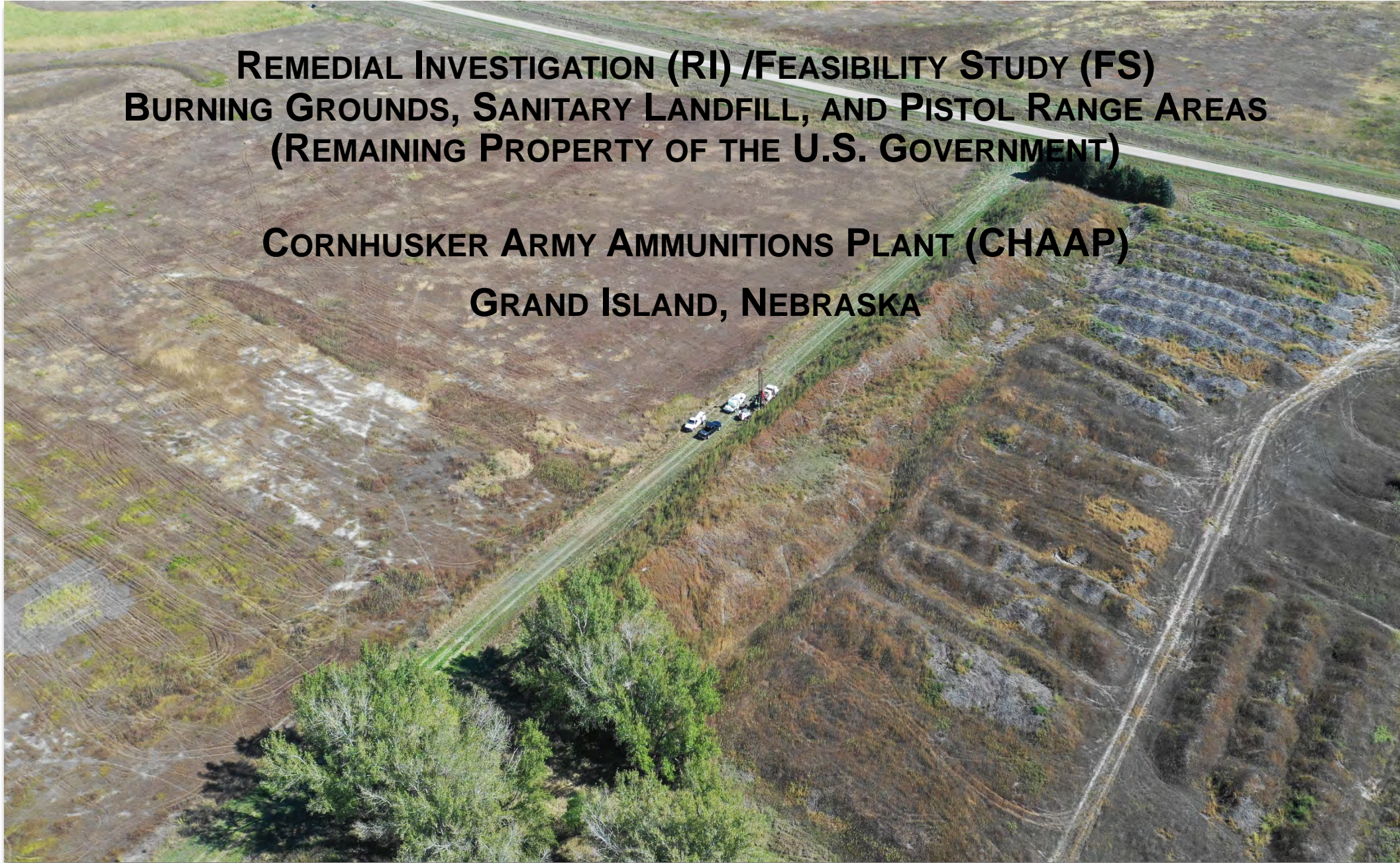


**REMEDIAL INVESTIGATION (RI) /FEASIBILITY STUDY (FS)
BURNING GROUNDS, SANITARY LANDFILL, AND PISTOL RANGE AREAS
(REMAINING PROPERTY OF THE U.S. GOVERNMENT)**

**CORNHUSKER ARMY AMMUNITIONS PLANT (CHAAP)
GRAND ISLAND, NEBRASKA**



Acronym List

2-Am-DNT	2-Amino-4,6-dinitrotoluene	MEC	munitions and explosives of concern
4-Am-DNT	4-Amino-2,6-dinitrotoluene	mg/kg	milligrams per kilogram
µg/L	micrograms per liter	MNA	monitored natural attenuation
bgs	below ground surface	MRS	Munitions Response Site
BPA	Burning Pit Area	PAH	polynuclear aromatic hydrocarbon
BTV	background threshold value	PRG	preliminary remediation goal
CHAAP	Cornhusker Army Ammunition Plant	RAA	remedial action alternative
cy	cubic yards	RAO	remedial action objective
DGM	digital geophysical mapping	RDX	cyclotrimethylenetrinitramine
DPT	direct-push technology	RI	Remedial Investigation
HI	hazard index	SLERA	Screening Level Ecological Risk Assessment
HHRA	Human Health Risk Assessment	SPLP	synthetic precipitation leaching procedure
HTRW	Hazardous, Toxic, and Radioactive Waste	TNT	2,4,6-trinitrotoluene
ISCO	in situ chemical oxidation	UGIA	Upper Grand Island Aquifer
LGIA	Lower Grand Island Aquifer	VOC	volatile organic compound
LUC	land use control		
MD	munitions debris		



Presentation Overview

- Task Order Objectives
- Major Work Elements of the RI/FS
- RI
 - Background Investigation
 - Tract Hazardous, Toxic, and Radioactive Waste (HTRW) Investigation (7 sites within 5 Government-owned Tracts)
 - Tract 20B Munitions Response Site (MRS) Investigations (2 sites within 1 Tract)
 - RI Conclusions
- FS
 - 5 HTRW Sites
 - 2 MRSs
 - Remediation Area Overviews
 - Site Remedial Action Objectives (RAOs) and Remedial Action Alternatives (RAAs)
- Reporting Schedule

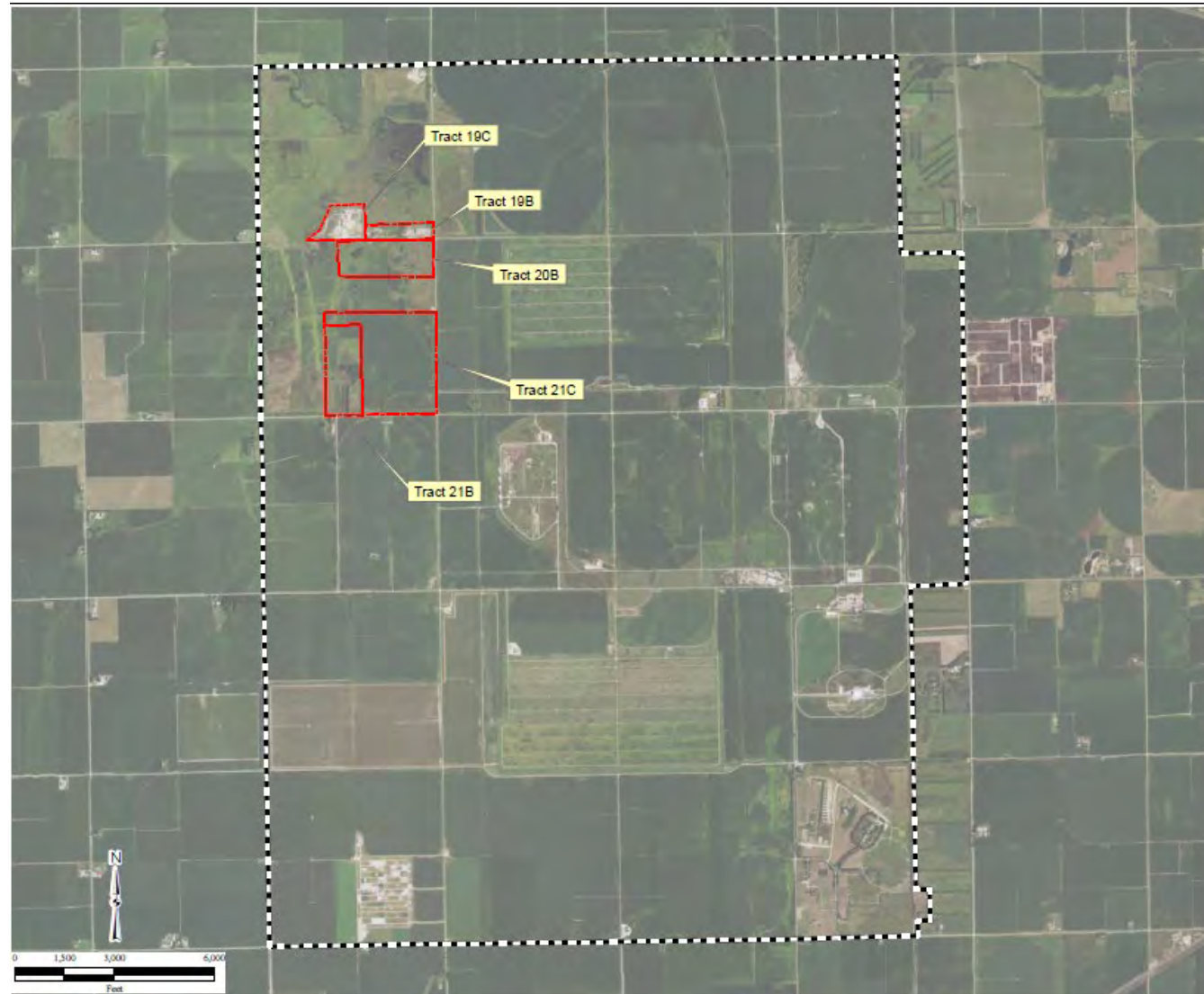


Task Order Objectives

- Perform a Background Study including soil and groundwater sampling to develop a background dataset to determine whether site data reflects natural background conditions, man-made or industrial influences, or site-related contamination
- Complete investigative fieldwork to include delineation of vertical and horizontal extent of contamination in soil and groundwater to the standards required for a RI (including a baseline risk assessment), and subsequent Feasibility Study at:
 - Tract 19B (property east of Tract 19C with stockpiled soil from Tract 19C)
 - Tract 19C (Demolition Burning Grounds aka Open Burning/Open Detonation Area)
 - Tract 20B (South Fuze Destruction Area)
 - Tract 21B (Firing Range/Backstop Berm and Static Ejection and Test Site, Burning Pit Area, Decanting Station and Leaching Pit Area)
 - Tract 21C (potential groundwater contamination migrating from east from Tract 21B)



CHAAP Tract Locations



Major Work Elements of the RI/FS

Site	Tasks
All Sites	<ul style="list-style-type: none"> • Planning Documents • Evaluation of Current Conditions/Existing Wells/Existing Structures • Filling of Data Gaps and Collection of Data Sufficient to Support RI/FS
Tracts 19B, 19C, 20B, 21B, and 21C	<ul style="list-style-type: none"> • Field Work (types and quantities defined in following slides) • Handling, transport, and disposal of all wastes • Geophysical Mapping of Abandoned Burning Areas and South Fuze Destruction Area
Background Study	<ul style="list-style-type: none"> • Collection of Surface and Subsurface Soil Samples • Installation of Monitoring Wells and Groundwater Sampling (Upper Grand Island Aquifer [UGIA] and Lower Grand Island Aquifer [LGIA])
Reporting for each Tract	<ul style="list-style-type: none"> • RI Report (including Human Health Risk Assessment [HHRA] and Screening Level Ecological Risk Assessment [SLERA]) • Feasibility Study Report
Optional Tasks	<ul style="list-style-type: none"> • Prepare Proposed Plans • Prepare Record of Decision • Well Abandonment

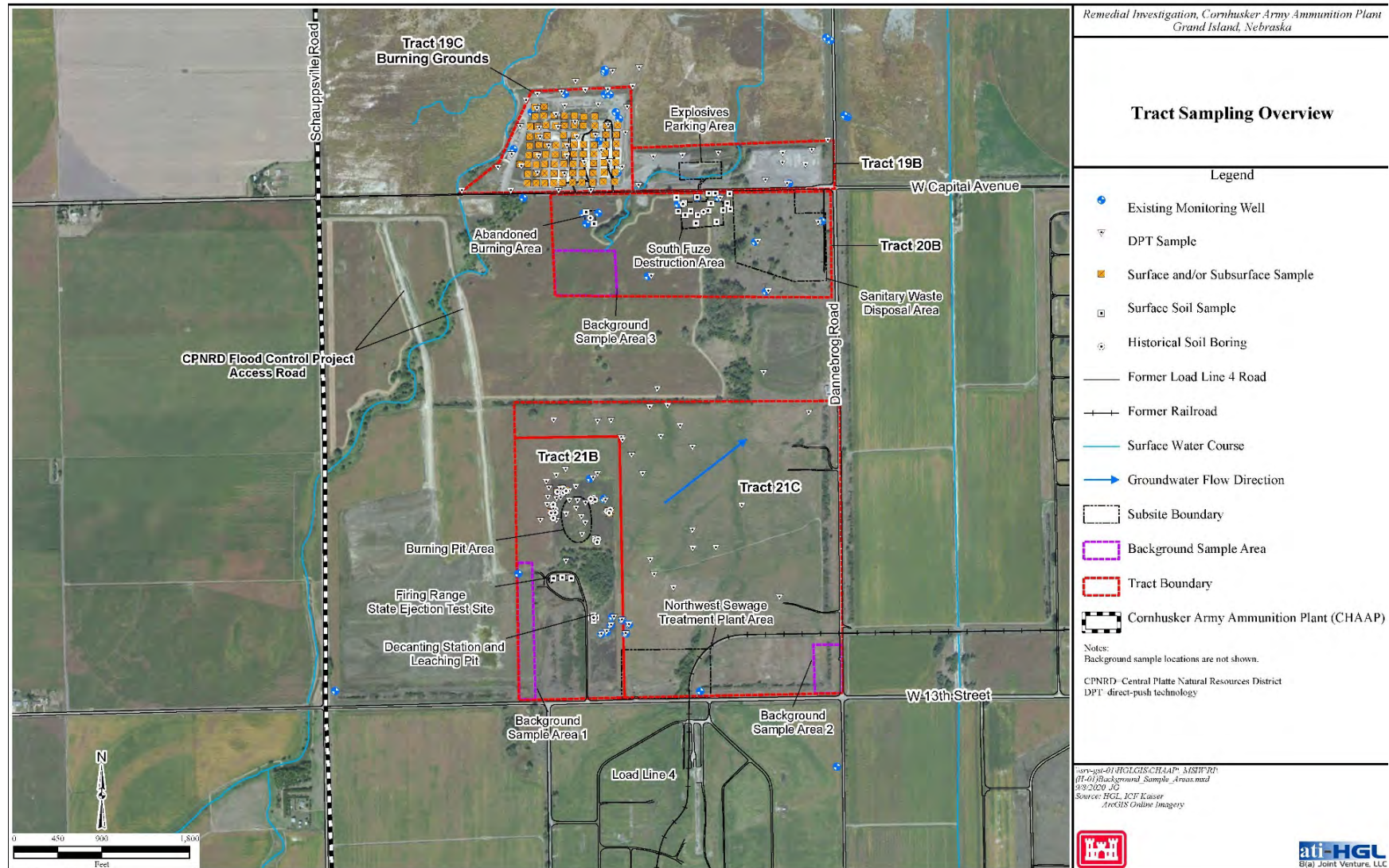


RI Status

- Field program completed at Tracts 19B, 19C, 20B, 21B, and 21C in summer to fall 2018.
- Geophysical investigation completed at Tract 20B MRSs in summer 2020.
- Draft RI submitted to USACE in April 2021
 - Nature and extent of contamination
 - Fate and transport of contamination
 - Background Study
 - HHRA/SLERA
 - Geophysical investigation results (Tract 20B only)
- Draft Final RI submitted August 2021
- Nebraska Department of Environment and Energy and U.S. Environmental Protection Agency Region 7 Comments received September 28, 2021; Response to comments on Draft Final RI submitted November 2021
- Includes the following for all tracts/sub-sites:



Sample Overview



Background Study

Field Activities and Sampling:

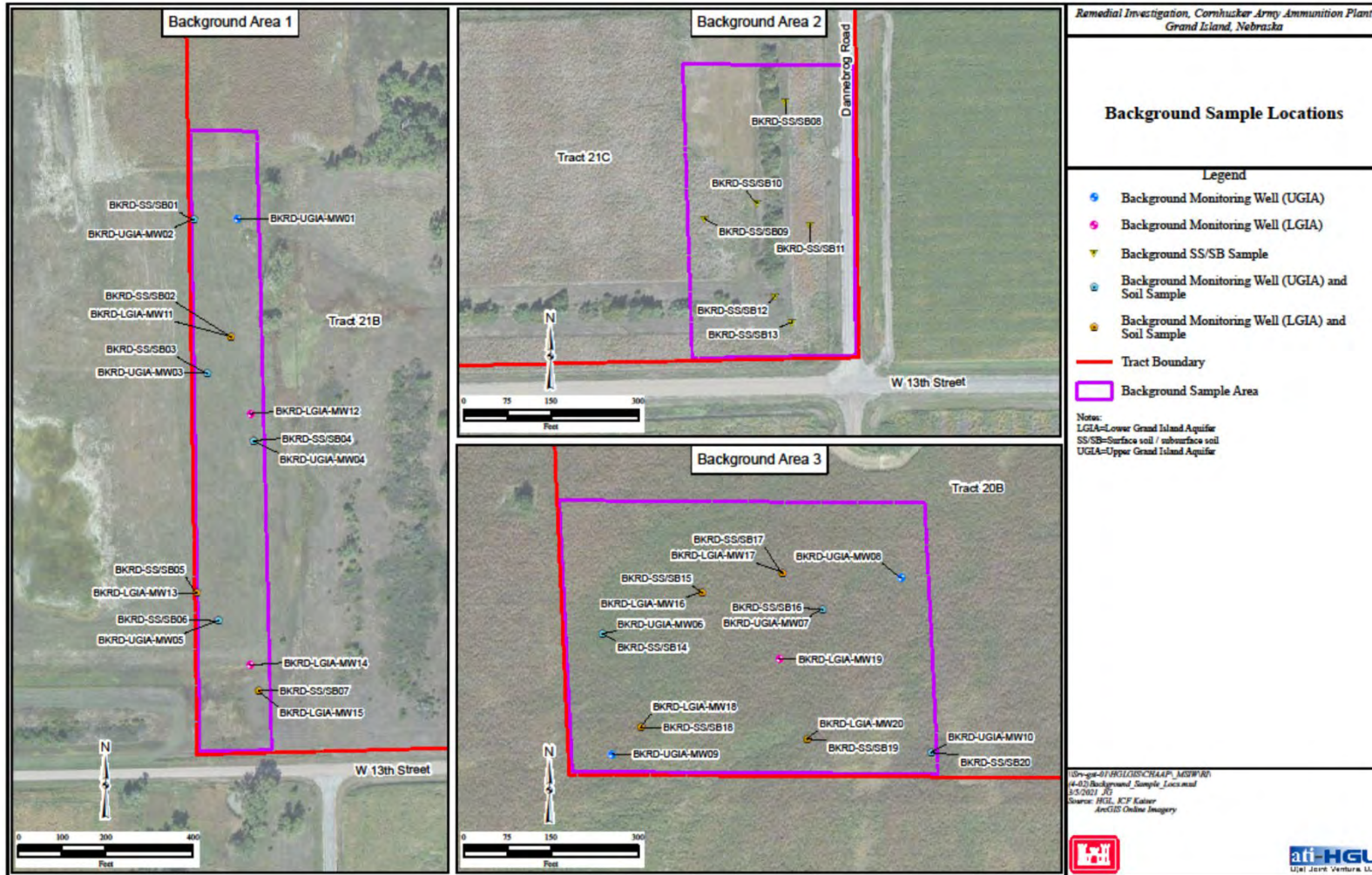
Matrix	Sampling Details	Analytical Parameters	Chemicals of Interest
Three Background Areas – soil and groundwater similar to evaluated sites but outside of known contamination			
Area 1 (Southwest of Tract 21B)	7 surface soil and 7 subsurface soil samples collected at randomly selected locations to calculate background threshold values (BTVs)	<ul style="list-style-type: none"> • VOCs • PAHs • Explosives • Metals 	VOCs: establish absence PAHs: establish BTVs Explosives: establish absence Metals: establish BTVs
Area 2 (Southeast of Tract 21C)	6 surface soil and 6 subsurface soil samples collected at randomly selected locations to calculate BTVs	<ul style="list-style-type: none"> • VOCs • PAHs • Explosives • Metals 	VOCs: establish absence PAHs: establish BTVs Explosives: establish absence Metals: establish BTVs
Area 3 (Southwest of Tract 20B)	7 surface soil and 7 subsurface soil samples collected at randomly selected locations to calculate BTVs	<ul style="list-style-type: none"> • VOCs • PAHs • Explosives • Metals 	VOCs: establish absence PAHs: establish BTVs Explosives: establish absence Metals: establish BTVs
Groundwater (Areas 1 and 3)	10 monitoring well locations screened within the upper Grand Island Aquifer and 10 monitoring well locations screened within the lower Grand Island Aquifer	<ul style="list-style-type: none"> • VOCs • PAHs • Explosives • Metals 	VOCs: establish absence PAHs: establish BTVs Explosives: establish absence Metals: establish BTVs

VOCs – volatile organic compounds

PAHs – polynuclear aromatic hydrocarbons



Background Sample Locations



Tract 19B

(Property east of Demolition Burning Grounds)

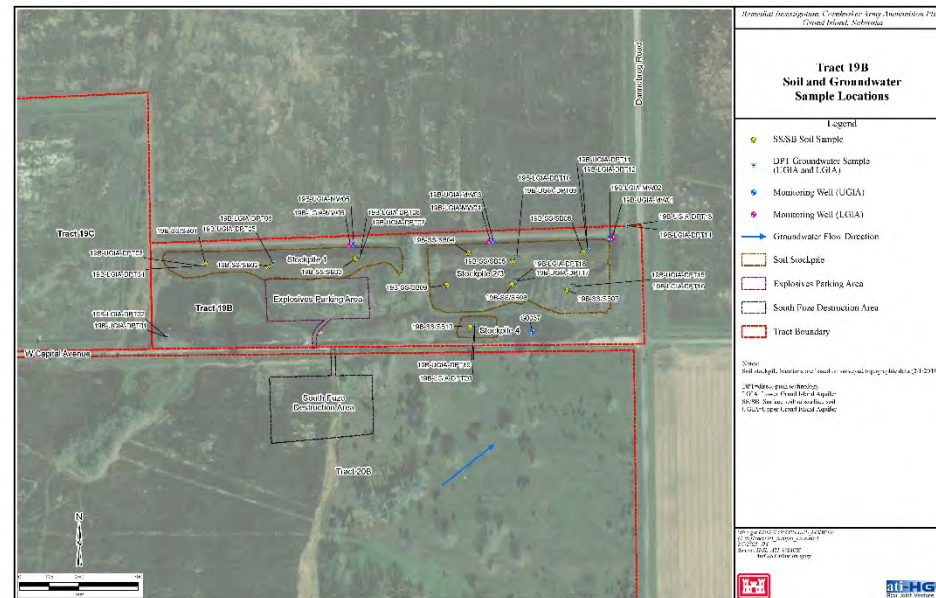
Field Activities and Sampling:

Matrix	Sampling Details	Analytical Parameters	Chemicals of Interest
Topographic survey identified four stockpiled soil areas.			
Stockpiled Soil	163 composite samples from top, middle, and base of each 800 cubic yard (cy) portion of @131,000 cy of stockpiled soil	<ul style="list-style-type: none"> Explosives Metals 	Explosives: cyclotrimethylenetrinitramine (RDX); 2,4,6-trinitrotoluene (TNT); 2-amino-4,6-dinitrotoluene (2-Am-DNT); 4-amino-2,6-dinitrotoluene (4-Am-DNT) Metals: Aluminum; Arsenic; Lead
SPLP	20 composite samples from stockpiled soil to further evaluate potential contaminant leaching	<ul style="list-style-type: none"> SPLP Explosives SPLP Metals 	Explosives: RDX, TNT, and 2,4-DNT Metals: Multiple
Native Soil	10 surface soil and 10 subsurface soil samples from across Tract 19B to evaluate impact to native soil from contaminants in stockpiled soil	<ul style="list-style-type: none"> Explosives Metals 	Metals: Arsenic
Groundwater	10 Direct Push Technology (DPT) locations upgradient, downgradient, and within suspected source areas; screened within UGIA and LGIA 3 monitoring well locations screened within UGIA and LGIA	<ul style="list-style-type: none"> VOCs Explosives Metals 	Metals: Manganese

*Stockpiled soil and native soil/groundwater are evaluated as separate media in RI to determine whether stockpiled soil requires off-site disposal
SPLP – synthetic precipitation leaching procedure



Tract 19B Sample Locations



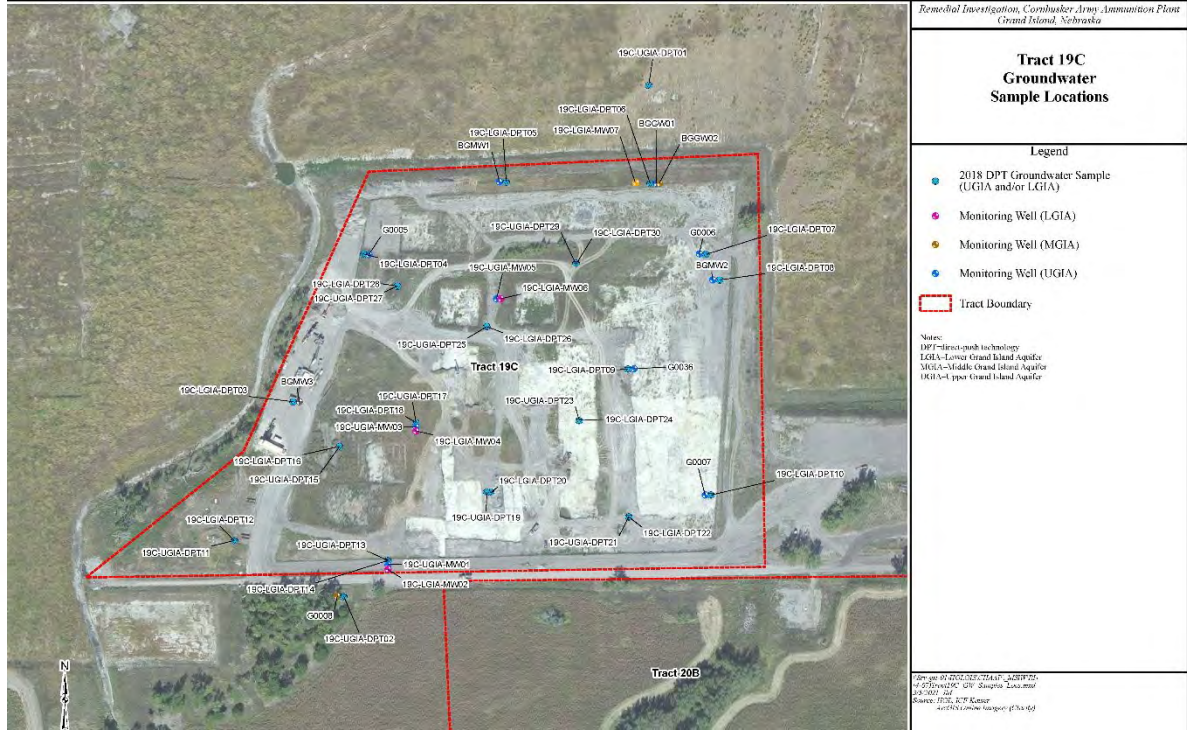
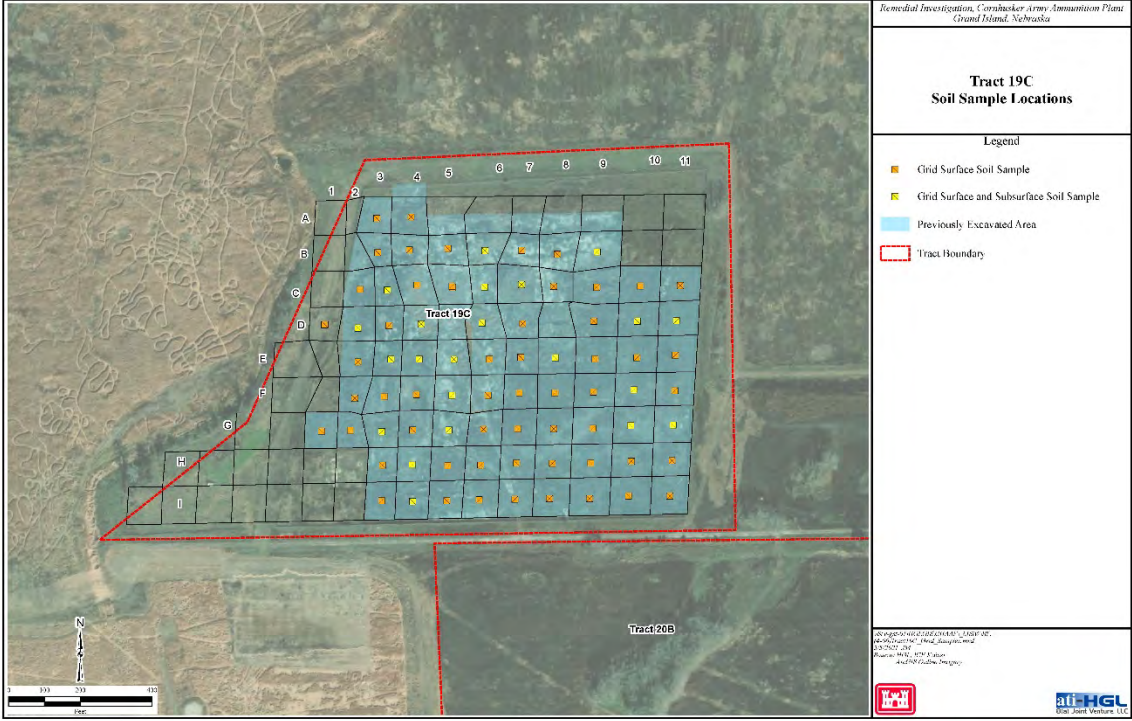
Tract 19C (Demolition Burning Grounds)

Field Activities and Sampling

Matrix	Sampling Details	Analytical Parameters	Chemicals of Interest
Surface Soil	<ul style="list-style-type: none"> 77 grid sample locations from previous removal (5-point composite surface oil samples from each grid) 	<ul style="list-style-type: none"> PAHs Explosives Metals 	Explosives: RDX, Nitrobenzene Metals: Arsenic; Manganese
Subsurface Soil	<ul style="list-style-type: none"> 25 samples collected between 4.5 and 8 feet below ground surface (bgs) - above water table 		
Groundwater	<ul style="list-style-type: none"> 30 groundwater samples collected from 15 locations (DPT paired with existing wells for paired upper and LGIA samples) 7 new monitoring wells (3 UGIA/3 LGIA installed) 	<ul style="list-style-type: none"> VOCs PAHs Explosives Metals 	VOCs: Freon 113 Metals: Arsenic; Manganese



Tract 19C



Tract 20B

(Fuze Destruction Area)

- Field Activities and Sampling:

Matrix	Sampling Details	Analytical Parameters	Chemicals of Interest
Surface and Subsurface Soil	<ul style="list-style-type: none"> 6 surface soil samples collected (0 to 0.5 feet bgs) 12 subsurface soil samples collected at select depths to 10 feet bgs at the above 6 locations Initial soil samples analyzed for PAHs, explosives, and metals 3 stepout surface soil samples analyzed only for RDX and/or explosives 15 stepout subsurface soil samples at 6 locations analyzed only for RDX, explosives, arsenic, and/or hexavalent chromium 	<ul style="list-style-type: none"> PAHs Explosives Metals 	Explosives: RDX
Groundwater	<ul style="list-style-type: none"> 8 monitoring wells (4 UGIA/4 LGIA) installed and analyzed for VOCs, PAHs, explosives, and metals 3 UGIA wells installed for the RI and, with existing well G0064, analyzed for RDX 	<ul style="list-style-type: none"> VOCs PAHs Explosives Metals 	Explosives: RDX



MMRP Field Effort Overview

Tract 20B

- Mobilized 26 May 2020
- Conducted onsite training and site preparation activities
 - Established GPS control points and site boundaries
 - Installed Instrument Verification Strip (IVS) and blind seeds
 - Conducted surface sweep and brush clearance
- Conducted Digital Geophysical Mapping (DGM) and excavated targets at:
 - 1) South Fuze Destruction Area (SFDA)
 - 2) Abandoned Burning Area (ABA)
- No munitions and explosives of concern (MEC) identified
- Inspected, shipped, and demilitarized 4.9 pounds of material documented as safe (MDAS)
- Demobilized 3 June 2020



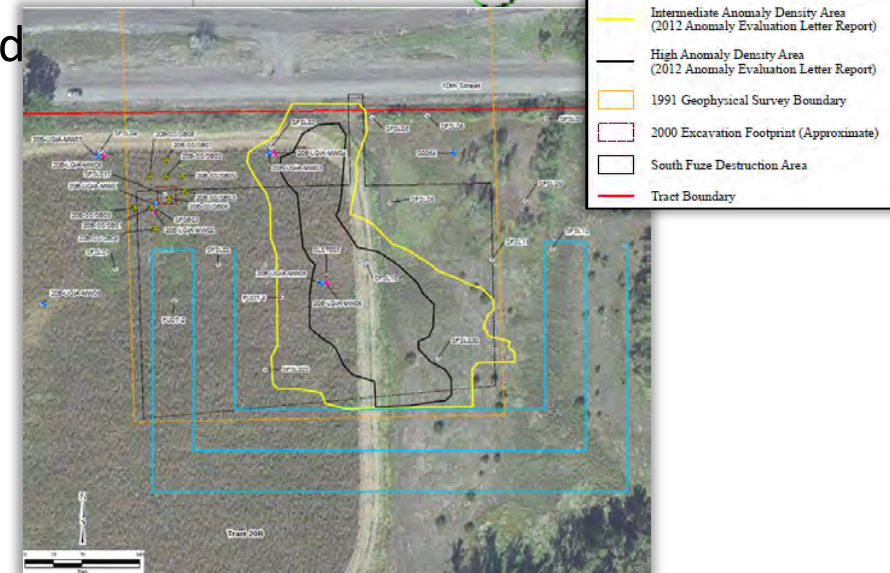
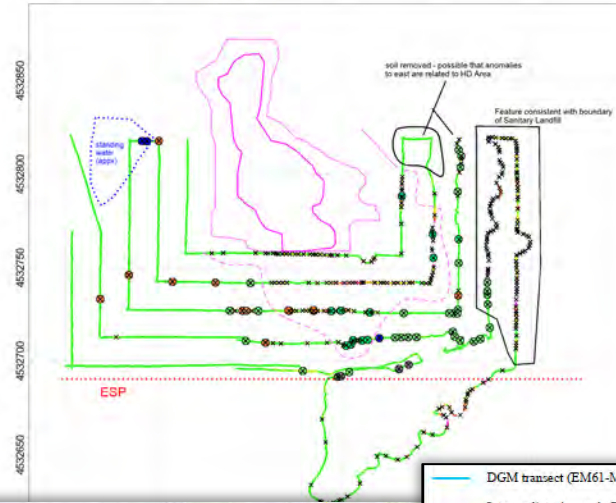
Demil Metals, Inc. demilitarized 4.9 pounds of MDAS



SFDA Investigation Summary

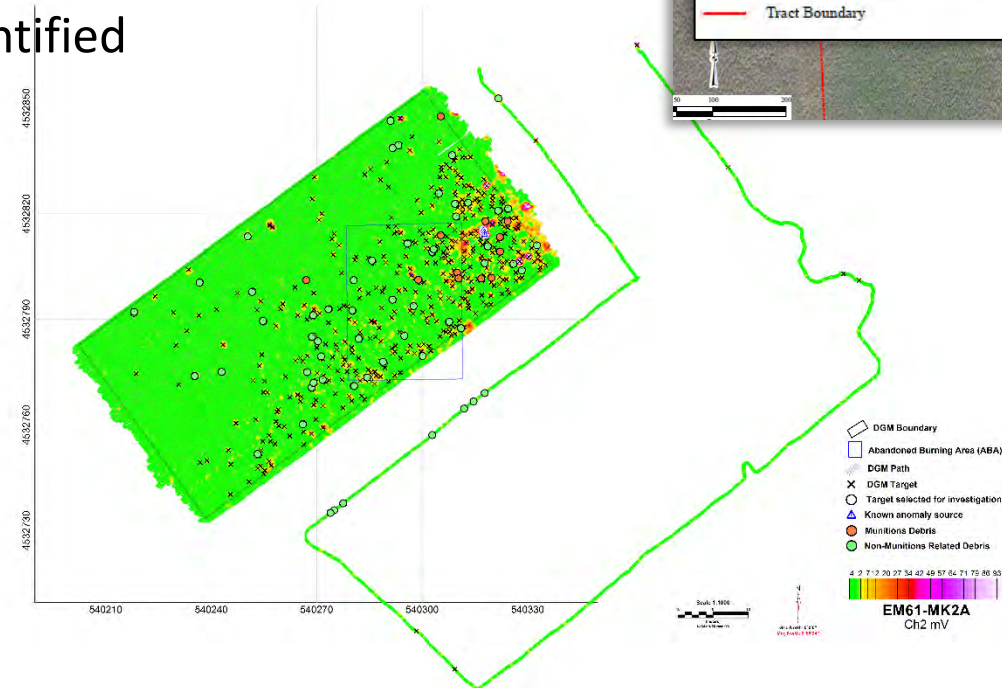
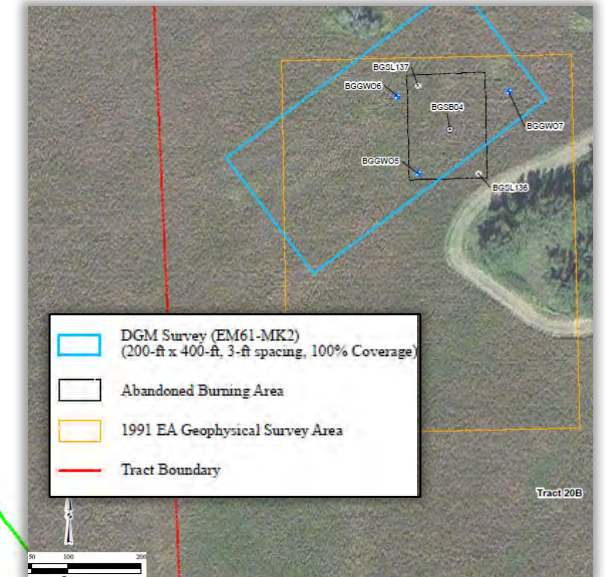
Tract 20B

- Investigate area with high density of anomalies where munitions debris (MD) straddles the border of investigated area
- DGM parallel transects
 - Planned 375-foot × 375-foot site at 50-foot spacing (~3,000 total feet [~0.2 acres])
 - Step-out transects until no MEC or MD identified
 - Actual DGM completed = 6,036.75 total feet
- Excavate targets that exceed project threshold
 - Planned for max of 50 targets
 - Number of targets excavated = 60



ABA Investigation Summary Tract 20B

- DGM to investigate region of higher ground conductivity identified in the 1991 geophysical survey
- Full coverage DGM at 2.5-foot transect spacing
 - Planned 100 feet × 150 feet + 100 feet buffer (~1.6 acres)
 - Step-out transects until no MEC or MD identified
 - Actual DGM completed = 1.84 acres
- Excavate targets that exceed project threshold
 - Planned for max of 25 targets
 - Number of targets excavated = 61



Tract 21B

Subareas	Matrix	Sampling Details	Analytical Parameters	Chemicals of Interest
Subareas: Burning Pit Area, Backstop Berm/Static Ejection Test Site; Decanting Station and Leaching Pit Area;	Surface Soil and Subsurface Soil	<ul style="list-style-type: none"> Burning Pit Area: 22 surface soil samples collected (0 to 0.5 feet bgs) 20 subsurface soil samples collected (3-4 and 7-8 feet bgs at 8 sample locations; 4-5 feet bgs at two soil sample locations; and 2-3 and 5-6 feet bgs at one of sample location) Backstop Berm/Static Ejection Test Site: 6 surface soil samples collected (0 to 0.5 feet bgs) 6 subsurface soil samples collected (3 to 4 feet bgs) Decanting Station and Leaching Pit Area: 12 surface soil samples collected (0 to 0.5 feet bgs) analyzed for VOCs, explosives, and metals 17 subsurface soil samples collected (12 from 4 to 5 feet bgs, 5 also from 9 to 10 feet bgs) analyzed for VOCs, explosives, and metals 	<ul style="list-style-type: none"> •VOCs •Explosives •Metals 	Burning Pit Area: Metals: Arsenic Backstop Berm and Static Ejection Site: None Decanting Station and Leaching Pit Area: Metals: Arsenic
	Groundwater	<ul style="list-style-type: none"> Burning Pit Area: 12 monitoring wells installed (7 UGIA/5 LGIA) 8 monitoring wells installed for the RI were sampled with 4 existing monitoring wells and analyzed for VOCs, explosives, and metals. Additional sampling of wells based on initial sampling results. Firing Range Backstop Berm/Static Ejection Test Site: 4 groundwater samples: UGIA/LGIA backstop berm well pair analyzed for metals only; Static Ejection Test Site well pair analyzed for explosives and metals. Decanting Station and Leaching Pit Area 7 UGIA/LGIA well pairs (newly installed and existing) sampled for VOCs, explosives and metals; 3 additional newly installed UGIA and 3 additional newly installed LGIA wells analyzed only for Freon 113 	<ul style="list-style-type: none"> •VOCs •Explosives •Metals 	BPA: VOCs: Freon 113 Explosives: RDX Backstop Berm and Static Ejections Site: None Decanting Station and Leaching Pit: VOCs: Freon 113



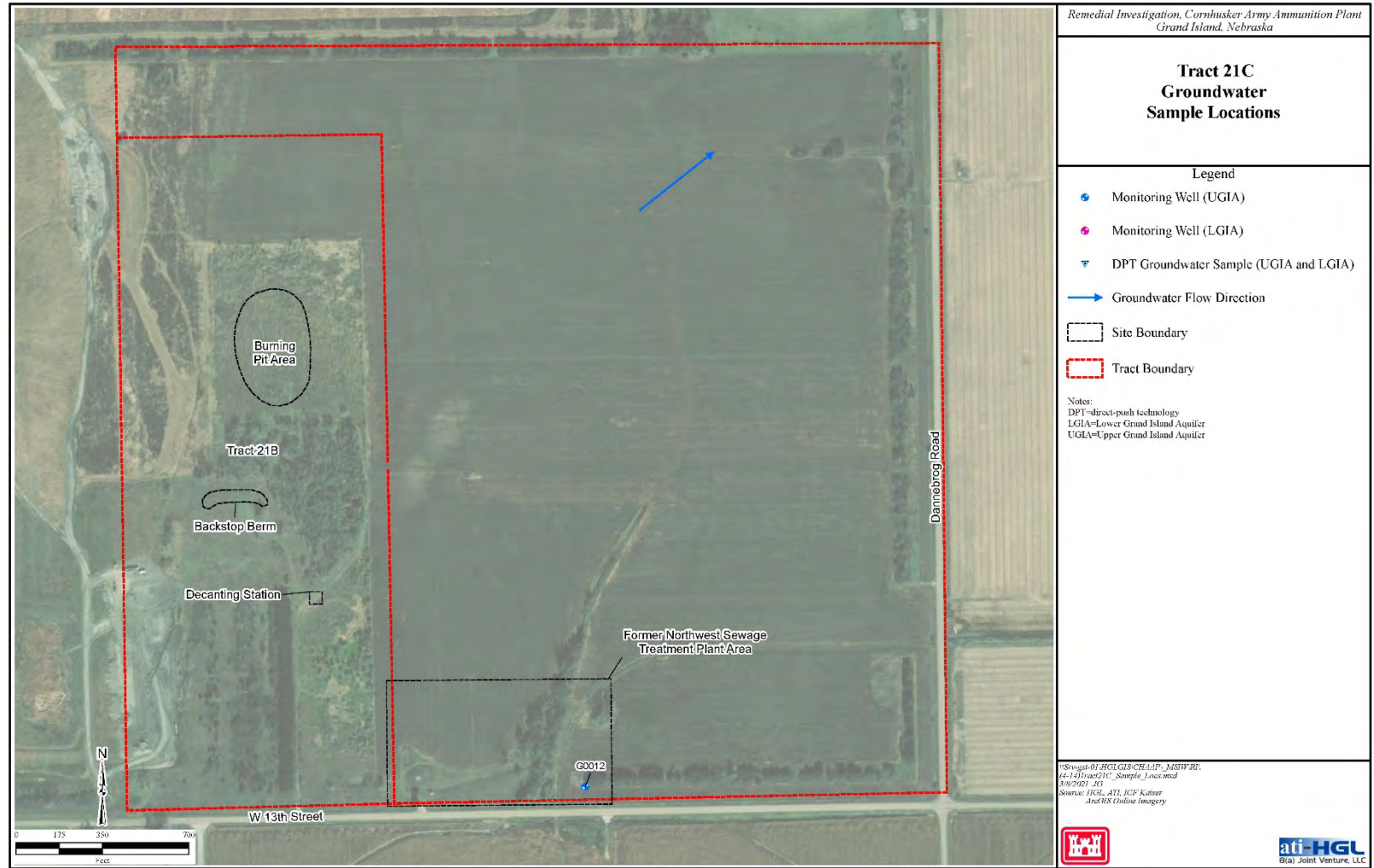
Tract 21C (Property east of Tract 21B)

Field Activities and Sampling:

Matrix	Sampling Details	Analytical Parameters	Chemicals of Interest
Groundwater	30 groundwater samples analyzed <ul style="list-style-type: none">• 20 DPT groundwater samples collected (10 UGIA/10 LGIA)• 10 monitoring wells (5 UGIA/10 LGIA) installed	<ul style="list-style-type: none">• VOCs• Explosives	VOCs: Freon 113

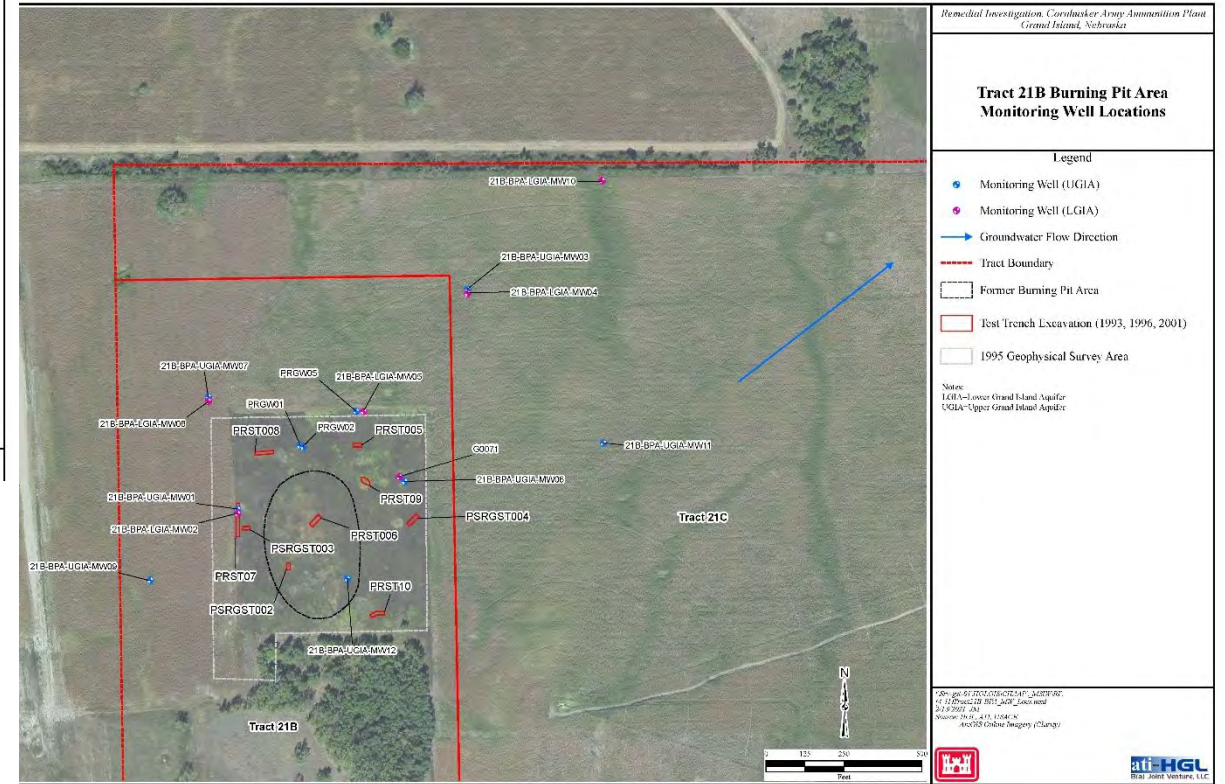
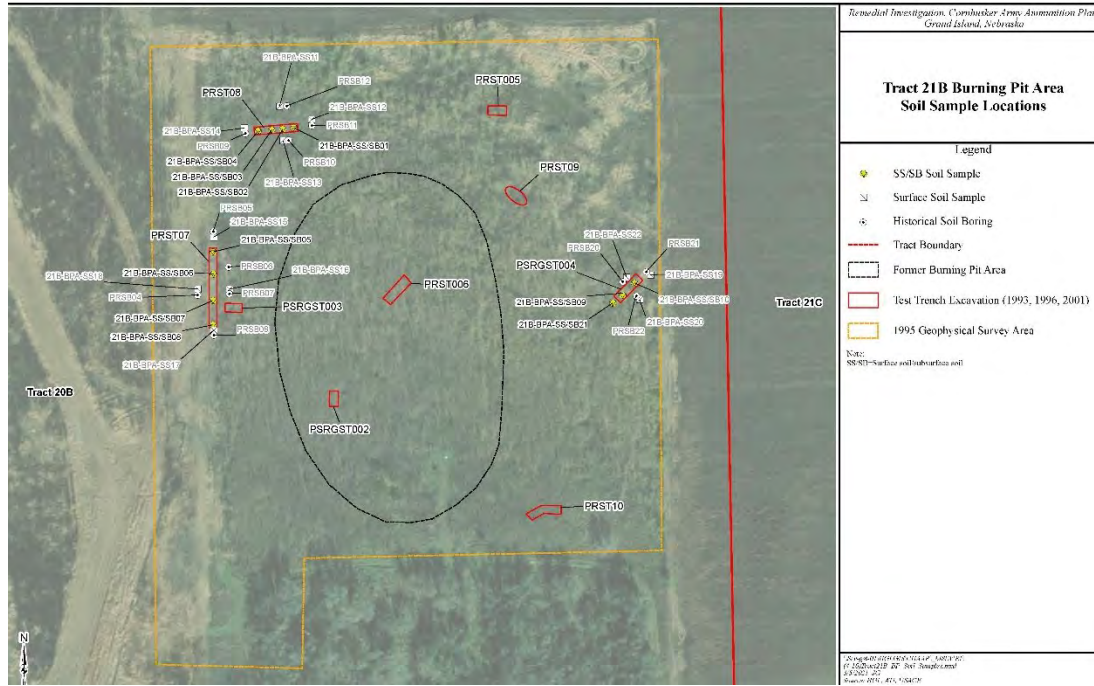


Tract 21B and 21C Sites



Tract 21B

Burning Pit Area Sampling Locations



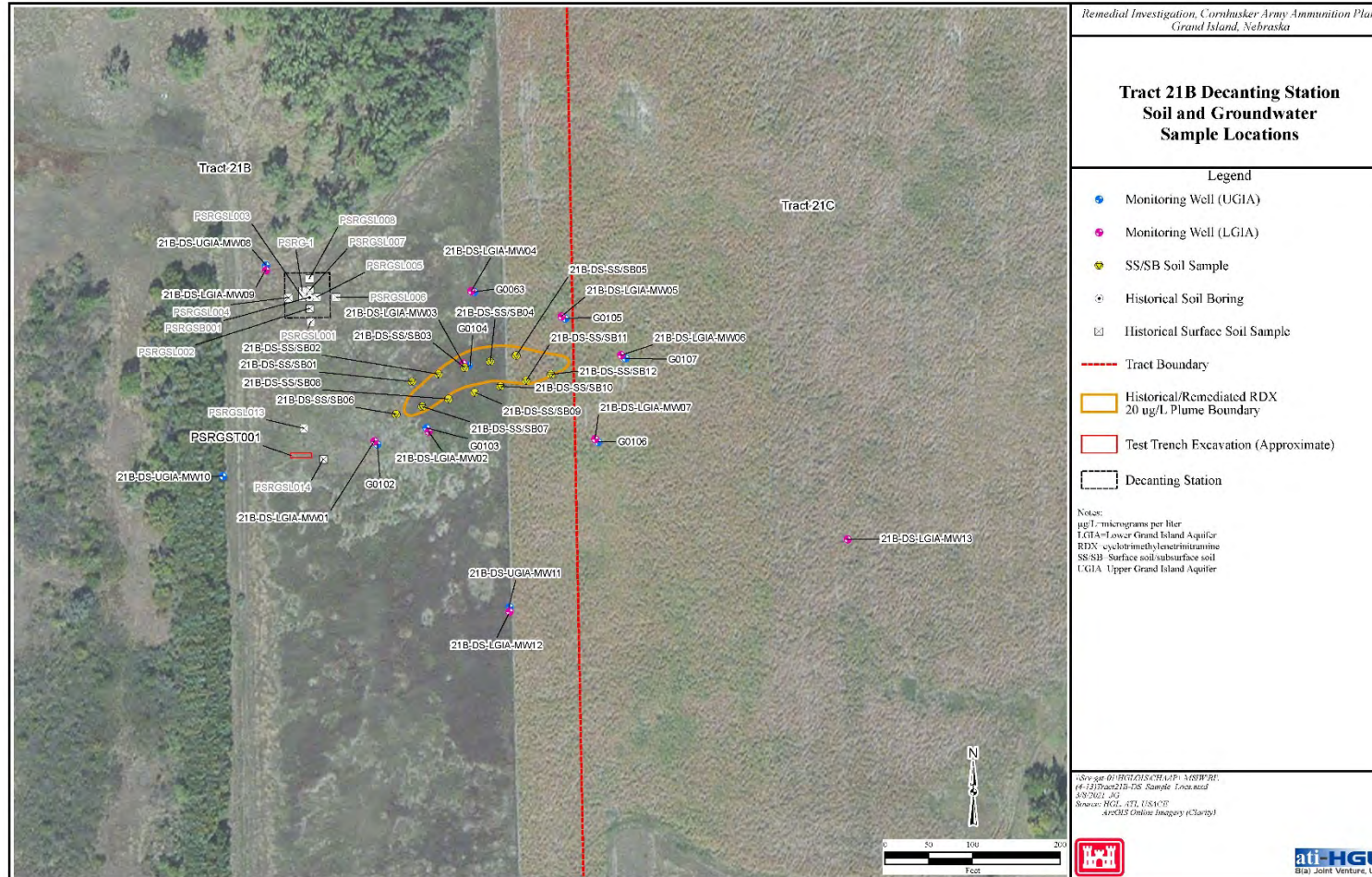
Tract 21B

Backstop Sampling Locations

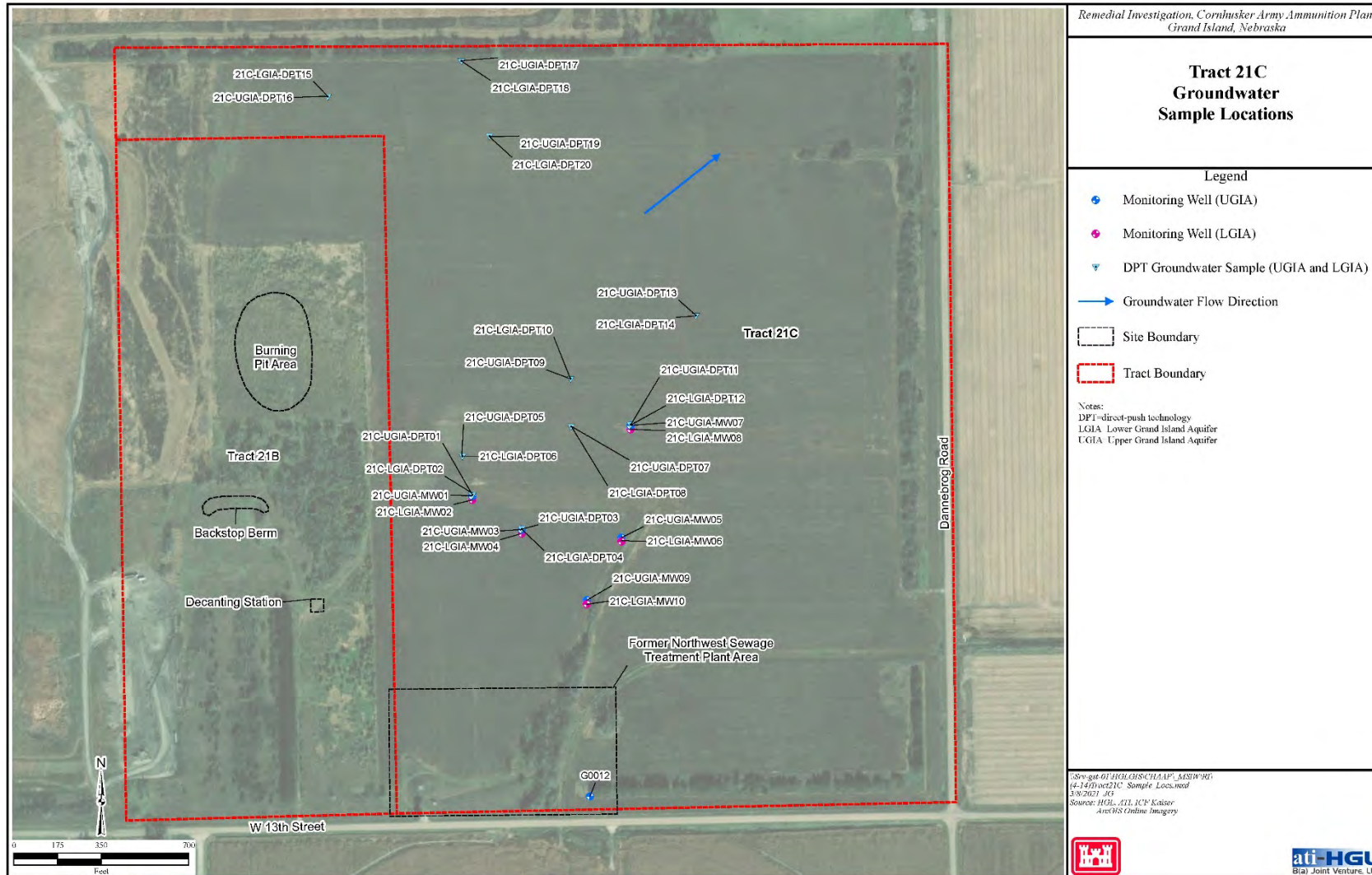


Tracts 21B

Decanting Station Sampling Locations



Tract 21C Sampling Locations



RI Conclusions

- Tract 21B-Backstop Berm and Static Ejection Site does not pose an unacceptable risk to human health and the environment; no further action recommended
- Tract 21C groundwater contamination should be merged with the upgradient source at Tract 21B-Decanting Station for FS
- Feasibility Study recommended for

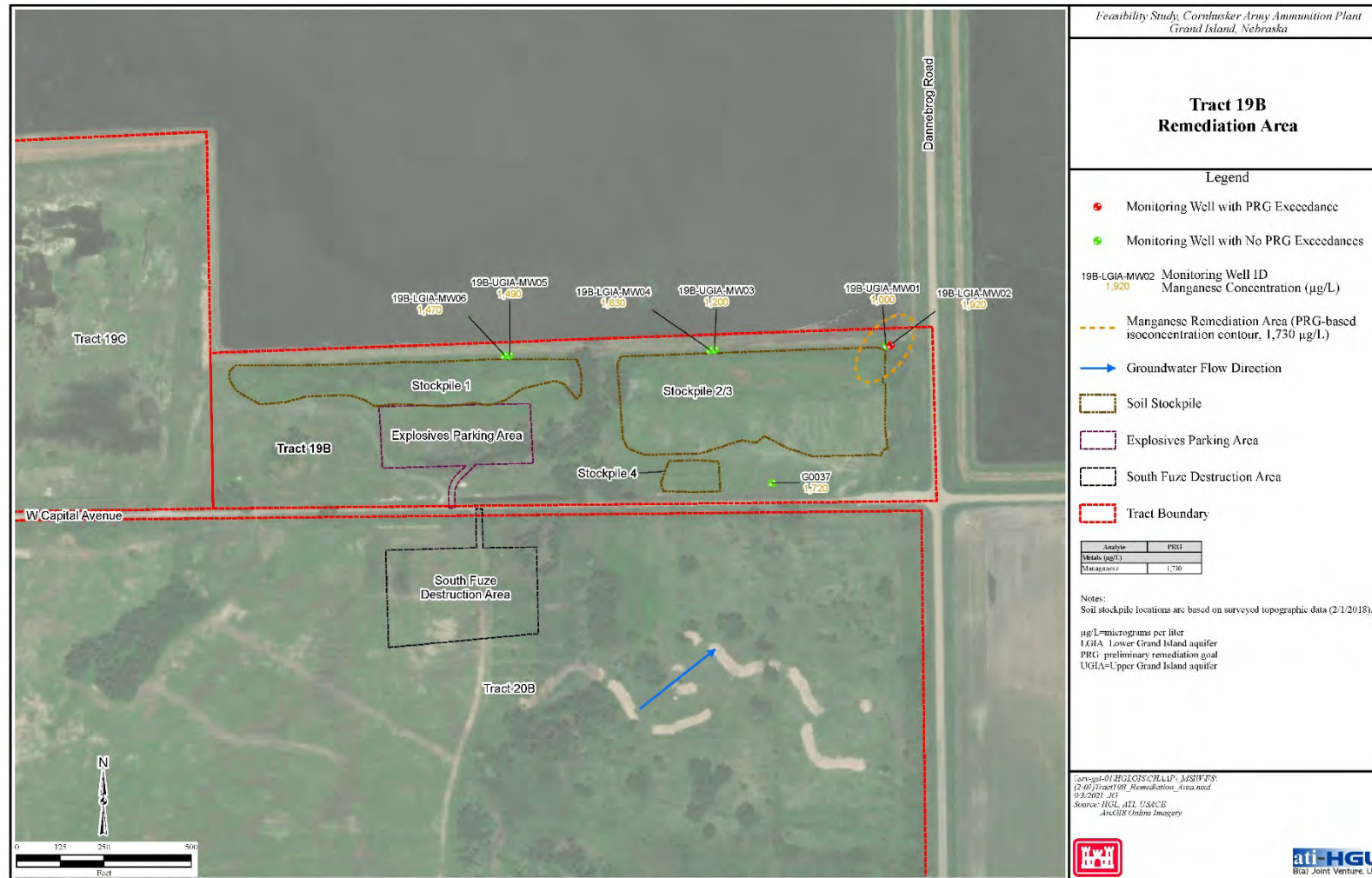
Tract	Soil Preliminary COCs	Groundwater Preliminary COCs
Tract 19B	Aluminum, manganese, explosives (stockpiled soil)	Manganese
	Aluminum manganese (native soil)	
Tract 19C	Arsenic	Freon 113, dichlorodifluoromethane
Tract 20B	Aluminum, arsenic, MEC*	RDX
Tract 21B – BPA	None	Freon 113, dichlorodifluoromethane, biphenyl
Tract 21B – Decanting Station/21C	None	Freon 113, dichlorodifluoromethane

Notes:

*FS recommended to evaluate MEC response actions at Tract 20B for the high use and low use areas at the South Fuze Destruction Area and Abandoned Burning Area MRSS.



Tract 19B Remediation Area



RAAs:

- RAA 1: No Action
- RAA 3: Land Use Controls (LUCs) and monitored natural attenuation (MNA)*
- RAA 4: In situ stabilization*

* Remedy includes removal and offsite disposal of stockpiled soil as nonhazardous waste.



Tract 19B RAOs*

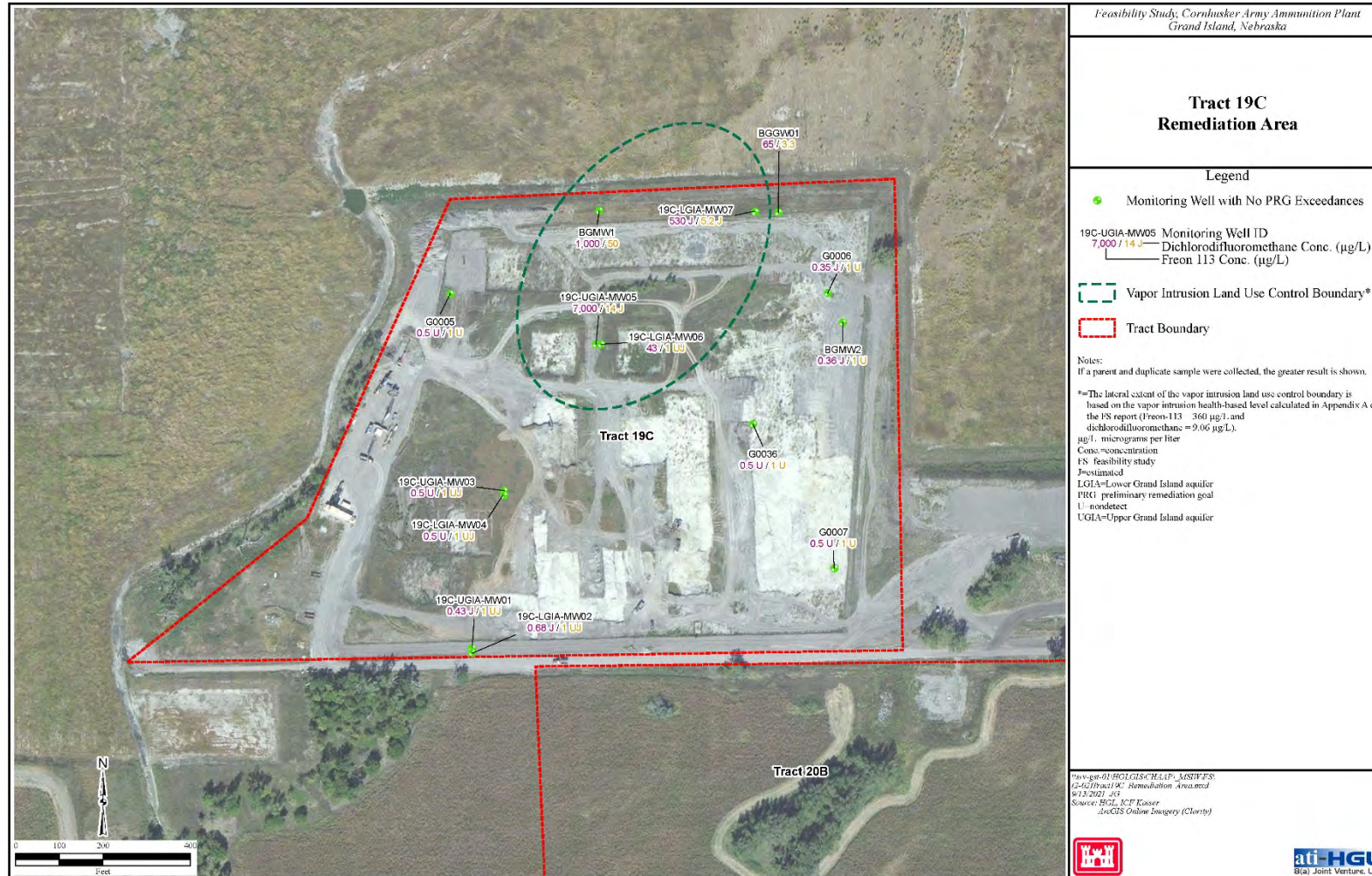
- Prevent human ingestion of and dermal contact with stockpiled soil with TNT concentrations greater than the recommended PRG of 3,618 milligrams per kilogram (mg/kg).
- Prevent leaching of RDX, TNT, 2-Am-DNT, 4-Am-DNT, aluminum, antimony, arsenic, chromium, cobalt, iron, lead, mercury, thallium, and vanadium from the stockpiled soil to groundwater at concentrations greater than the soil SPLP preliminary remediation goals** (PRGs).
- Prevent human ingestion of and dermal contact with Tract 19B groundwater with manganese concentrations greater than the recommended PRG of 1,730 micrograms per liter ($\mu\text{g/L}$) (the BTV for manganese in groundwater).
- Protect human health and the environment by preventing exposure to contaminated on-site groundwater.
- Prevent further degradation of the groundwater.
- Prevent further contaminant migration in the groundwater.
- Restore the aquifer to the recommended PRG within a reasonable timeframe (i.e., 20-30 years).

*Note: All RAOs or Remedial Action Objectives for each Tract are proposed at this time until the FS has been approved.

**Note: The RI results and conclusions were used to identify the contaminants of concern (COCs) and support development of the remedial action objectives (RAOs) and preliminary remediation goals (PRGs). PRGs are the preliminary contaminant concentrations that the remedial alternatives will need to achieve and are derived from several sources: chemical-specific ARARs; risk-based calculations; TBC criteria; and background concentrations.



Tract 19C Remediation Area



RAAs:

- RAA 1: No Action
- RAA 2: LUCs

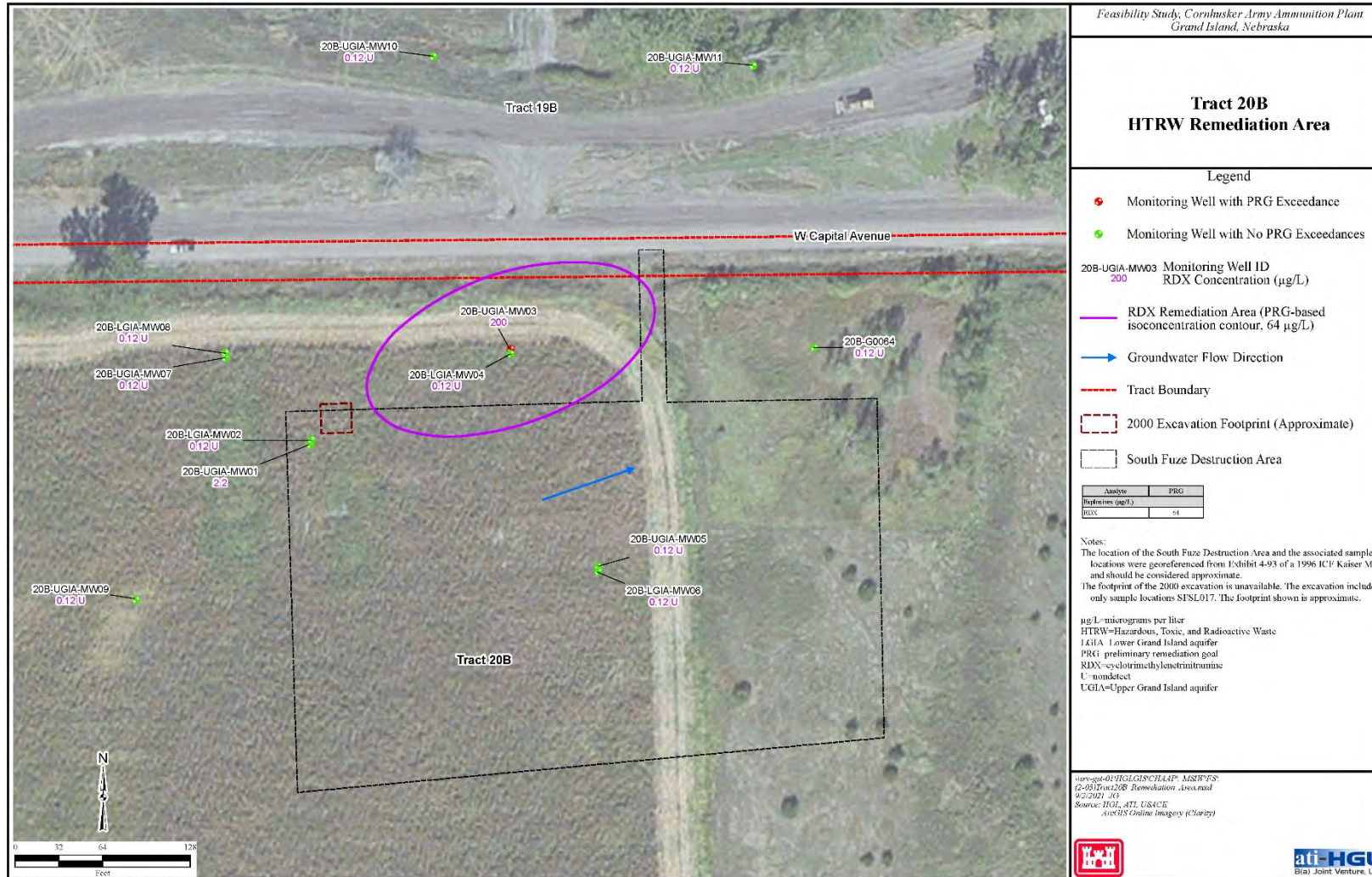


Tract 19C RAOs

- Prevent inhalation exposure to Freon 113 and dichlorodifluoromethane in indoor air from the vapor intrusion pathway that would result in a target organ hazard index (HI) greater than 1.
- Prevent further degradation of the groundwater.
- Prevent further contaminant migration in the groundwater.



Tract 20B HTRW Remediation Area



Tract 20B MRS Remediation Areas



Tract 20B Proposed RAOs

HTRW

- Prevent human ingestion of and dermal contact with Tract 20B groundwater with RDX concentrations greater than the PRG of 64 µg/L.
- Protect human health and the environment by preventing exposure to contaminated on-site groundwater.
- Prevent further degradation of the groundwater.
- Prevent further contaminant migration in the groundwater.
- Restore the aquifer to PRG within a reasonable timeframe (i.e., 20-30 years).

MEC

- Eliminate exposure and interaction with potential MEC such that a negligible risk to human receptors can be demonstrated in the South Fuze Destruction Area MRS and the Abandoned Burning Area MRS.



Tract 20B RAAs

HTRW

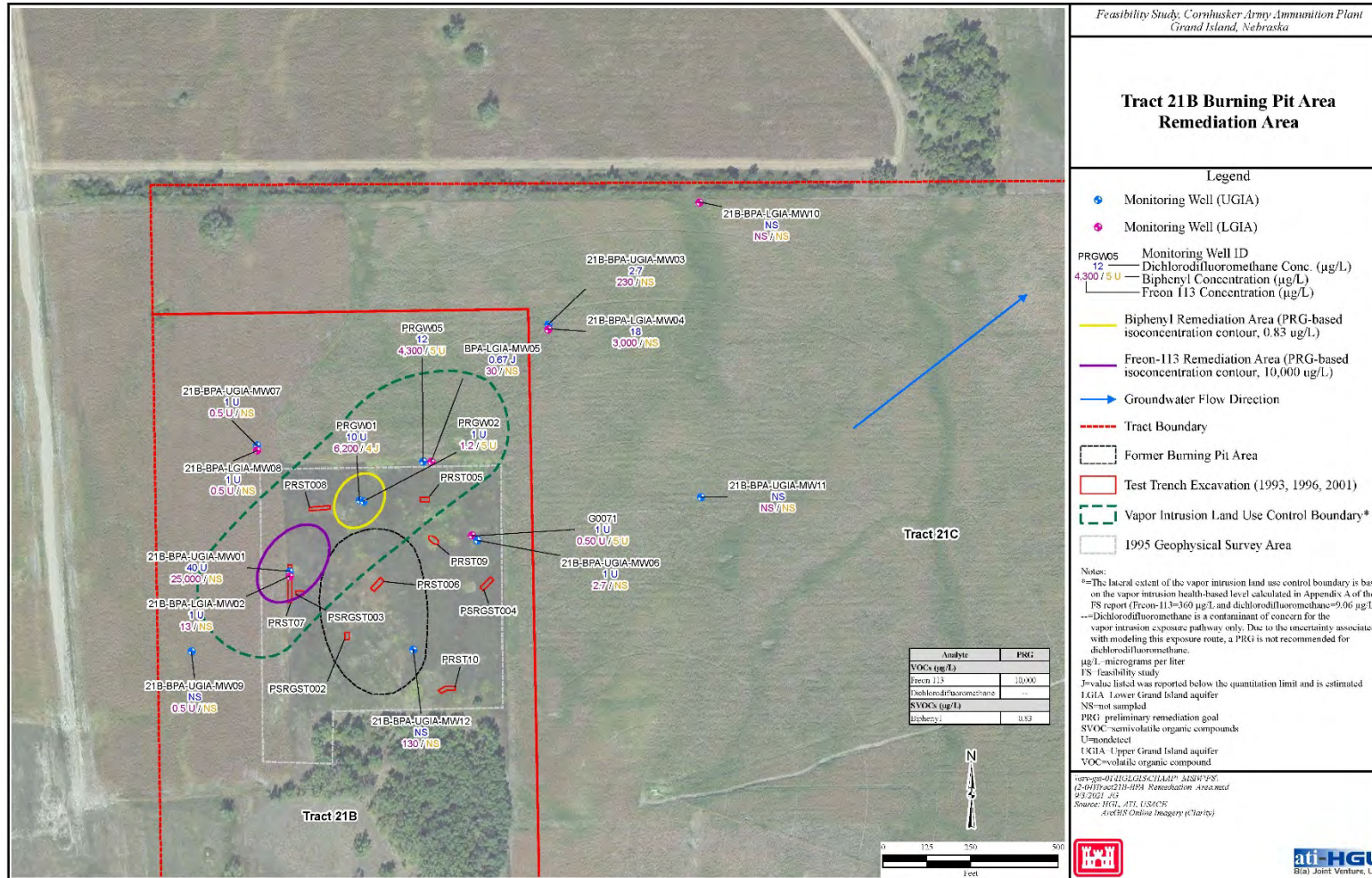
- RAA 1: No Action
- RAA 3: LUCs and MNA
- RAA 5: ISCO (In Situ Chemical Oxidation)
- RAA 6: ISCO and MNA
- RAA 7: In situ enhanced biodegradation
- RAA 8: In situ enhanced biodegradation and MNA

MEC

- RAA 1: No Action
- RAA 11: LUCs
- RAA 12: Focused subsurface removal in the high density area, surface removal in remaining 2,400-foot radius buffer area, and LUCs
- RAA 13: Focused subsurface removal in the high density area and expansion, surface removal over half of remaining 2,400-foot radius buffer area, and LUCs
- RAA 14: Complete surface and subsurface removal over the 2,400-foot radius buffer area



Tract 21B-Burning Pit Area Remediation Area



RAAs

- RAA 1: No Action
- RAA 3: LUCs and MNA
- RAA 5: ISCO
- RAA 7: In situ enhanced biodegradation

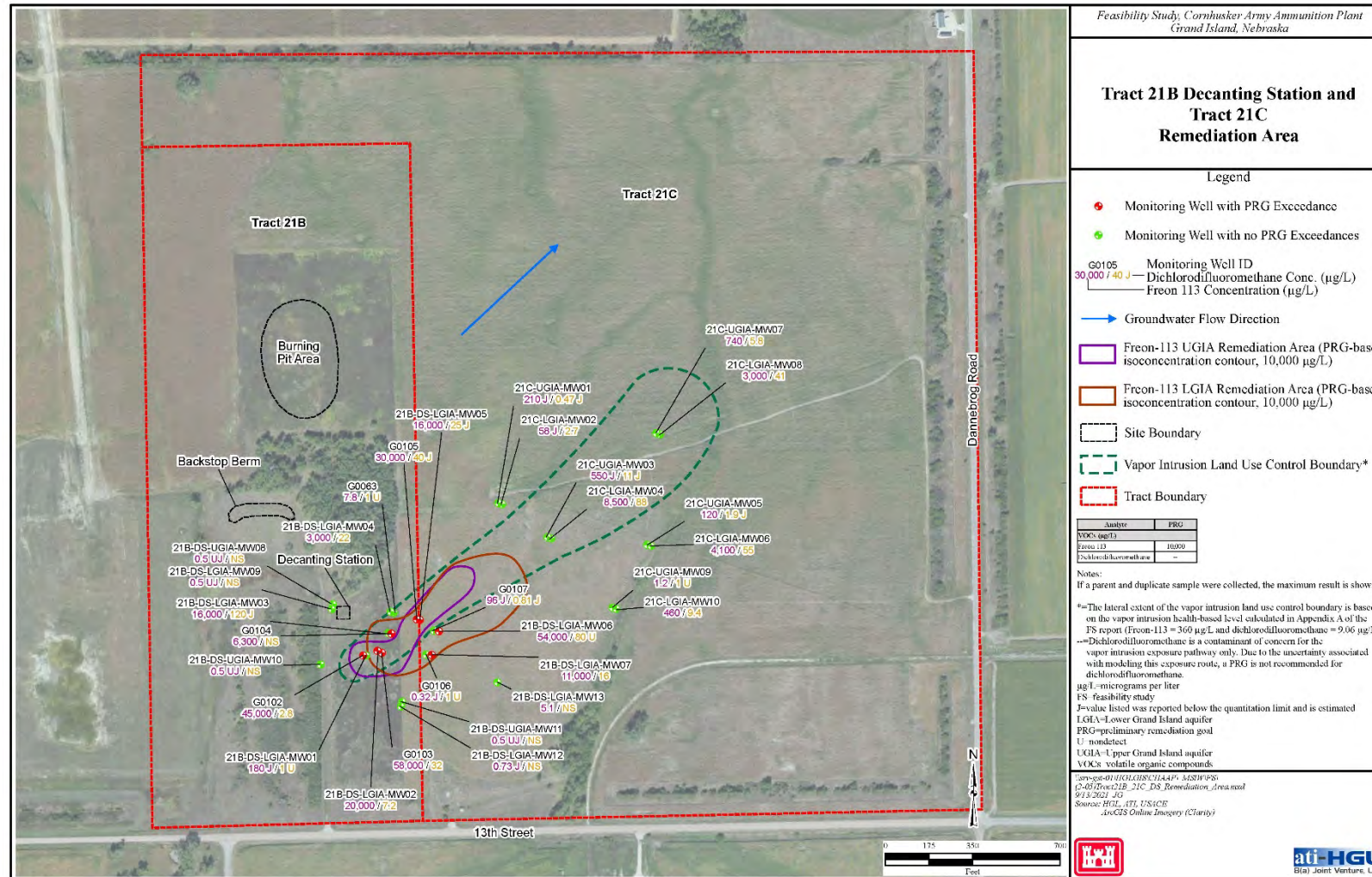


Tract 21B-Burning Pit Area RAOs

- Prevent human inhalation of biphenyl released to indoor air during potable water use of Tract 21B-BPA groundwater with biphenyl concentrations greater than the recommended PRG of 0.83 µg/L.
- Prevent human inhalation of Freon 113 and dichlorodifluoromethane in indoor air or air in an excavation from the vapor intrusion pathway that would result in a target organ HI greater than 1.
- Prevent human inhalation of Freon 113 and dichlorodifluoromethane in indoor air from the vapor intrusion pathway that would result in a target organ HI greater than 1.
- Protect human health and the environment by preventing exposure to contaminated on-site groundwater.
- Prevent further degradation of the groundwater.
- Prevent further contaminant migration in the groundwater.
- Restore the aquifer to PRGs within a reasonable timeframe (i.e., 20-30 years).



Tract 21B-Decanting Station Remediation Area



Tract 21B-Decanting Station RAOs

- Prevent human inhalation of Freon 113 released to indoor air during potable water use of Tract 21B-DS/21C groundwater with Freon 113 concentrations greater than the recommended PRG of 10,000 µg/L.
- Prevent human inhalation of Freon 113 and dichlorodifluoromethane in indoor air or air in an excavation from the vapor intrusion pathway that would result in a target organ HI greater than 1.
- Protect human health and the environment by preventing exposure to contaminated on-site groundwater.
- Prevent further degradation of the groundwater.
- Prevent further contaminant migration in the groundwater.
- Restore the aquifer to PRGs within a reasonable timeframe (i.e., 20-30 years).

Tract 21B-Decanting Station RAAs

- RAA 1: No Action
- RAA 3: LUCs and MNA
- RAA 5: ISCO
- RAA 6: ISCO and MNA
- RAA 7: In situ enhanced biodegradation
- RAA 8: In situ enhanced biodegradation and MNA
- RAA 9: Air sparging
- RAA 10: Air sparging and MNA



Reporting Review

- RI Report
 - Final Report December 2021
- Feasibility Study Report
 - Draft Report in review
 - Draft Final and Final Winter 2021/2022

