Results

Table 5-4 provides a summary of SWDD subsurface soil analytical results for constituents that were detected in at least one sample in concentrations exceeding the USEPA RSLs and the BTVs. Dibenz[a,h]anthracene was detected in sample SWDD-01 at 22 µg/kg, which is slightly above the USEPA RSL of 15 µg/kg and above the site background of 2.7 µg/kg (for total soils). SWDD-01 is the furthest downstream location investigated. The dibenz[a,h]anthracene concentration at this location is not considered to represent a potential unacceptable risk for the following reasons:

- The USEPA RSL is based on default parameters and factors that represent reasonable maximum conditions for long-term (chronic) exposures in a residential setting (USEPA, 2010). This condition does not exist at SWDD-01.
- The USEPA considers the acceptable range of excess lifetime cancer risks to be between one in ten thousand (i.e., 10^{-4}) and one in a million (i.e., 10^{-6}). The 15 µg/kg RSL that is used for comparison represents an excess lifetime cancer risk of 10^{-6}. The detected concentration (22 µg/kg) is within the acceptable range of 10^{-4} to 10^{-6} for residential soil.
- The sample was collected from 2.5 to 3 ft bgs and exposures to soil at this depth/location do not currently exist.

Appendix G presents provides a summary of analytical results for each SWDD sample that was analyzed. Screening levels are provided for every constituent that was detected in at least one sample. No metals were detected in the subsurface soil samples at concentrations above both site background and the USEPA RSLs. Seven metals, aluminum, arsenic, chromium, cobalt, iron, lithium, and manganese were detected at concentrations above the USEPA RSLs, but below site background. Benzo[a]pyrene (a PAH) was detected in two samples, SWDD-03 (16 µg/kg) and SWDD-01 (42 µg/kg) above the USEPA RSL of 15 µg/kg; however, both concentrations were below site background (313 µg/kg).

5.4.3 Southwest Drainage Ditch Surface Water Analytical Results

Constituents detected in at least one surface water sample in concentrations above the ecological or human health screening levels and the BTVs are provided in Table 5-5. Two metals, lithium and magnesium, were detected above both site background and the ecological screening levels. Lithium was also detected above the adjusted USEPA tap water RSL (7.3 micrograms per liter [µg/L]). The lithium concentrations (20.7 to 62.9 µg/L) were above the BTVs and ecological screening levels in all surface water samples, with higher concentrations found at the upstream portion of the SWDD. Magnesium was detected (83,800 to 88,000 µg/L) in four locations above the ecological screening level (82,000 µg/L) and site background (30,200 µg/L). The highest concentrations of lithium and magnesium were found in the central portion of the investigated SWDD (i.e., SWDD-02, -03, and -04) and decreased at the northern (downstream) location. Although lithium exceeded 1/10th of the USEPA RSL for tap water (i.e., potable), it did not exceed the unadjusted USEPA tap water RSL of 73 µg/L. Accordingly, lithium is not considered to represent a human health concern because the SWDD is not used as a drinking water source. Surface water quality criteria for lithium are not available in 6 NYCRR Part 703. No human health screening value is available for magnesium, since it is a nutrient essential for human health. The quantity or quality of data used to develop the ecological screening values for lithium and magnesium do not meet the data specifications used to develop national ambient water quality criteria so exceedances cannot definitely lead to a conclusion that these constituents pose a risk to aquatic life in the ditch.

Three organic compounds were detected in surface water above one or more of the screening levels. These compounds were not detected in surface water upstream of NFSS. One VOC (carbon disulfide) was detected in three surface water samples above the NFSS ecological screening level of 0.92 µg/L, but below the adjusted EPA RSL for tap water (100 µg/L). Carbon disulfide was also detected in the laboratory blank sample and the reported concentrations are believed to be caused by laboratory contamination. One SVOC, bis (2-ethylhexyl) phthalate, was detected in two samples above the ecological screening value of 0.6 µg/L but below the USEPA RSL for tap water (0.48 µg/L). This compound was also detected in the laboratory blank sample and the reported concentrations are believed to be caused by laboratory contamination. A single low level detection of 2-nitrotoluene was reported in SWDD-04 (2.1 µg/L) above the USEPA tap water RSL (0.31 µg/L). No ecological screening value is available for this constituent. A site-specific risk-based screening level for 2-nitrotoluene was developed for the NFSS RI (25,000 µg/L) that was considered to be protective of a hypothetical child living on-site and having chronic exposure to the water (USACE, 2007a). This site-specific screening level more reasonably represents potential risk to human health caused by exposure to surface water at SWDD-04 because the USEPA RSL presumes that the water is used for human consumption.

Appendix G provides a summary of analytical results for every SWDD surface water sample that was analyzed. Screening levels are provided for every constituent that was detected in at least one sample. Four metals, aluminum, barium, iron, and manganese, were detected at concentrations above the NFSS ecological screening level, but below site background levels. Benzo[a]anthracene and chrysene were detected in one surface water sample (the furthest upstream) above the associated ecological screening levels, but below the site background levels and USEPA RSLs for tap water.

Table 5-1. Anomalies Investigated on Undeveloped L-P CSD Property

Location		Coordinates [2] [3]		Anomaly Type Aerial Photo Interpretation [4]	Approximate Size (type)	No. Soil Borings	Soil Types	Field Screening Measurements				Soil Samples for Lab Analysis [9]			Anomaly Observations
ID	Description [1]	Northing	Easting					Exp [5]	PID [6] (ppm)	Rad Detector [7] [8] (µrem/hr)	Rad Detector (cpm)	ID	Depth (ft bgs)	Rationale	
A01	West of SWDD, near soccer field	1174036.3641	1033406.4419	mound	< 200 ft^3 (mounded soil)	1	0-1 ft: topsoil	ND	0.2	6	8,964	A01-0.5	0-0.5	Ground surface	Small mound. Mounded material appeared consistent with native soils
							1-4 ft: clay		1.2	5	7,326	A01-4	3-4	Bottom of boring	
A02	Intersection of 30-inch outfall line and SWDD	1174035.7760	1034121.8360	mound	> 200 ft^3 (mounded soil)	4	0-0.3 ft: topsoil	ND	0	7	8,355	A02-0.5	0-0.5	Ground surface	Large mound. Appearance of stockpiled native soils, potentially from excavation of SWDD or 30 in outfall
							0.3-8 ft: clay		0	7	7,985	A02-7	6-7	Disturbed/undisturbed soil interface	
									0						
A03	East of SWDD and north of 30-inch outfall line	1174276.4103	1035521.6320	mound	no evidence of anomaly found	1	0-0.3 ft: topsoil	ND	0	9	7,163	A03-0.5	0-0.5	Ground surface	NA - No mound observed
							0.3-4 ft: clay		0	6	7,155	A03-4	3-4	Bottom of boring	
A04	East of SWDD and north of 30-inch outfall line	1174352.9468	1036064.3452	mound	no evidence of anomaly found	1	0-0.2 ft: topsoil	ND	0	6	7,554	A04-0.5	0-0.5	Ground surface	NA - No mound observed
							0.2-4: clay		0	6	7,429	A04-3	2-3	Sample volume	
A05	East of SWDD and north of 30-inch outfall line	1174547.7670	1036130.4449	mound	< 200 ft^3 (mounded soil)	1	0-0.5 ft: topsoil	ND	0	6	7,799	A05-0.5	0-0.5	Ground surface	Small mound. Mounded material appeared consistent with native soils
							0.5-4 ft: clay		0	6	7,899	A05-4	3-4	Bottom of boring	
A06	East of SWDD and north of 30-inch outfall line	1173897.2068	1036453.9855	trench	no evidence of anomaly found	1	0-1 ft: topsoil	ND	0	6	7,676	A06-0.5	0-0.5	Ground surface	NA - No trench observed
							1-4 ft: silt		1.2	5	7,666	A06-4	3-4	Bottom of boring	
A07	East of SWDD and south of 30-inch outfall line	1173272.8518	1036202.6135	mound	> 200 ft^3 (mounded soil)	4	0-3 ft: topsoil	ND	0	8	7,631	A07-0.5	0-0.5	Ground surface	Long linear mound. Appearance of stockpiled native soils.
							3-4 ft: clay		0	7	7,357	A07-3	2-3	Disturbed/undisturbed soil interface	
A08	South of 30-inch outfall line	1173281.4360	1035010.2291	mound	no evidence of anomaly found	1	0-1 ft: topsoil	ND	0	7	7,984	A08-0.5	0-0.5	Ground surface	NA - No mound observed
							1-4 ft: clay		1.2	6	8,254	A08-4	3-4	Bottom of boring	
A09	Southeast corner of undeveloped L-P CSD property	1170957.5100	1036179.1500	pit	no evidence of anomaly found	1	0-0.5 ft: topsoil	ND	0	7	8,216	A09-0.5	0-0.5	Ground surface	NA - No mound observed
							0.5-4 ft: clay		0	5	6,769	A09-4	3-4	Bottom of boring	
A10	Southeast corner of undeveloped L-P CSD property	1170687.1770	1036423.1290	pit	> 200 ft^3 (mounded soil)	4	0-0.3/0.6/0.7 ft: topsoil	ND	0	8	10,062	A10-0.5	0-0.5	Ground surface	Long linear mound. Appearance of stockpiled native soils.
							0.3/0.6/0.7-4 ft: clay		0	5	9,707	A10-3	2-3	Disturbed/undisturbed soil interface	
A10A	Southeast corner of undeveloped L-P CSD property	1170745.3910	1036450.0890	none	< 200ft^3 (pit)	1	0-0.3 ft: topsoil	ND	0	NM	NM	A10A-0.5	0-0.5	Ground surface	NA - No pit observed
							0.3-4 ft: clay		0	6	7,497	A10A-4	3-4	Bottom of boring	

Notes:
1 *Refer to Figure 4-1.*
2 *NAD 1983, State Plane New York West – U.S. Survey feet*
3 *Where multiple soil borings were drilled, coordinates are presented for the boring where soil samples were collected for lab analysis.*
4 *Refer to Section 2.1 (USAGC, 2009)*
5 *DropEx® field screening kit*
6 *Photoionization detector with 10.6 electron volt lamp*
7 *Bicron MicroRem dose rate meter*
8 *Site background is 7.7 uR/hr and 8,000 cpm*
9 *VOCs, SVOCs, PCBs, explosives, and metals (refer to Section 4.3)*

Abbreviations
bkgd *background*
cpm *counts per minute*
ft bgs *feet below ground surface*
ft^3 *cubic feet*
NA *Not applicable*
NAD *North American Datum*
ND *Not detected*
NM *Not measured*
PID *photoionization detector*
ppm *parts per million*
µrem/hr *microRems per hour*

Table 5-2. Anomaly Surface Soil Results Summary

				Sample Location	A01	A02	A03	A04	A05	A06	A07	A08	A09	A10	A101A
				Sample Name	C2-LPCSD-SO-A01-0.5	C2-LPCSD-SO-A02-0.5	C2-LPCSD-SO-A03-0.5	C2-LPCSD-SO-A04-0.5	C2-LPCSD-SO-A05-0.5	C2-LPCSD-SO-A06-0.5	C2-LPCSD-SO-A07-0.5	C2-LPCSD-SO-A08-0.5	C2-LPCSD-SO-A09-0.5	C2-LPCSD-SO-A10-0.5	C2-LPCSD-SO-A10A-0.5
				Sample Date	8/25/10	8/24/10	8/24/10	8/24/10	8/24/10	8/24/10	8/24/10	8/24/10	8/25/10	8/25/10	8/25/10
				Sample Depth	0 - 0.5 ft	0 - 0.5 ft	0 - 0.5 ft	0 - 0.5 ft	0 - 0.5 ft	0 - 0.5 ft	0 - 0.5 ft	0 - 0.5 ft	0 - 0.5 ft	0 - 0.5 ft	0 - 0.5 ft
Analyte	**USEPA RSL**		**NFSS BTV**	**Units**											
Semivolatile Organic Compounds															
Dibenz[a,h]anthracene	15		ND	µg/kg	**19**	2.2 U	2.7 U	2.3 U	2.3 U	2.6 U	2.2 U	**17**	2.4 U	**19**	2.4 U

Legend:
Samples were analyzed for metals, VOCs, SVOCs, PCBs, and explosives. Analytes included in the table were detected in at least one sample in concentrations at or exceeding the USEPA RSL. See Appendix G for all complete analytical results.
Background data are from the Baseline Risk Assessment Report for the Niagara Falls Storage Site, (USACE, 2007a, prepared by SAIC)
USEPA RSL = Residential Soil Regional Screening Level, May 2010
BTV = Background Threshold Value
The USEPA RSL presented for chromium is for hexavalent chromium. USEPA RSL for trivalent chromium is 120,000 mg/kg
ND = Constituent not detected in background data set
U = Not detected; the associated number is the reporting detection limit
Bolded/shading values indicate concentrations that exceeded both the USEPA RSL and, if available, the site specific background value. If no background value was available, bold text indicates concentration exceeds the USEPA RSL.

Table 5-3. Southwest Drainage Ditch Sediment Results Summary

Sample Location							**SWDD-01**	**SWDD-01**	**SWDD-02**	**SWDD-03**	**SWDD-04**	**SWDD-05**	**SWDD-06**
Sample Name							**C2-SWDD-SO-01-1**	**C2-SWDD-SO-01-1DUP**	**C2-SWDD-SO-02-1**	**C2-SWDD-SO-03-1**	**C2-SWDD-SO-04-1**	**C2-SWDD-SO-05-1**	**C2-SWDD-SO-06-1**
Parent Sample								**C2-SWDD-SO-01-1**					
Sample Date							**8/25/10**	**8/25/10**	**8/26/10**	**8/26/10**	**8/26/10**	**8/26/10**	**8/26/10**
Sample Depth							**0.5 - 1 ft**	**0.5 - 1 ft**	**0.5 - 1 ft**	**0.5 - 1 ft**	**0.5 - 1 ft**	**0.5 - 1 ft**	**0.5 - 1 ft**
Matrix							**Sediment**	**Sediment**	**Sediment**	**Sediment**	**Sediment**	**Sediment**	**Sediment**
Analyte	**USEPA RSL**		**RSL Note**	**Eco Sediment Screen**	**NFSS BTV**	**Units**							
Semivolatile Organic Compounds													
Anthracene	1,700,000	*	n	57.2	ND	µg/kg	37	**58**	49	**1,000**	**74 J**	**87 J**	11 J
Benzo[a]anthracene	150		c	108	399	µg/kg	250	**400**	140	**5,300**	330	370	38 J
Benzo[a]pyrene	15		c	150	618	µg/kg	330	590	140	**7,500**	500	430	37 J
Benzo[b]fluoranthene	150		c	NSA	1,090	µg/kg	690	**1,200**	190	**12,000**	680	550	42
Benzo[k]fluoranthene	1,500		c	NSA	381	µg/kg	7.7 U	13 U	79	**4,300**	330	220	20 J
Carbazole	NSA			NSA	ND	µg/kg	38	64	31 J	1,100	67 J	67 J	6 U
Chrysene	15,000		c	166	470	µg/kg	320	**520**	160	**8,500**	**550**	470	43
Dibenz[a,h]anthracene	15		c	33	ND	µg/kg	**130**	**230**	**23 J**	**1,300**	**86 J**	**59 J**	8.6 J
Di-n-octyl phthalate	NSA			NSA	ND	µg/kg	23 U	38 U	29 U	84 J	81 U	74 U	30 U
Fluoranthene	230,000	*	n	423	696	µg/kg	580	**990**	340	**18,000**	**980**	**810**	73
Fluorene	230,000	*	n	77.4	ND	µg/kg	19 J	32 J	21 J	**390**	34 J	45 J	10 U
Indeno[1,2,3-c,d]pyrene	150		c	NSA	265	µg/kg	**300**	**540**	91	**5,300**	**410**	**310**	20 J
Phenanthrene	3,600		c*	204	169	µg/kg	180	300	150	**6,800**	310	370	24 B
Pyrene	170,000	*	n	195	1,000	µg/kg	510	840	260	**12,000**	650	610	65

Legend:
Samples were analyzed for metals, VOCs, SVOCs, PCBs, and explosives. Analytes included in the table were detected in at least one sample in concentrations at or exceeding the USEPA RSL. See Appendix G for all complete analytical results.
Background data are from the Baseline Risk Assessment Report for the Niagara Falls Storage Site, (USACE, 2007a, prepared by SAIC)
USEPA RSL = Residential Soil Regional Screening Level, May 2010
** Denotes a non-carcinogen, and the USEPA RSL value has been adjusted by a factor of 0.1*
c = cancer; n= non-cancer health endpoint, c = where: non-cancer screening level (SL) is < 100X cancer SL, m = Concentration may exceed ceiling limit 10+5 mg/kg which is equivalent to a chemical representing 10% by weight of the soil sample; s = Concentration may exceed soil saturation concentration. Above this concentration, the soil contaminant may be present in free phase*
USEPA Sediment Screening values are consensus threshold effects concentrations from USEPA 2002
BTV = Background Threshold Value
ND = Constituent not detected in background data set
NSA = No screening level available
J = Estimated value
U = Not detected; the associated number is the reporting detection limit
B = Indicates possible blank contamination.
Bold/shading indicates the detected concentration is above both of the screening levels and also above background
Bold indicates that the detected concentration is above either the one but not both ecological or and human health screening level values and exceeds the background concentration

Table 5-4. Southwest Drainage Ditch Subsurface Soil Results Summary

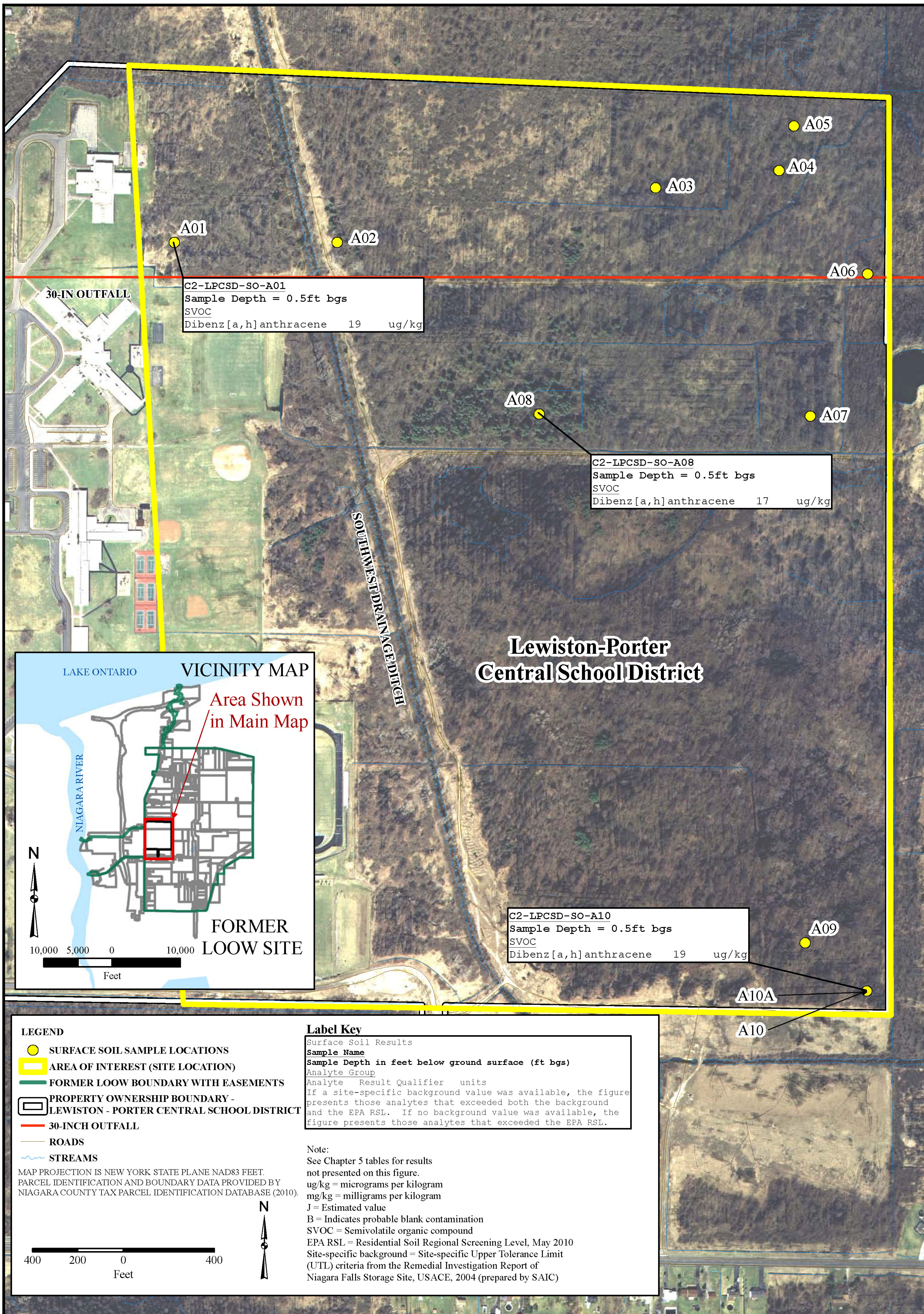
			Sample Location	**SWDD-01**	**SWDD-02**	**SWDD-03**	**SWDD-04**	**SWDD-05**	**SWDD-06**
			Sample Name	**C2-SWDD-SO-01-3**	**C2-SWDD-SO-02-3**	**C2-SWDD-SO-03-3**	**C2-SWDD-SO-04-3**	**C2-SWDD-SO-05-3**	**C2-SWDD-SO-06-3**
			Parent Sample						
			Sample Date	**8/25/10**	**8/26/10**	**8/26/10**	**8/26/10**	**8/26/10**	**8/26/10**
			Sample Depth	**2.5 - 3 ft**	**2.5 - 3 ft**	**2.5 - 3 ft**	**2.5 - 3 ft**	**2.5 - 3 ft**	**2.5 - 3 ft**
			Matrix	**Subsurface Soil**	**Subsurface Soil**	**Subsurface Soil**	**Subsurface Soil**	**Subsurface Soil**	**Subsurface Soil**
Analyte	**USEPA RSL**	**NFSS BTV**	**Units**						
Metals									
Semivolatile Organic Compounds									
Dibenz[a,h]anthracene	15	2.7	µg/kg	**22**	2.2 U	2.3 U	2.1 J	2.4 U	12 U

Legend:
Samples were analyzed for metals, VOCs, SVOCs, PCBs, and explosives. Analytes included in the table were detected in at least one sample in concentrations at or exceeding the USEPA RSL. See Appendix G for all complete analytical results.
Background data are from the Baseline Risk Assessment Report for the Niagara Falls Storage Site, (USACE, 2007a, prepared by SAIC)
USEPA RSL = Residential Soil Regional Screening Level, May 2010
BTV = Background Threshold Value
NSA = No screening level available
J = Estimated value
U = Not detected; the associated number is the reporting detection limit
Bolded/shading values indicate concentrations that exceeded both the USEPA RSL and, if available, the site specific background value. If no background value was available, bold text indicates concentration exceeds the USEPA RSL.

Table 5-5. Southwest Drainage Ditch Surface Water Results Summary

				Sample Location	SWDD-01	SWDD-01	SWDD-02	SWDD-03	SWDD-04	SWDD-05	SWDD-06
				Sample Name	C2-SWDD-SW-01	C2-SWDD-SW-01DUP	C2-SWDD-SW-02	C2-SWDD-SW-03	C2-SWDD-SW-04	C2-SWDD-SW-05	C2-SWDD-SW-06
				Sample Date	8/25/10	8/25/10	8/26/10	8/26/10	8/26/10	8/26/10	8/26/10
				Parent Sample		C2-SWDD-SW-01					
Analyte	**Ecological Screening Level**	**Human Health Screening Level**	**NFSS BTV**	**Units**							
Metals (total)											
Lithium	14	7.3*	13.2	µg/L	**20.7**	**20.9**	**60.3**	**62.9**	**60.5**	**59.2**	**56.4**
Magnesium	82,000	NSA	30,200	µg/L	33,100	32,400	**86,000**	**88,000**	**85,900**	**83,800**	79,900
Volatile Organic Compounds											
Carbon disulfide	0.92	100*	ND	µg/L	**1.2 B**	**1.1 B**	0.39 B	0.8 B	0.72 B	0.71 B	**1.2 B**
Semivolatile Organic Compounds											
Bis(2-ethylhexyl) phthalate	0.6	4.8	ND	µg/L	1.9 U	2 U	**1.1 B**	**1.4 B**	1.9 U	1.9 U	2 U
Explosives											
2-nitrotoluene	NSA	0.31	ND	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	**2.1**	0.2 U	0.2 U

Legend:
Samples were analyzed for metals, VOCs, SVOCs, PCBs, and explosives. Analytes included in the table were detected in at least one sample in concentrations at or exceeding the NFSS screening levels. See Appendix G for all complete analytical results.
Screening Levels and background data are from the Baseline Risk Assessment Report for the Niagara Falls Storage Site, (USACE, 2007a, prepared by SAIC)
** Denotes a noncarcinogen, and the USEPA RSL value has been adjusted by a factor of 0.1*
BTV = Background Threshold Value
ND =Constituent not detected in background data set
NSA = No screening level available
B = Indicates probable blank contamination
J = Estimated value
U = Not detected; the associated number is the reporting detection limit
Bold/shading indicates the detected concentration is above both of the screening levels and also above background
Bold indicates that the detected concentration is above either the one but not both ecological or and human health screening level values and exceeds the background concentration



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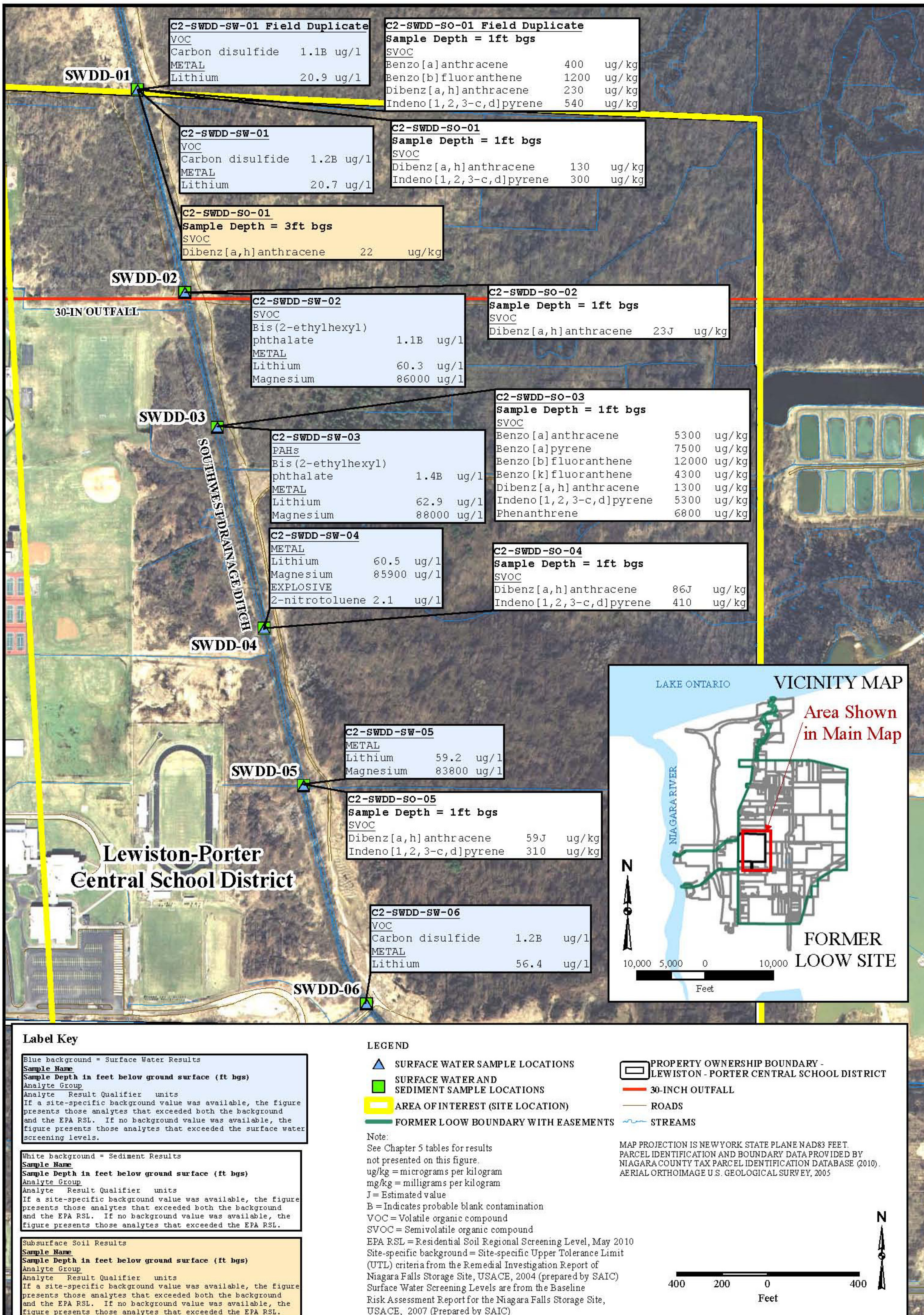
NIAGARA COUNTY, NEW YORK

FIGURE 5-1
SURFACE SOIL SAMPLE ANALYTICAL RESULTS ABOVE COMPARISON CRITERIA



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NIAGARA COUNTY, NEW YORK

FIGURE 5-2
SWDD SOIL, SEDIMENT, AND SURFACE WATER SAMPLE ANALYTICAL RESULTS ABOVE COMPARISON CRITERIA

6.0 SUMMARY AND CONCLUSIONS

6.1 Summary

6.1.1 Anomaly Investigation

Ten anomalies on the L-P CSD property were identified in historical aerial photographs as mounds, trenches, or pits. GPS coordinates were obtained from the aerial photographs and each anomaly was investigated. Of the 10 anomalies, five were visible in the field; Anomalies A01, A02, A05, A07 and A10. In addition, during the field work, one anomaly was determined to be a mound rather than a pit, and an additional anomaly was identified in the southeast corner of the property.

Surface and subsurface soil samples were collected from the actual or presumed location of each anomaly. Based on visual observations of the soil cores obtained during sampling, all the materials appeared to be displaced or undisturbed native soils. Field screening measurements did not identify potential contamination.

Laboratory analysis of the soil samples did not detect any metals that were above both background concentrations and the USEPA RSLs. Most metal concentrations were below background levels. One PAH, dibenz[a,h]anthracene, was detected above the USEPA RSL in three surface soil sample locations. This compound was not detected in site background surface soil, and was detected at levels slightly higher than the USEPA RSL, which is set to protect against chronic, intensive exposure to soils that may occur in a residential setting (i.e., if someone were living on the property). The potential for occasional exposure that may occur from the undeveloped portion of the school property is much less than what is assumed in developing the screening levels and a slight exceedance of the screening levels does not indicate any potential risk nor should it be a concern to the school community.

6.1.2 Southwest Drainage Ditch Sampling

Surface water, sediment, and subsurface soil samples were collected at six locations in the SWDD within the L-P CSD property. The locations were spaced roughly equidistant along the SWDD from where it enters the L-P CSD to where it exits. Laboratory analysis of the sediment samples indicate that the highest concentrations of PAHs occur in the central portion of the SWDD. Twelve PAHs were detected at sample location SWDD-03 at levels significantly higher than the other locations and above background levels. Two other SVOCs (carbazole, used in making dyes, and di-n-octyl phthalate, a component of some plastics) were detected in some of the samples. These constituents were not detected in sediments upstream of NFSS and do not have any USEPA risk-based screening values. Their use in dye and plastics manufacturing indicates that their presence in the SWDD may not be associated with prior DoD activities on the former LOOW. The southern (upstream) end of the SWDD showed no concentrations of PAHs above background and USEPA RSLs. At the northern (downstream) end, two PAHs were detected above both background levels and the USEPA RSLs. Because the most elevated concentrations of PAHs were found to occur in one of six locations sampled (i.e., the elevated results are isolated), exposure to this location would be intermittent and neither the duration nor intensity needed to approach a risk level would be met.

Laboratory analysis of the subsurface soils indicated that one PAH (dibenz[a,h]anthracene) was detected at the furthest downstream sample above background and just above the USEPA RSL. The USEPA RSL is based on default exposure parameters and factors that represent reasonable maximum exposure conditions for long-term/chronic exposures in a residential setting (USEPA 2010). The RSL used (15 µg/kg) is based on an excess lifetime cancer risk of 10^{-6}, which is within the USEPA's acceptable range of 10^{-4} to 10^{-6}. The dibenz[a,h]anthracene concentration of 22 µg/kg is not considered to represent a potential unacceptable risk even if it were found in soils in a residential setting. The reported concentration is considerably less than RSL corresponding to a 10^{-4} excess lifetime cancer risk and is within the USEPA's acceptable risk range. Furthermore, the sample in which this slight exceedance of the RSL was detected was obtained from a depth of 2.5 to 3 ft within the SWDD. No exposures to this soil location currently exist and no real risks are incurred in the absence of exposure.

Surface water analytical results indicated that two metals (lithium and magnesium) were above both background and ecological risk-based screening levels. The highest concentrations of these metals were found in the central portion of the SWDD and decreased at the furthest northern (downstream) location. Although lithium exceeded $1/10^{th}$ of the EPA RSL for tap water (drinking water), it did not exceed the full tap water RSL of 73 µg/L, indicating that it would not pose a concern for human health, especially since the ditch is not a drinking water supply. No human health screening value is available for magnesium, since it is a nutrient essential for human health. NY State does not have a surface water criterion for lithium. The quantity or quality of the data used to develop the ecological screening levels for lithium and magnesium do not meet the specification for data used to develop national ambient water quality criteria. Consequently, exceedances of these screening levels cannot definitely lead to a conclusion that these constituents pose a risk to aquatic life in the SWDD. A single detection of 2-nitrotoluene (2.1 µg/L) in surface water (SWDD-06) was below the site-specific RSL used for NFSS (25,000 µg/L), which was developed to be protective of a hypothetical child living on-site and having chronic exposure to a ditch as if it were on their property (USACE, 2007a). This indicates that exposure to 2-nitrotoluene at this location would not pose a risk for someone coming into occasional contact with the SWDD water.

6.2 Conclusions

6.2.1 Anomaly Investigation

Five of the 10 aerial anomalies were visible in the field on the L-P CSD property and a small depression was observed in the southeast corner of the property. Field screening, soil sampling and analytical testing did not identify any signs of potential contamination that would be associated with previous DoD activities. The results of this investigation are comparable with previous investigations of the L-P CSD property. No metals were found in the soils (surface or subsurface) that were above both background and USEPA RSLs. Visual observations of mounds that were investigated suggest that they were likely displaced native soils, possibly from past agricultural activities. In addition, some of these features might have been created during excavations of the SWDD or 30-inch outfall line.

6.2.2 Southwest Drainage Ditch Sampling

Field screening and sampling of surface water, sediments, and subsurface soils within the SWDD did not indicate the possible presence of contamination resulting from DoD activities. Analytical testing identified some elevated PAHs and other SVOCs in sediment from the central portion of the ditch. The source of the elevated PAHs was not confirmed; levels could be the result of asphalt runoff or by-products of petroleum combustion.

Lithium and magnesium (a naturally occurring substance and essential nutrient) were detected in most surface water samples at levels above background and the risk-based screening levels. The concentrations of lithium and magnesium were highest in locations SWDD-02, -03, and -04, and decreased at the northern (down gradient) end. These metals would not have the potential to pose any unacceptable risks to individuals using or visiting the L-P CSD property.

7.0 REFERENCES

Chopra-Lee, 2001a. Letter Report submitted to Lewiston-Porter Central School District Regarding Soil Sampling for Heavy Metals at the Northeast Side of the Lewiston Porter Central School. July.

Chopra-Lee, 2001b. Letter Report submitted to Lewiston-Porter Central School District Regarding Soil Sampling for Heavy Metals at the Northeast Side of the Lewiston Porter Central School. July.

Chopra-Lee, 2001c. Letter Report submitted to Lewiston-Porter Central School District Regarding Soil Sampling for Heavy Metals at the Northeast Side of the Lewiston Porter Central School. August.

Chopra-Lee, 2003. *Letter Report submitted to Lewiston-Porter Central School District regarding soil sampling at two proposed playground areas and a dirt mound on the school property*. January.

Gardella, et al., 2004. *Sampling and Analysis of Soil Quality and Geographic Information Analysis of Soil Contamination on the Lewiston-Porter School Campus*. University of Buffalo Environmental and Society Institute. March.

New York State Department of Environmental Conservation, 2004. *Technical and Operational Guidance Series (1.1.1): Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations*. Amended June.

Niagara County Department of Health, 2002. *Letter to Assistant Superintendent for Administrative Services, Lewiston-Porter Central School District from Paul R. Dicky, P.E. Supervisory Public Health Engineer, Niagara County Department of Health, regarding review of samples collected from the SWDD on the school property*. June

Non-destructive Testing Resource Center, 2010. Measures Relative to the Biological Effect of Radiation Exposure. *In Education Resources - NDT Course Material - Radiation*. Retrieved October 20, 2010, from http://www.ndt-ed.org/EducationResources/CommunityCollege/RadiationSafety/theory/Measures.htm.

Panamerican Environmental Inc (PEI), 2004. *Letter Report Submitted to Lewiston-Porter Central School District Regarding Soil Sampling/Testing Program at the School Campus*. October.

PEI, 2005. *Letter Report submitted to Lewiston-Porter Central School District regarding soil sampling/testing program at the school campus*. October

PEI, 2006. *Letter Report submitted to Lewiston-Porter Central School District regarding soil sampling/testing program at the school campus*. January

PEI, 2007. *Soils Management Plan: Lewiston-Porter Schools Campus, Youngstown, Niagara County, New York.* March.

Suter, G.W., II, and C.L. Tsao. 1996. *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision.* ES/ER/TM-96/R2. Lockheed Martin Energy Systems, Oak Ridge National Laboratory, Oak Ridge, Tennessee

U.S. Army Corps of Engineers (USACE), 1999. *Report for Phase I Remedial Investigation at the Former Lake Ontario Ordnance Works, Niagara County, NY*. Prepared by EA. July.

USACE, 2002. *Final Gamma Walkover Survey Report, Lewiston-Porter School Property, Youngtown, New York*. Prepared by SAIC. February

USACE, 2007a. *Baseline Risk Assessment Report for the Niagara Falls Storage Site*. Prepared by SAIC. December.

USACE, 2007b. *Remedial Investigation Report for the Niagara Falls Storage Site*. Prepared by SAIC. December.

USACE, 2008. *Report of Results for the Remedial Investigation of Underground Utility Lines, Formerly Used by the Department of Defense, Lake Ontario Ordnance Works (LOOW), Niagara County, NY*. Prepared by EA. September.

USACE, 2009a. *Field Sampling Plan Addendum for Phase IV Remedial Investigation/Feasibility Studies at the Former Lake Ontario Ordnance Works, Niagara County, New York.* Prepared by ERT/EA. January.

USACE, 2009b. *Quality Assurance Project Plan Addendum for Phase IV Remedial Investigation/Feasibility Studies at the Former Lake Ontario Ordnance Works, Niagara County, New York*. Prepared by ERT/EA. January.

USACE, 2009c. *Site Specific Health and Safety Plan for Phase IV Remedial Investigation/Feasibility Studies at the Former Lake Ontario Ordnance Works, Niagara County, New York*. Prepared by ERT/EA. January.

USACE, 2010a. *Field Sampling Plan Addendum for Occidental Chemical Corporation Property Data Gap and Lewiston-Porter Central School District Investigations at the Former Lake Ontario Ordnance Works, Niagara County, New York*. Prepared by ERT/EA. August.

USACE, 2010b. *Quality Assurance Project Plan Addendum for Occidental Chemical Corporation Property Data Gap and Lewiston-Porter Central School District Investigations at the Former Lake Ontario Ordnance Works, Niagara County, New York.* Prepared by ERT/EA. August.

USACE, 2010c. *Site Safety and Health Plan Addendum for Occidental Chemical Corporation Property Data Gap and Lewiston-Porter Central School District Investigations at the Former Lake Ontario Ordnance Works, Niagara County, New York*. Prepared by ERT/EA. August.

U.S. Army Geospatial Center (USAGC), 2009. *Niagara Falls Storage Site Historical Photographical Analysis*. September.

U.S. Army Topographic Engineering Center (USATEC), 2002. *Historic Photographic Analysis Report, Former Lake Ontario Ordnance Works.* September.

U.S. Environmental Protection Agency (USEPA), 2002. *A Guidance Manual to Support the Assessment of Contaminated Sediments in Freshwater Ecosystems Volume III - Interpretation of the Results of Sediment Quality Investigations.* EPA-905-B02-001-C United States Great Lakes National Program Office.

USEPA, 2010. *Regional Screening Levels for Chemical Contaminants at Superfund Sites*. May.

APPENDIX A
Analytical Reference Limits

APPENDIX B
Background Data Evaluation

APPENDIX C
Soil Boring Logs

APPENDIX D
Anomaly and Sampling Photographs

APPENDIX E
Health and Safety Radiological Screening

APPENDIX F
Explosives Field Screen Results

APPENDIX G
Complete Analytical Data