US Army Corps
of Engineers®
Buffalo District

Proposed Plan
Balance of Plant and Groundwater Operable Units
Niagara Falls Storage Site

Authorized under the
Formerly Utilized Sites Remedial Action Program

Niagara Falls Storage Site
Lewiston, New York

Prepared by:
U.S. Army Corps of Engineers - Buffalo District
1776 Niagara Street
Buffalo, New York 14207

October 2020

This page is intentionally blank.

UNITED STATES ARMY CORPS OF ENGINEERS
PROPOSED PLAN
BALANCE OF PLANT AND GROUNDWATER OPERABLE UNITS
NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK

CORPS OF ENGINEERS ANNOUNCES PROPOSED PLAN

This *Proposed Plan for the Balance of Plant (BOP) and Groundwater Operable Units (OUs) at the Niagara Falls Storage Site* identifies the preferred alternative to remediate the Balance of Plant and Groundwater OUs at the Niagara Falls Storage Site (NFSS) in Lewiston, New York. The U.S. Army Corps of Engineers (Corps of Engineers) prepared this document under the Formerly Utilized Sites Remedial Action Program (FUSRAP), initiated in 1974 to identify, investigate, and if necessary, clean up or control sites that were contaminated from activities associated with the Nation's early atomic energy program. The Corps of Engineers executes FUSRAP in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, and the National Oil and Hazardous Substances Pollution Contingency Plan. The proposed plan summarizes information found in greater detail in NFSS remedial investigation reports issued in 2007 and 2011 and the Balance of Plant and Groundwater OUs feasibility study issued in October 2019. These and other major documents regarding the Niagara Falls Storage Site are available on the web in the Reports section at https://www.lrb.usace.army.mil/Missions/HTRW/FUSRAP/Niagara-Falls-Storage-Site/.

Public Comment Period
October 5, 2020 to December 5, 2020

The Corps will accept written comments on the proposed plan during the public comment period. Written comments may be emailed to fusrap@usace.army.mil or mailed to:
U.S. Army Corps of Engineers Buffalo District
Environmental Project Management Section
1776 Niagara Street
Buffalo, New York 14207

Virtual Public Meeting
Wednesday, October 21, at 7 p.m.
Please email fusrap@usace.army.mil to register and let us know if you will be providing comments during the meeting by October 19, 2020.

Administrative Record File
The administrative record file is publicly accessible electronically at: https://www.lrb.usace.army.mil/Missions/HTRW/FUSRAP/Niagara-Falls-Storage-Site/ in the Administrative Record File section.

The public is invited to review and comment on this proposed plan that presents the Corps of Engineers' preferred remedial alternative, selected from among five alternatives evaluated in the feasibility study. The Corps of Engineers' preferred alternative is Alternative 3: Removal and Building Decontamination, that addresses the following impacted media:

- Soil
- Road bedding
- Utilities (former Building 401 drain system)
- Building 433
- Building foundations
- Groundwater

Remedial activities specified by Alternative 3 are excavation and off-site disposal of impacted soil, road bedding, groundwater, and Building 401 foundation/utilities, and decontamination of former building foundations. Following completion of Alternative 3, the site would be remediated to levels suitable for industrial use (i.e., protective of both construction and industrial workers). Since the preferred alternative may be modified based on any new information acquired during the designated public comment period, the public is encouraged to review and comment on all of the alternatives presented in this proposed plan.

Members of the public who wish to comment on this proposed plan may submit their comments during the 60-day comment period between October 5, 2020, and December 5, 2020. Written comments may be sent to the following address:

U.S. Army Corps of Engineers, Buffalo District
Special Projects Branch, Environmental Project Management Section
1776 Niagara Street
Buffalo, NY 14207-3199

Comments also may be submitted via email to fusrap@usace.army.mil. Please refer to this proposed plan, or NFSS, in any comments you make and write "NFSS Balance of Plant Proposed Plan Comments" in the subject line. If there are any questions regarding the comment process or the proposed plan, please direct them to the address noted above or telephone 1-800-833-6390 (Option 4). Due to restrictions that are in place in regard to public gatherings, a virtual public meeting will be conducted on Wednesday, October 21, 2020, at 7 p.m. Space is limited, so please email fusrap@usace.army.mil by October 19, 2020, to register for the meeting, and to let us know if you will be providing comments.

The supporting documents which further describe the conditions at NFSS and form the basis for this proposed plan may be found in the administrative record file for the site, which is available on the web in the Administrative Records File section at https://www.lrb.usace.army.mil/Missions/HTRW/FUSRAP/Niagara-Falls-Storage-Site/.

After the close of the public comment period, the Corps of Engineers will review, consider, and respond to all public and regulator comments. After reviewing and considering all information provided during the comment period, the Corps of Engineers may go forward with the preferred alternative, modify it, or select another remedial alternative presented in this proposal. The Corps of Engineers will document the determination of the appropriate remedial response in a record of decision for the Balance of Plant and Groundwater OUs at NFSS.

SITE BACKGROUND

The NFSS represents a portion of the former Lake Ontario Ordnance Works, a World War II munitions production facility used by the Manhattan Engineer District and U.S. Atomic Energy Commission to store radioactive residues and other materials beginning in 1944. Uranium ore residues were generated through the processing of uranium ore for development of the atomic bomb. The first materials sent to NFSS for storage were radioactive residues from processing uranium ore at the Linde Air Products facility located in Tonawanda, New York. These residues resulted from processing ores with uranium (U_3O_8) contents ranging from 3.5% to 10% and were known as R-10, L-30, L-50, and F-32 residues. Beginning in 1949, radioactive residues from uranium processing at the Mallinckrodt Chemical Works located in St. Louis, Missouri – referred to as the K-65 residues – were shipped to NFSS in 55-gallon drums for storage. The uranium ore from which these residues were generated contained 35% to 65% U_3O_8, as well as uranium decay products, primarily radium and thorium, in secular equilibrium with the uranium prior to processing. Between 1950 and 1952, the K-65 residues were transferred from the drums to a large concrete (former water storage) tower on site, referred to as Building 434. In addition to the residues, radioactively contaminated materials from decommissioning wartime uranium-processing plants and uranium and thorium billets and rods (processed at private facilities) were sent to NFSS for temporary storage.

The U.S. Department of Energy (USDOE), successor to earlier U.S. energy agencies, conducted cleanup activities at NFSS between 1982 and 1986. During that time, the USDOE constructed the Interim Waste Containment Structure (IWCS) to store the residues and contain contaminated soil and construction debris in a controlled configuration until a final determination on the disposition of the residues was made.

An ongoing environmental surveillance program at NFSS, initiated by the USDOE in 1979 and performed by the Corps of Engineers since 1999, has produced over 30 years of groundwater, surface water, sediment, and radiological emissions data. The data are presented in annual technical memoranda and demonstrate that site controls are performing as designed to protect human health and the environment.

Between 2007 and 2015, the Corps of Engineers completed several site characterization investigations to determine the nature and extent of contamination in the various media at NFSS. The results of a remedial investigation and subsequent addendum (see U.S. Army Corps of Engineers [USACE] 2007 and 2011) included a records review, the characterization of various media, geophysical and radiological surveys, a baseline risk assessment, fate and transport groundwater flow modeling, and an assessment of the integrity of the IWCS. In 2013 and 2015, additional investigations were performed to delineate contaminants in soil and groundwater and to eliminate potential preferential pathways for off-site migration by plugging subsurface pipelines located near site boundaries.

SITE CHARACTERISTICS

The NFSS is a 77.3-hectare (191-acre) property located at 1397 Pletcher Road in the Town of Lewiston, New York, 30.6 kilometers (19 miles) north of Buffalo, New York. The NFSS is owned by the federal government. The main feature of the site is the 4-hectare (10-acre) IWCS that is surrounded by paved access roads and chain-link security fencing. The entire site is also surrounded by a chain-link fence and entry onto the site is restricted to one locked main gate. Lake Ontario Ordnance Works- (LOOW-) era buildings remaining at the site include Building 433 (historically called the radium vault) and Building 429, currently used as an office. Except for Buildings 433 and 429, the buildings have been demolished, and only some of the building foundations remain.

Land ownership in the vicinity of NFSS is shown on Figure 1. The NFSS property is bordered on the north and northeast by the CWM Chemical Services, LLC, a hazardous waste disposal facility; on the east and south by the Modern Landfill, Inc., a solid waste disposal facility; and on the west by a transmission corridor owned by National Grid (formerly Niagara Mohawk). Given the current zoning of NFSS, and the presence of adjacent municipal and hazardous waste landfills, the reasonably anticipated future land use for NFSS is industrial.

There are no public water supply wells (i.e., greater than 25 connections) in the site area. Public water is supplied to county residents from the upper Niagara River, which has been utilized by almost all county residents for several decades. The Niagara County Water District obtains water from the west branch of the Niagara River and supplies water to the residents of Lewiston and Porter.

In March 2006, the Niagara County Department of Health conducted a private well study and identified 117 private wells near the LOOW property. The study found that only 19 of the 117 wells were active. Thirteen of the 19 active wells were sampled and analyzed for various chemical and radioactive constituents; all 13 wells met safe drinking water standards with respect to radiological quality. This contributed to USACE's determination that private wells did not have a radiological concern in the vicinity of the LOOW property.

The NFSS and surrounding vicinity are underlain by two water-bearing zones within 50 feet of the ground surface; these are separated by an aquitard, or confining unit. The two water-bearing zones are known as the upper water-bearing zone and the lower water-bearing zone. Both water-bearing zones exhibit significant concentrations of naturally occurring total dissolved solids that indicate NFSS groundwater is classifiable as a NY State Class GSA water resource (saline groundwater) and a U.S. Environmental Protection Agency (USEPA) Class IIIB nonpotable and limited beneficial use water. To be a potable water source, groundwater at NFSS would require resource-intensive treatment by reverse osmosis (desalination). Since there is a replaceable surface water source via the Niagara River/Lake Ontario and groundwater south of the site (Lockport Formation), it is reasonable to assume that no municipality or service would find NFSS groundwater economically viable to develop as a drinking water source.

The remedial investigations and feasibility study identified the types, quantities, and locations of contaminants and developed ways to address the potential risks posed by the contamination. This proposed plan addresses chemicals and radionuclides of concern in soil, road bedding, Building 433, building foundations, utilities (Building 401 drain system), and groundwater. Surface water and sediment were investigated and evaluated, but not identified as media of concern based on risk analyses.

In general, contamination is present in surface soils and at various depths, with most of the contamination limited to the top 0.6 meters (2 feet) of soil, as well as in building/building foundations, and road bedding. Some deeper impacts were also found, but those impacts were primarily limited to the Organic Burial Area where waste is known to have been buried during USDOE remediation activities. Radionuclides are more widespread than chemical constituents, although chemical constituents also are present in the utilities of former Building 401 and groundwater (upper water-bearing zone). Attached Figure 2 shows the extent of contamination.

SCOPE AND ROLE OF OPERABLE UNITS

To manage CERCLA activities at NFSS, the Corps of Engineers established three separate OUs that include the IWCS OU, Balance of Plant OU, and the Groundwater OU. The IWCS OU is an engineered landfill within the diked area of the site and applies to all of the material within the IWCS. The Balance of Plant OU includes all of the material at NFSS not in the IWCS and excludes groundwater. The Groundwater OU refers to contaminated groundwater.

The IWCS OU was the first OU to proceed through the CERCLA process and the IWCS record of decision was signed on March 25, 2019. The alternative selected in the record of decision for the IWCS OU is removal of IWCS contents with off-site disposal. The BOP OU includes impacted soils remaining following the removal of the IWCS; those locations and volumes will not be known until after the IWCS has been removed.

SUMMARY OF SITE RISKS AND REMEDIAL ACTION OBJECTIVES

To determine the current and potential future effects of site-related constituents on human health and the environment, the Corps of Engineers conducted both a human health baseline risk assessment and a screening-level ecological risk assessment following USEPA guidance for performing CERCLA risk assessments. The current and anticipated future land use at NFSS is industrial, so the land use scenario considered for development of the site is industrial. Since there are currently no habitable structures on the site, no useable utility infrastructure, and inadequate vehicle access, construction workers were selected as the receptors that could be exposed to contaminated surface soil, subsurface soil, building foundations, road bedding, and groundwater (upper water-bearing zone) while on-site.

Human Health Risks

As part of the 2007 remedial investigation report, the Corps of Engineers completed a baseline risk assessment. To quantify exposures to human receptors in the baseline risk assessment, the 191-acre NFSS was both assessed as a whole and also divided into smaller areas to better represent the area encompassed by a work place or residence. The areas are termed "exposure units" or EUs, and are assumed to represent parcels of land in which a person might live, work, or recreate. Seventeen on-site EUs are evaluated in this human health risk assessment. EU1 through EU16 are subsections of NFSS while EU17 represents a site-wide unit (Figure 2). EU18 refers to the off-site areas where background samples were collected. These EUs provided the geographical framework for the determination of site-related constituents which are defined as those compounds that exceed background screening levels in their respective EUs.

The 2007 baseline risk assessment considered all potential current and future exposure pathways and receptors; however, this summary is limited to receptors under the current and reasonably anticipated future land use scenario, which is industrial. On-site receptors for industrial land use include adult and adolescent trespassers, construction workers, maintenance workers, and industrial workers. Exposure pathways include incidental ingestion, inhalation, dermal contact (for chemicals of potential concern) and external gamma (for radionuclides of potential concern) present within BOP soils, buildings/foundations, utilities, upper groundwater, ditch sediments and surface water.

What is "risk" and how is it calculated?

A baseline risk assessment is an estimate of the likelihood of health problems occurring if no cleanup action were taken at a site. The Corps of Engineers follows the process developed by the USEPA:

Step 1: Analyze Contamination (data collection and evaluation) occurs during the remedial investigation phase. The Corps of Engineers collects samples from site soils, groundwater, sediments, surface water, and building materials, where appropriate. These samples are analyzed for hazardous substances that are likely present as a result of past activities. For example, if a site stored uranium compounds, the site would be tested for uranium and the radioactive decay products of uranium, such as thorium-230.

Step 2: Estimate Exposure (exposure assessment) occurs when the risk assessor considers different ways people might be exposed to the radionuclides and chemicals identified in Step 1 by developing a conceptual site model that identifies current and potential future land users and maps out the different ways in which each could be exposed to hazardous materials at the site. For example, someone who traverses the site occasionally could be exposed approximately two hours a day, up to seven days a week. They would likely not come in contact with groundwater or soils below a certain depth. By comparison, a construction worker might come in contact with deeper soils through excavation activities. The exposure assessment considers the concentrations that people might be exposed to in environmental media, and the potential frequency and duration of exposure. Using this information, the risk assessor estimates a reasonable maximum exposure intake of contamination for likely future receptors, which is the highest level of human exposure to site contaminants that could reasonably be expected to occur.

Step 3: Assess Potential Health Dangers (toxicity assessment) by the risk assessor involves compiling information on the toxicity of each site-related chemical, as well as the radioactivity (radioactive energy) of each radionuclide to assess potential health risks. The risk assessor considers two types of chemically-based health risks: cancer risk and non-cancer risk, and also the radiological dose resulting from exposure to radioactive contaminants. The likelihood of the occurrence of cancer resulting from exposures at remediation sites is generally expressed as an upper bound probability; for example, a one in 10,000 chance of cancer occurrence over a lifetime. In other words, for every 10,000 people that could be exposed at the reasonable maximum exposure level, at most, one extra cancer would be expected to occur over a lifetime. An extra cancer case means that one more person could get cancer than would normally be expected to from all other causes. For non-cancer health effects, the risk assessor calculates a hazard quotient, which is the ratio of the expected chronic daily intake of contaminant to a "safe dose" level identified by the USEPA. In addition to evaluating cancer risks and non-cancer health effects from exposures to chemicals, this step evaluates how much of a radiological dose someone exposed to the radioactive contamination may incur.

Step 4: Characterize Site Risk (risk characterization) is the final step and incorporates the results of the three previous steps into a risk summary. The risk assessor determines whether the potential health risks are acceptable for people at or near the site according to relevant benchmarks promulgated by the USEPA or other agencies, such as the Nuclear Regulatory Commission or USDOE.

Quantitative risk characterizations identified chemicals of concern (COCs) and radionuclides of concern (ROCs) that posed a cancer risk greater than one in 100,000 (if the total location-specific risk exceeded one in 10,000) or exhibited a noncancer hazard quotient value greater than 1.

Radionuclides that presented a dose greater than 2.5 millirem per year (mrem/yr) (if the total location-specific dose exceeded 25 mrem/yr) were also identified as ROCs. Considering that the reasonably anticipated future land use scenario is industrial, selection of the construction worker as the representative critical group results in the most comprehensive (combined) list of ROCs and COCs and the most conservative preliminary remediation goals (PRGs) for ROCs.

Based on this evaluation, radiological contaminants are more widespread than chemical contaminants. The ROCs and COCs are present in surface soils and at various depths, with most of the contamination limited to the top 0.6 meters (2 feet) of soil. There are also COCs present in the pipelines associated with Building 401. Groundwater COCs are limited to the upper water bearing zone in the northeast portion of the site.

Eight ROCs are identified for Balance of Plant soil, road bedding, Building 433, and building foundations; these ROCs include actinium-227, protactinium-231, lead-210, radium-226, thorium-230, uranium-234, uranium-235, and uranium-238. Preliminary remediation goals were developed for the three representative ROCs: radium-226, thorium-230, and uranium-238. These individual radionuclide PRGs include contributions from long-lived daughter products actinium-227, protactinium-231, uranium-234, and uranium-235 (included in uranium-238 PRG) and lead-210 (included in radium-226 PRG).

The Corps of Engineers established Preliminary Remediation Goals for three BOP OU Radionuclides of Concern

The Corps of Engineers established PRGs for three FUSRAP-related ROCs in soil, road bedding, Building 433, and building foundations.

Radium: Radium is a naturally-occurring radioactive metal. Radium is a radionuclide formed by the decay of uranium and thorium in the environment. It occurs at low levels in virtually all rock, soil, water, plants, and animals. Long-term exposure to radium increases the risk of developing several diseases. Inhaled or ingested radium increases the risk of developing such diseases as lymphoma, bone cancer, and diseases that affect the formation of blood, such as leukemia and aplastic anemia. These effects usually take years to develop. External exposure to radium's gamma radiation increases the risk of cancer to varying degrees in all tissues and organs.

Thorium: Thorium is a naturally occurring radioactive metal found at very low levels in soil, rocks, and water. It has several different isotopes, all of which are radioactive. The principal concern from low to moderate level exposure to ionizing radiation is increased risk of cancer. Studies have shown that inhaling thorium dust causes an increased risk of developing lung cancer and pancreatic cancer. Bone cancer risk is also increased because thorium may be stored in bone.

Uranium: Uranium is a naturally occurring radioactive element commonly found in very small amounts in rocks, soil, water, plants, and animals (including humans). Uranium is weakly radioactive and contributes to low levels of natural background radiation in the environment. Intake of uranium can lead to increased cancer risk, kidney damage, or both.

Several COCs, known collectively as polycyclic aromatic hydrocarbons (PAHs), are identified for Balance of Plant soil and building foundations. The PAHs include benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, and dibenz(a,h)anthracene.

Chlorinated volatile organic compounds (CVOCs), which include tetrachloroethene, trichloroethene, cis-1,2-dichloroethene, and vinyl chloride, are COCs in soil and groundwater in the northeast portion of the site (EU4), as well as in a small pocket of soil in the near center of the site (EU13).

Polychorinated bipenyls (Aroclor-1254 and/or Aroclor-1260) are COCs in the Building 401 foundation, as well as utility water and sediment associated with this building.

The Corps of Engineers established Preliminary Remediation Goals for all BOP and Groundwater OUs Chemicals of Concern

The Corps of Engineers established preliminary remediation goals for all COCs in soil, Building 433, building foundations, Building 401 utilities, and groundwater.

PAHs: PAHs are released to the environment through natural and synthetic sources such as emissions from volcanoes, forest fires, wood burning, and vehicle emissions. Other potential sources of PAHs in soil include sludge disposal from public sewage treatment plants, automotive exhaust, and use of soil compost and fertilizers. The principal sources of PAHs in soil along highways and roads are vehicular exhausts and emissions from wearing of tires and asphalt. Human health effects from environmental exposure to low levels of PAHs are unknown. Some PAHs are considered to be carcinogenic.

Chlorinated Volatile Organic Compounds (CVOCs): The primary CVOC at the site is tetrachloroethene, commonly used as a degreaser and cleaner for metallic parts. Releases into the environment are usually through surface spills or leaking tanks/drums. Health effects may include: eye, nose and throat irritation; headaches, loss of coordination and nausea; and, damage to liver, kidney, circulatory, and central nervous system. Some organics are suspected or known to cause cancer in humans.

Polychlorinated biphenyls (PCBs): PCBs, commonly found in electrical, heat transfer, and hydraulic equipment, are nonpolar and only slightly soluble in water, which makes them bind strongly to soil. PCBs have relatively low vapor pressures but can volatilize allowing them to be transported long distances in air and re-deposited by settling due to precipitation. Animal studies have shown PCBs to cause cancer; non-cancer health effects impact the immune, reproductive, nervous, and endocrine systems. Studies in humans support evidence for potential carcinogenic and non-carcinogenic effects of PCBs.

Ecological Risks

The purpose of the screening-level ecological risk assessment (SLERA) was to determine the potential for adverse ecological impacts resulting from exposure to chemicals and radionuclides related to past activities at the site. The SLERA provides information to help determine whether ecological risks at the site are negligible, if further information and evaluation are necessary to better define potential ecological risks at the site, or if mitigation should be done without further evaluation. Following field observations that showed relatively healthy and functioning terrestrial and aquatic ecosystems, as well as abundantly present vegetation and wildlife, the SLERA concluded that the reality of functioning vegetation and wildlife, as well as lack of sensitive habitats or species, indicate no further action for ecological receptors is warranted.

REMEDIAL ACTION OBJECTIVES

Remedial action objectives are specific goals that remedial alternatives must fulfill to be protective of human health and the environment, as well as be compliant with identified applicable or relevant and appropriate requirement (ARARs). Remedial action objectives provide the basis for selecting remedial technologies and developing and evaluating remedial alternatives. The remedial action objectives for the Balance of Plant and Groundwater OUs are:

- Prevent unacceptable exposure of the construction worker to ROCs and COCs via incidental ingestion, inhalation, dermal contact (for COCs) and external gamma (for ROCs) present within the BOP soils, road bedding, buildings/foundations, and utilities by reducing/removing contaminant concentrations to ARAR-based remediation goals.

- Prevent unacceptable exposure of the construction worker to CVOCs and PCBs present within the groundwater and utilities, respectively, by reducing/removing contaminant concentrations to risk-based remediation goals.

In order to meet these objectives, the Corps of Engineers developed PRGs for each of the ROCs and COCs, based on a review of federal requirements that are applicable or relevant and appropriate to the situation or ROCs/COCs at the site. If no applicable or relevant and appropriate requirements are available, risk-based values are developed. PRGs for the ROCs and COCs identified for the Balance of Plant and Groundwater OUs are based on the following requirements:

- **ROCs in soil, road bedding, Building 433, and building foundations**: Appendix A of Title 10 of the Code of Federal Regulations, Part 40 (10 CFR 40), Criterion 6(6).

- **PAHs in soil and building foundations**: Title 6 New York Codes, Rules, and Regulations (NYCRR) Part 375-6.8(b) for restricted industrial use.

- **PCBs in the former Building 401 foundation and utility sediment:** Toxic Substances Control Act (TSCA), codified under Title 40 CFR 761.

- **CVOCs in soil and groundwater and PCBs in former Building 401 utility water:** Corps of Engineers calculated risk-based values that account for dermal contact, inhalation of vapor, and incidental ingestion by the construction worker.

The PRGs for the Balance of Plant and Groundwater OUs were developed to be protective of human health for the reasonable future land use, and are presented in the following table.

Summary of Preliminary Remediation Goals

Media	Constituent	Units	FS PRG	Basis for FS PRG (ARAR or Risk)	FS PRG Reference
Soil					
	Radium-226	pCi/g	5/15*	ARAR	10 CFR Part 40, Appendix A
	Thorium-230	pCi/g	18/55*	ARAR	10 CFR Part 40, Appendix A
	Uranium-238	pCi/g	115/346*	ARAR	10 CFR Part 40, Appendix A
	Benzo(a)pyrene	mg/kg	1.1	ARAR	6 NYCRR Part 375-6.8(b)
	Benzo(a)anthracene	mg/kg	11	ARAR	6 NYCRR Part 375-6.8(b)
	Benzo(b)fluoranthene	mg/kg	11	ARAR	6 NYCRR Part 375-6.8(b)
	Dibenz(a,h)anthracene	mg/kg	1.1	ARAR	6 NYCRR Part 375-6.8(b)
	Tetrachloroethene	mg/kg	1.53	Risk	BOP & GW OU FS, Appendix E
	Trichloroethene	mg/kg	0.33	Risk	BOP & GW OU FS, Appendix E
	Cis-1,2-dichloroethene	mg/kg	0.75	Risk	BOP & GW OU FS, Appendix E
	Vinyl chloride	mg/kg	0.07	Risk	BOP & GW OU FS, Appendix E
Road Bedding					
	Radium-226	pCi/g	5/15*	ARAR	10 CFR Part 40, Appendix A
	Thorium-230	pCi/g	18/55*	ARAR	10 CFR Part 40, Appendix A
	Uranium-238	pCi/g	115/346*	ARAR	10 CFR Part 40, Appendix A
Building Foundations**					
	Radium-226	pCi/g	5/15*	ARAR	10 CFR Part 40, Appendix A
	Thorium-230	pCi/g	18/55*	ARAR	10 CFR Part 40, Appendix A
	Uranium-238	pCi/g	115/346*	ARAR	10 CFR Part 40, Appendix A
	Benzo(a)pyrene	mg/kg	1.1	ARAR	6 NYCRR Part 375-6.8(b)
	Benzo(a)anthracene	mg/kg	11	ARAR	6 NYCRR Part 375-6.8(b)
	Benzo(b)fluoranthene	mg/kg	11	ARAR	6 NYCRR Part 375-6.8(b)
	Dibenz(a,h)anthracene	mg/kg	1.1	ARAR	6 NYCRR Part 375-6.8(b)
	Aroclor-1254	mg/kg	25	ARAR	40 CFR Part 761.61
	Aroclor-1260	mg/kg	25	ARAR	40 CFR Part 761.61
Utility Sediment (Building 401 utility drains only)					
	Aroclor-1254	mg/kg	25	ARAR	40 CFR Part 761.61
Utility Water (Building 401 utility drains only)					
	Aroclor-1260	mg/L	0.0001	Risk	USACE 2007
	Aroclor-1254	mg/L	0.0001	Risk	USACE 2007
Groundwater					
	Tetrachloroethene	mg/L	1.5	Risk	BOP & GW OU FS, Appendix E
	Trichloroethene	mg/L	0.33	Risk	BOP & GW OU FS, Appendix E
	Cis-1,2-dichloroethene	mg/L	2.4	Risk	BOP & GW OU FS, Appendix E
	Vinyl chloride	mg/L	0.17	Risk	BOP & GW OU FS, Appendix E

Notes: *Surface soil (upper 15 centimeters)/subsurface soil (below 15 centimeters) averaged over an area of 100 square meters. Also, actinium-227, proactinium-231, uranium-234, and uranium-235 included under uranium-238 and lead-210 included under radium-226. PRGs for uranium-238 and thorium-230 are calculated in accordance with 10 CFR 40, Appendix A, Criterion 6(6).
**Building foundations are assumed to have the same impacts as adjacent soils. PRGs for Building 433 are only ROCs.
FS – feasibility study; mg/kg - milligrams per kilogram; mg/L - milligrams per liter; pCi/g - picoCuries per gram
USACE 2007: Table A 702, Baseline Risk Assessment for the Niagara Falls Storage Site, December 2007
10 CFR Part 40: 10 CFR Part 40, Appendix A, Criterion 6(6)
40 CFR Part 761.61 criteria is for total PCBs
BOP & GW OU FS: Balance of Plant and Groundwater Operable Units feasibility study, USACE October 2019

DISCUSSION OF REMEDIAL ALTERNATIVES

Five remedial alternatives were retained for detailed evaluation in the feasibility study. These alternatives are numbered 1 through 5 and include the no action alternative (Alternative 1) that is required by CERCLA. Since Alternative 1 is not protective of human health as determined by the feasibility study, it will not be considered further in this proposed plan. The remaining four alternatives (Alternatives 2 through 5) would remediate to levels suitable for industrial use (i.e., protective of both construction and industrial workers). The estimated *in situ* volumes of impacted environmental media that require remediation are presented in the table below.

Estimated *In Situ* Volumes Requiring Remediation

Basis	Matrix	Volume (cubic meters)	Volume (cubic yards)
Soil, includes road bedding and EU13 VOC soil, excludes EU4 VOC plume soil(1)	Soil	1,529	2,000
EU4 VOC plume soil	Soil	2,600	3,400
Building 431/432 trench (estimated ½ soil, ½ concrete)	Soil/Concrete	764	1,000
Building 401 foundation (including drains)	Concrete(3)	556	727
Building 430 foundation	Concrete(2)	688	900
Building 431/432 foundation	Concrete(2)	414	541
Building 433 foundation, sidewalls, and roof	Concrete(2)	31	41
Total Volume		**6,582**	**8,609**
	Matrix	**Volume (liters)**	**Volume (gallons)**
EU4 VOC plume (assume 1 gal/yd^3 of EU4 plume soil removed)	Groundwater	12,499	3,302
Total Volume		**12,499**	**3,302**

NOTES: (1) Soils beneath the IWCS are not included in this list.
(2) Volumes not removed but scarified will generate approximately 63 cubic meters (83 cubic yards) of contaminated concrete dust.
(3) Complete removal, no scarification intended.

All building foundations, Building 433, and soil beneath the IWCS following removal of its contents will be characterized as part of remedial design work to definitively determine the presence of contamination during remedial design.

Alternative 2: Complete Removal

Under Alternative 2, contaminated media would be excavated for off-site disposal. This includes soil, road bedding, building foundations (Buildings 401, 430, and 431/432), Building 433, and Building 401 utilities, as well as CVOC-impacted soil and groundwater in EU4. As part of the CVOC remediation effort in EU4, groundwater entering the excavation would be removed via dewatering and sent off-site for treatment and disposal. Following removal of impacted media to below feasibility study PRGs, excavated areas would be backfilled with clean soil; in EU4, bioremediation amendments would be added prior to backfilling to enhance the degradation of residual, dissolved-phase impacts. Five-year reviews would be performed to ensure that the anticipated future land use, which is industrial, has not changed and that the remedy remains protective. A 1,000-year monitoring period was selected to be consistent with the timeframe required by 10 CFR 40 Criterion 6(6) for dose calculations.

An estimated 6,582 m^3 (8,609 yd^3) of *in situ* contaminated soil and concrete (including buildings and building foundations) and 12,499 liters (3,302 gallons) of impacted groundwater would be excavated/recovered for off-site disposal under Alternative 2.

The total cost of Alternative 2 is $35,668,897: $35,225,753 for capital and contingency costs that include among other components, preparation of remedial designs and plans, excavation, confirmatory sampling, transport, off-site disposal, site restoration, and preparation of a remedial action completion report; and, $414,153 for implementing five-year reviews over a 1,000-year duration (referred to as operation and maintenance [O&M] costs in the feasibility study). The estimated time to complete remedial work for Alternative 2 is 28.5 months: 24 months to develop remedial designs and plans and 4.5 months for construction.

Alternative 3: Removal with Building Decontamination

Alternative 3 is similar to Alternative 2 and includes the excavation and off-site disposal of impacted soil, road bedding, groundwater, and Building 401 foundation/utilities; and, five-year reviews to ensure protectiveness of the remedy. However, unlike Alternative 2, building foundations (Buildings 430 and 431/432) and Building 433 determined to be impacted would be decontaminated by scarifying[1] and left in place.

An estimated 5,449 m^3 (7,127 yd^3) of *in situ* contaminated soil and concrete (Building 401 foundation only) and 12,499 liters (3,302 gallons) of impacted groundwater would be excavated/recovered for off-site disposal under Alternative 3. A nominal amount of impacted concrete dust from scarification (approximately 63 m^3 [83 yd^3]) would also require disposal.

The total cost of Alternative 3 is $24,536,468: $24,093,324 for capital and contingency costs that include among other components, preparation of remedial designs and plans, excavation, confirmatory sampling, transport, off-site disposal, site restoration, and preparation of a remedial action completion report; and, $414,153 for implementing five-year reviews over a 1,000-year duration (referred to as O&M costs in the feasibility study). The estimated time to complete remedial work for Alternative 3 is 28.5 months: 24 months to develop remedial designs and plans and 4.5 months for construction.

Alternative 4: Removal with Building Decontamination and *In Situ* Remediation

Alternative 4 is similar to Alternative 3 and includes: excavation and off-site disposal of impacted soil, road bedding, groundwater, and Building 401 foundation/utilities; scarification of contaminated building foundations (Buildings 430 and 431/432) and Building 433; and, five-year

[1] Scarifying is the process of removing surface contamination in concrete through physical pulverization or scraping. Using this process, the outer, impacted surface of the concrete is removed to below FS PRG levels, leaving the remaining unimpacted concrete in place.

reviews to ensure protectiveness of the remedy. Unlike Alternative 3, CVOC-impacted soil and groundwater in EU4 would be remediated by *in situ* thermal treatment.[2]

An estimated 2,849 m^3 (3,727 yd^3) of *in situ* contaminated soil (excludes EU4 VOC plume soil) and concrete (Building 401 foundation only) would be excavated for off-site disposal under Alternative 4. A nominal amount of impacted concrete dust from scarification (approximately 63 m^3 [83 yd^3]) would also require disposal.

The total cost of Alternative 4 is $22,915,153: $22,472,009 for capital and contingency costs that include among other components, preparation of remedial designs and plans, excavation, confirmatory sampling, transport, off-site disposal, site restoration, and preparation of a remedial action completion report; and, $414,153 for implementing five-year reviews over a 1,000-year duration (referred to as O&M costs in the feasibility study). The estimated time to complete remedial work for Alternative 4 is 37 months: 24 months to develop remedial designs and plans and 13 months for construction.

Alternative 5: Removal with Building Decontamination and *Ex Situ* Remediation

Alternative 5 is similar to Alternative 3 and includes: excavation and off-site disposal of non-CVOC-impacted soil, road bedding, groundwater, and Building 401 foundation/utilities; scarification of contaminated building foundations (Buildings 430 and 431/432) and Building 433; and, five-year reviews to ensure protectiveness of the remedy. Unlike Alternative 3, CVOC-impacted soil in EU4 would be remediated by *ex situ* thermal treatment.[3]

Under Alternative 5, an estimated 2,849 m^3 (3,727 yd^3) of *in situ* contaminated soil and concrete (Building 401 foundation only) and 12,499 liters (3,302 gallons) of impacted groundwater would be excavated/recovered for off-site treatment and disposal, and an estimated 2,600 m^3 (3,400 yd^3) of CVOC-impacted soil would be excavated for on-site treatment. A nominal amount of impacted concrete dust from scarification (approximately 63 m^3 [83 yd3]) would also require disposal.

The total cost of Alternative 5 is $27,265,533: $26,822,389 for capital and contingency costs that include preparation of a remedial design work plan, excavation, confirmatory sampling, transport, off-site disposal, site restoration, preparation of a remedial action completion report, and other components; and, $414,153 for implementing five-year reviews over a 1,000-year duration (referred to as O&M costs in the feasibility study). The estimated time to complete remedial work

---

[2] *In situ* thermal treatment is a process of heating impacted soil to temperatures that would remove, through volatilization, CVOC impacts in the soil and groundwater to levels below the FS PRGs. The heat is applied to the subsurface through the use of electrodes. The process has a high power demand and may require an extended period to achieve treatment goals. Treated soil and groundwater would remain in place and not require off-site disposal. Off-gases would be collected and treated to destroy contaminants.

[3] *Ex situ* thermal treatment involves excavation and transfer of impacted soil and groundwater (within the soil matrix) to an on-site treatment area where the excavated material would be heated to temperatures that would volatilize CVOC impacts in the soil and groundwater to levels below the FS PRGs. The excavated material would be placed into a fully enclosed containment cell and heated air would be applied through the use of blowers. Volatilized impacts would be collected and treated in an off-gas system. The process has a high power demand and may require an extended period to achieve treatment goals. Treated soil could remain on-site. Groundwater would be recovered during the excavation process and taken off-site for treatment and disposal. Off-gases would be collected and treated to destroy contaminants.

for Alternative 5 is 37 months, which includes 24 months to develop remedial designs and plans and 13 months for construction.

Summary

The table below presents the volumes of impacted media removed and disposed off-site, as well as the estimated time to complete remedial work, for each remedial alternative.

Volumes of Impacted Media Removed and Disposed Off-site

Media Removed	**Alternative 2: Complete Removal**	**Alternative 3: Removal with Building Decontamination**	**Alternative 4: Removal with Building Decontamination and *In Situ* Remediation**	**Alternative 5: Removal with Building Decontamination and *Ex Situ* Remediation**
Soil* (cy)	3000	3000	3000	3000
Building 401 (cy)	727	727	727	727
EU4 VOC Soil (cy)	3400	3400	0	3400**
EU4 VOC Groundwater (gal)	3302	3302	0	3302
Foundations (cy)	1482	0	0	0
Concrete dust (cy)	0	83	83	83
Time to Complete (months)	28.5	28.5	37	37

NOTES:
*Includes road bedding, EU13 VOC soil, and Buildings 431/432 trench soil/concrete; excludes EU4 VOC plume soil
**Soil removed is treated and left on-site
cy – cubic yards
gal – gallons

EVALUATION OF ALTERNATIVES

Nine CERCLA criteria are used to evaluate the different remedial alternatives individually and against each other in order to select a remedy. This section of the proposed plan profiles the relative performance of each alternative against the nine criteria, noting how it compares to the other options under consideration. The nine evaluation criteria are discussed below. A detailed analysis of the alternatives can be found in the feasibility study.

Both threshold criteria (overall protectiveness of human health and the environment, and compliance with ARARs) must be met by any remedial alternative for it to be considered a viable remedy. The five balancing criteria (long-term effectiveness and permanence; short-term effectiveness; reduction of toxicity, mobility, or volume through treatment; implementability; and cost) represent the primary criteria upon which the detailed analysis is based. The remaining two of the nine CERCLA criteria (state/support agency acceptance and community acceptance), referred to as modifying criteria, are typically evaluated following the public comment period on the proposed plan, and will be addressed during preparation of the record of decision.

EVALUATION CRITERIA FOR CERCLA REMEDIAL ALTERNATIVES

Overall Protectiveness of Human Health and the Environment determines whether an alternative eliminates, reduces, or controls threats to human health and the environment through institutional controls, engineering controls, or treatment.
Compliance with ARARs evaluates whether the alternative meets substantive cleanup criteria, standards of control, or other requirements from other environmental laws and regulations that pertain to the contamination, or whether a waiver is justified.
Long-Term Effectiveness and Permanence considers the ability of an alternative to maintain protection of human health and the environment over time.
Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.
Short-Term Effectiveness considers the length of time needed to implement an alternative and the risks the alternative poses to workers, residents, and the environment during implementation.
Implementability considers the technical and administrative feasibility of implementing the alternative, including factors such as the relative availability of goods and services.
Cost includes estimated capital and annual operations and maintenance costs, as well as present worth cost. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50% to -30%.
State/Support Agency Acceptance considers whether the state agrees with the Corps of Engineers' analyses and recommendations, as described in the remedial investigation/feasibility study and proposed plan.
Community Acceptance considers whether the local community agrees with the Corps of Engineers' analyses and preferred alternative. Comments received on the proposed plan are an important indicator of community acceptance.

1. Overall Protectiveness of Human Health and the Environment

Alternatives 2, 3, 4, and 5 are protective of human health and the environment because impacted soil, road bedding, foundations, Building 401 utilities, and groundwater are either removed or treated, effectively reducing levels of ROCs and COCs to below PRGs.

2. Compliance with ARARs

Alternatives 2, 3, 4, and 5 comply with ARARs since they meet the ARAR-based performance standards.

3. Long-Term Effectiveness and Permanence

The excavation and removal or treatment of impacted soil, groundwater, and other media under remedial Alternatives 2 through 5 is considered highly effective in the long term and would permanently reduce on-site exposures. For Alternative 4, off-site destruction of off-gases from the *in situ* treatment of the EU4 VOC plume soil and groundwater would also be highly effective and permanent in reducing contaminant concentrations. Any residual contaminated soil, groundwater, and other media at the site would be at concentrations below the feasibility study PRGs.

4. Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment

Only Alternatives 4 and 5 reduce toxicity, mobility, or volume through treatment. Alternative 4 employs *in situ* thermal treatment of the CVOC-impacted soil and groundwater in EU4, while Alternative 5 uses *ex situ* thermal treatment for CVOC-impacted soil and groundwater in EU4. Under Alternative 5, groundwater that enters the excavation is removed for off-site treatment and disposal, and under both Alternatives 4 and 5, off-gas contaminants are destroyed off-site. Both of these processes result in an overall reduction in contaminant volume through treatment.

5. Short-Term Effectiveness

Alternatives 2, 3, 4, and 5 are all rated low for short-term effectiveness. This is due to the fact that all of the alternatives require excavation of a large volume of soil and media, resulting in similar levels of effectiveness and risk. Decontamination of building foundations and *in situ/ex situ* thermal treatment of the CVOC plume in EU4 also present similar levels of effectiveness and risk when compared to excavation.

In all cases, the risks are relatively easily controlled. A site operations plan, site-specific health and safety plan, transportation plan, and other documents would outline procedures for safe completion of the work and for monitoring plans to ensure the safety of remediation workers and the general public. Most of the short-term risks would be addressed through relatively simple means such as dust control and air monitoring. The risks would only be present for the duration of the intrusive remedial activities. Once the material is removed from the site, there is no further risk.

6. Implementability

Alternatives 4 and 5 are rated moderate for implementability and would be the most difficult to implement since there are only a few firms that perform either *in situ* or *ex situ* thermal treatment of soil. Alternatives 2 and 3 are rated high because no specialized equipment, personnel, or services are required to implement soil excavation, transport, and disposal activities. The required resources are readily available and use conventional earth-moving equipment. Dewatering and excavation controls are expected to be minimal and fairly simple to implement, if required. Equipment and services required for the concrete scarification are relatively available since the same equipment and services are also used outside of the remediation industry.

7. Cost

The costs range from $22.9 million for Alternative 4 to $35.7 million for Alternative 2. All of the alternatives remediate the site to promulgated industrial use criteria or site-specific risk-based values for the industrial land use receptor (construction worker). In addition, the alternatives all require five-year reviews, so these estimated costs are the same. Contingency costs are estimated for each remedial alternative to account for unknown or unplanned circumstances that could occur as cleanup decisions proceed (e.g., discovery of additional contaminated soil during remediation).

Despite the similar remedial approach, Alternatives 2 and 3 differ in cost by over $11,000,000. This difference is due to the amount of contaminated concrete building foundations assumed to be transported and disposed off-site, which is also reflected in the difference in the contingency costs. Since no analytical data was available for the foundations during the feasibility study, it was assumed for Alternative 2 that all of the concrete building foundations would be excavated and disposed off-site as contaminated, whereas Alternative 3 would remove (scarify) the contaminated portion of the concrete slab and greatly reduce the volume of concrete to be removed and disposed of (assumed to be a decrease of more than 95 percent). If analytical data collected during remedial design work determines that none of the concrete is contaminated, there would be no cost difference between Alternatives 2 and 3. Alternative 4 is the least expensive at $22,915,153.

8. State/Support Agency Acceptance

State/support agency acceptance of the preferred alternative will be evaluated after the public comment period ends and will be considered in the record of decision for the site.

9. Community Acceptance

Community acceptance of the preferred alternative will be evaluated after the public comment period ends and will be described in the record of decision for the site.

The table below summarizes the comparative analysis of the four remedial alternatives.

Comparative Analysis of Remedial Alternatives

Criteria	Alternative 2: Complete Removal	Alternative 3: Removal with Building Decontamination	Alternative 4: Removal with Building Decontamination and *In Situ* Remediation	Alternative 5: Removal with Building Decontamination and *Ex Situ* Remediation
Threshold Criteria				
Overall Protection of Human Health and the Environment	Protective	Protective	Protective	Protective
Compliance with ARARs	Compliant	Compliant	Compliant	Compliant
Balancing Criteria				
Long-Term Effectiveness and Permanence	High	High	High	High
Reduction in Toxicity, Mobility, or Volume through Treatment	Low	Low	Moderate	Moderate
Short-Term Effectiveness	Low	Low	Low	Low
Implementability	High	High	Moderate	Moderate
Capital Cost	$23,814,326	$17,557,536	$17,180,164	$19,784,859
Present Worth Five-Year Review Costs (referred to as O&M Costs in the feasibility study)	$414,153	$414,153	$414,153	$414,153
Contingency Costs	$11,440,418	$6,564,779	$5,320,836	$7,066,521
Total Cost	$35,668,897	$24,536,468	$22,915,153	$27,265,533

SUMMARY OF PREFERRED ALTERNATIVE

The preferred alternative for the BOP and Groundwater OUs is Alternative 3: Removal with Building Decontamination. Under Alternative 3, impacted soil, road bedding, and groundwater are removed, Buildings 430, 431/432, and 433 foundations decontaminated, and Building 401 foundation and utilities removed. This alternative satisfies the CERCLA threshold criteria and reduces risk through:

- Excavation and off-site disposal of
    - Impacted soil, groundwater, and road bedding
    - Building 401 foundation and utilities
- Removal (through scarification) of impacted concrete in former building foundations and off-site disposal of collected dust and debris

Like all of the remedial alternatives considered for the BOP and Groundwater OUs, Alternative 3 achieves the remedial action objectives; however, it does so at a capital cost that is among the lowest. Alternative 4 has a lower overall cost but this is due to the differences in the estimated contingency costs. Furthermore, Alternative 4 is more difficult to implement than Alternative 3.

The Corps of Engineers expects the preferred alternative to satisfy the following statutory requirements of CERCLA Section 121(b): (1) be protective of human health and the environment; (2) comply with ARARs; (3) be cost-effective; and (4) utilize permanent solutions that will preclude any future environmental impact. Although Alternative 3 does not include on-site treatment of CVOC-contaminated soils like Alternatives 4 and 5, the shorter completion time (28.5 months versus 37 months) and ease of implementation are critical at NFSS. The BOP and Groundwater OU remedial activities are integral to a holistic site-wide remediation that includes the logistically complex removal of the IWCS in accordance with a separate signed record of decision.

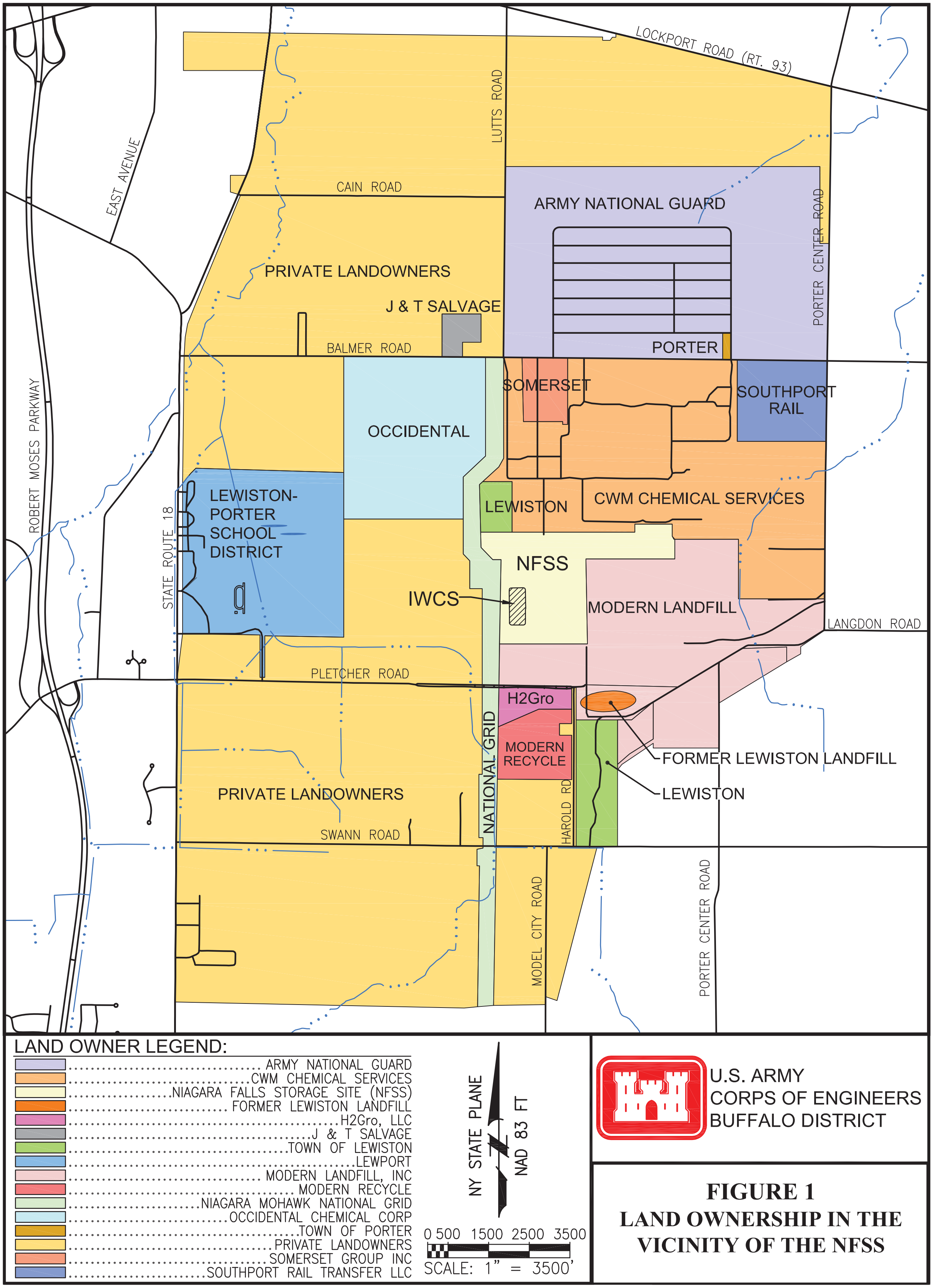
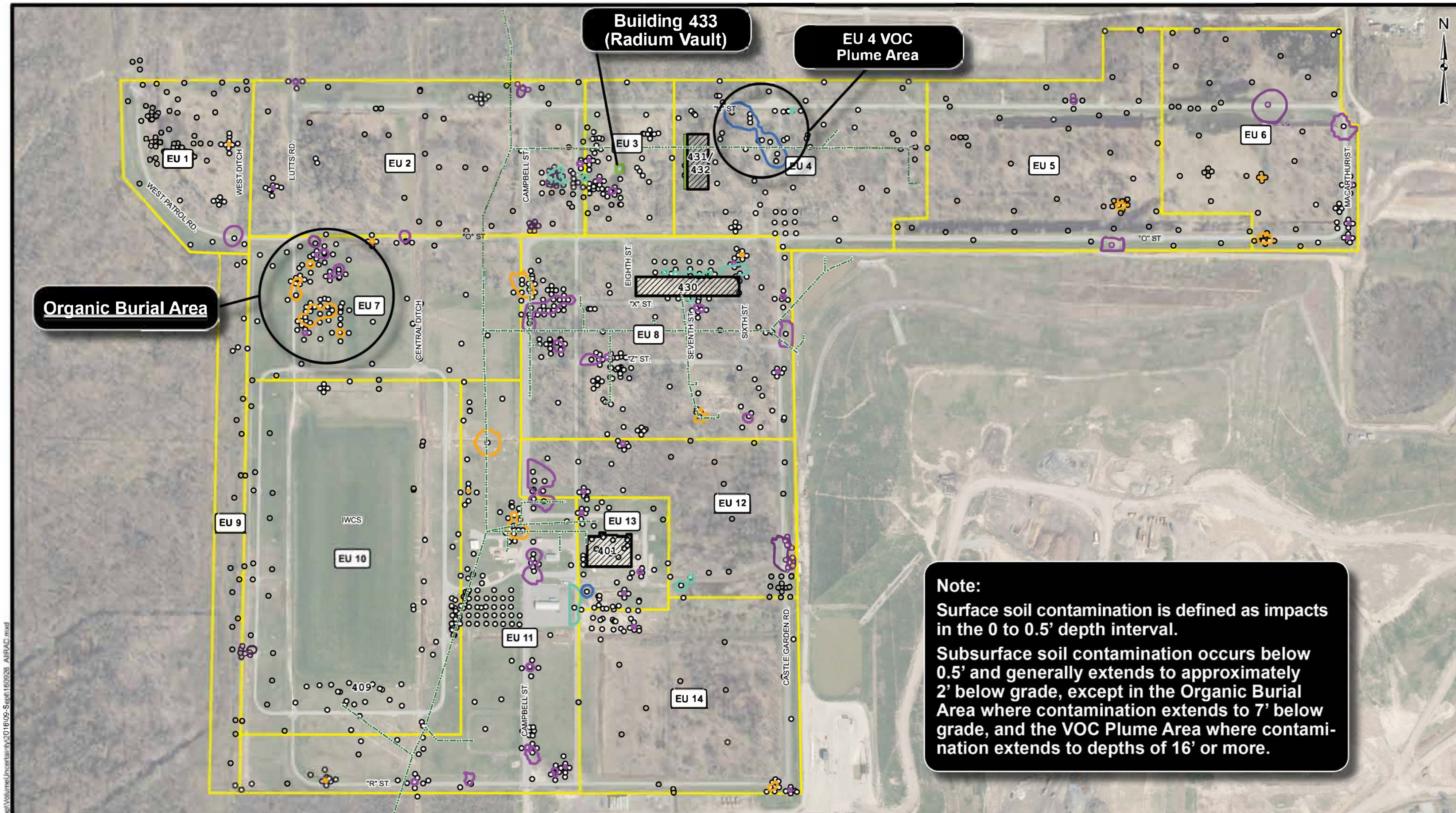


FIGURE 1
LAND OWNERSHIP IN THE VICINITY OF THE NFSS



Legend

- Soil Sample Location
- Modeled Extent of Organic Contamination
- Extent of VOC Contaminated Soils
- Modeled Extent of Surface Radiological Contamination
- Modeled Extent of Subsurface Radiological Contamination
- Foundation to be Remediated
- Former Building 431/432 Trench
- Building to be Removed
- Sanitary Sewer

0 175 350 700 Feet

US Army Corps of Engineers. Buffalo District — U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS BUFFALO, NY	ESTIMATED EXTENT OF SOIL CONTAMINATION	
Document Name: 160926_AllRAD.mxd Drawn By: H5TDESPM Date Saved: 04 Sep 2019 Time Saved: 8:03:01 AM	NIAGARA FALLS STORAGE SITE LEWISTON, NEW YORK	FIGURE 2

Tear-off sheet

Dear Buffalo District FUSRAP Team,

I would like to provide you with the following comments on the *Proposed Plan for the Balance of Plant and Groundwater Operable Units at the Niagara Falls Storage Site*:

____

____

____

____

____

____

____

____

____

____

____

____

____

Submitted by

Name: ______________________________________

Organization: ______________________________________

Address: ______________________________________

____

____

Tape Here

Tape

Tape

2nd Fold Here

Please
Affix
First
Class
Postage

U.S. Army Corps of Engineers, Buffalo
District Special Projects Branch
Environmental Project Management Team
1776 Niagara Street
Buffalo, NY 14207-3199

1st Fold Here