US Army Corps of Engineers®
Omaha District

Operable Unit 1

Background, History of Past Actions, Explosives Plume Extent, Current Program, and Path Forward

Cornhusker Army Ammunition Plant (CHAAP)
Grand Island, Nebraska

8 September 2022

Prepared by:
Brice Engineering

Introductions

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Agenda

- **Operable Unit 1**
  - **Site Background**
  - **History of OU1 Past Actions**
  - **Historical Extent of OU1 Explosives Plume**
  - **Current OU1 Program**
  - **OU1 Path Forward**
- **Presentation of Groundwater Sampling Activities Near Archer, Nebraska by the Nebraska Department of Environment and Energy (NDEE)**
- **Questions**

Operable Unit 1 Definition

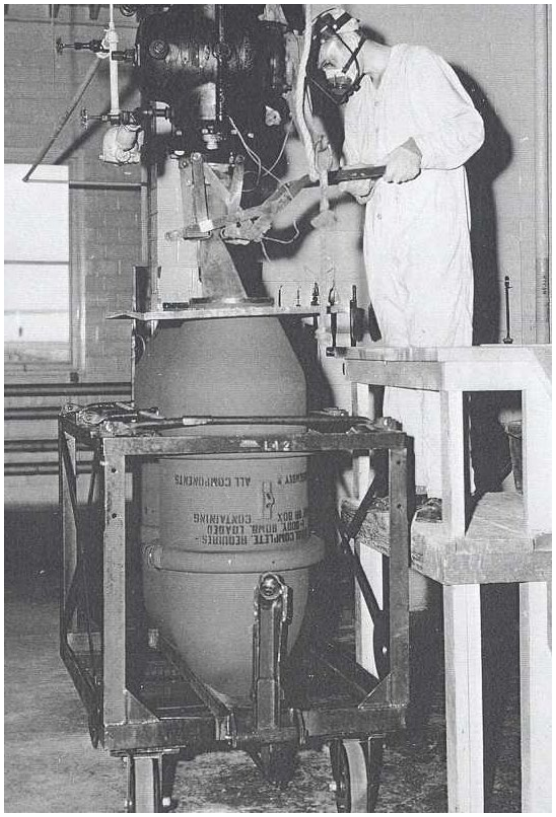
Geographical Area: CHAAP and Areas to Northeast

Specific Problem: Explosives Compounds

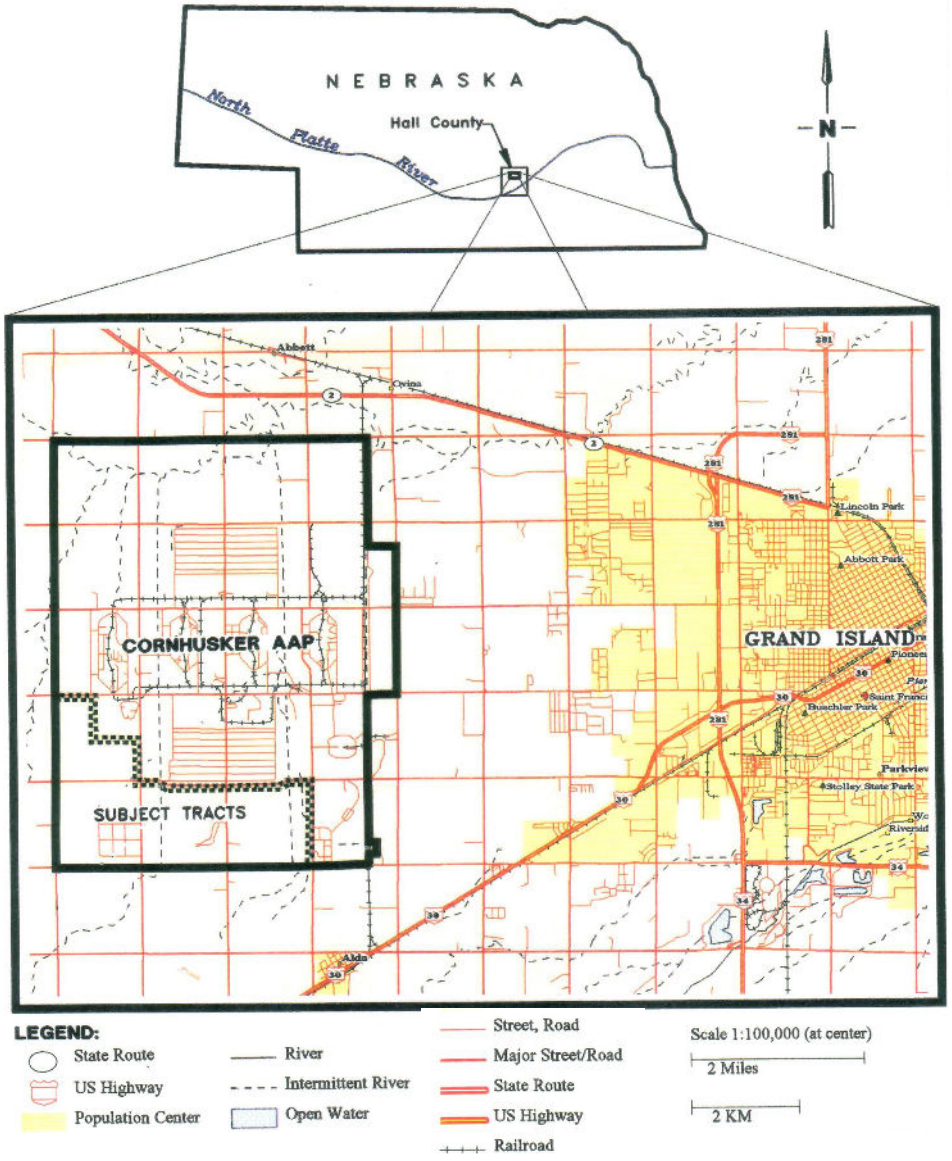
Media: Groundwater

Site Background

- The former CHAAP was located on an 11,936-acre tract approximately 2 miles west of Grand Island, Nebraska. CHAAP was constructed and became fully operational in 1942. CHAAP operated periodically for 18 years and became inactive in 1974 but maintained in a high state of readiness until January 1989 when the plant was declared in excess to Army needs.
- CHAAP includes five former load lines (LL), LL1 through LL5 that were primarily used to load, assemble, and pack 1,000-pound bombs, 2,000-pound bombs, 50-pound fragmentation bombs, 90-pound fragmentation bombs, 105-millimeter projectiles, 90-millimeter projectiles, 3.5-inch high explosive rockets, 4.5-inch high explosive rockets, 155-millimeter high explosive projectiles, A2 fuzes, Micro-Gravel Mines XM45, and supplementary charges in support of World War II, Vietnam Conflict and Korean War.
- Disposal of wastewater (pink water) in unlined leach pits & cesspools resulted in explosives-contaminated groundwater plumes and source areas.



Site Background



Site Background

- CHAAP became a Superfund Site in 1990 and cleanup is being completed under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act.
- The cleanup at CHAAP is managed and funded by the U.S. Army Corps of Engineers and the U.S. Army Environmental Command, with oversight by the U.S. Environmental Protection Agency (USEPA) Region VII and the Nebraska Department of Environment and Energy (NDEE).
- OU1 consists of explosives-contaminated groundwater plumes exceeding Action Levels. Action Levels were established in the 1994 Record of Decision and the Subsequent 2001 Record of Decision Amendment and approved by the Army, USEPA and NDEE.
- USEPA Health Advisory Levels (HALs) were established as Action Levels for hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), 2,4,6-trinitrotoluene (TNT), and octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX).
- The HALs for RDX and TNT are 2 micrograms per liter (µg/L) and 400 µg/L for HMX. Note: 1 µg/L is same as 1 part per billion (PPB) or one cent ($0.01) in $10,000,000.00.

History of OU1 Past Actions

- **Emergency Response – Supply Drinking Water**
  - The Army provided bottled water to 250 homes with contaminated wells until residences were connected to the city's water supply in 1996.
  - In 2001 to 2002, the Army provided bottled water to additional homes with contaminated wells until residences were connected to the city's water supply.
- **Contaminated Soil Removal**
  - From 1987 to 1988, the U.S. Army completed an incineration project designed to excavate and treat soils beneath the unlined leach pits and cesspools at the CHAAP load lines. Only half of the 58 excavations removed explosives to action levels. Some locations may represent continuous source areas to groundwater.
  - After the load line buildings were removed in the early 2000s, soils under building floor slabs and foundations were excavated and disposed of at an appropriate permitted landfill off-site between 2006 and 2007. Soils were removed to eliminate potential exposure to contaminated soils and to remove potential source areas to groundwater.

History of OU1 Past Actions

- **Remedial Investigation - 1996**
  - Previously collected data as well as data collected as part of the Remedial Investigation were used to determine the nature and extent of contamination and to determine the potential impact to human health and the environment. The Remedial Investigation Report is available in the Administrative Records at the Grand Island Public Library, 1124 W 2nd Street, Grand Island, Nebraska.

- Results of the human health risk assessment indicated the following:
  - **Groundwater:** Only explosives were found to be at unacceptable levels. Results of the risk assessment were used in the Feasibility Study to select a cleanup method for the contaminated groundwater. The Army recommended pump and treatment as a cleanup method and the U.S. Environmental Protection Agency, and the Nebraska Department of Environment and Energy (formerly Nebraska Department of Environmental Quality) concurred.
  - **Surface and subsurface soil:** Areas where there were potential discharge of contaminants to the surface were investigated. No unacceptable levels of contamination in surface and subsurface soils.
  - **Surface water and sediment:** No documented discharge of contaminants to surface waters, only unlined leach pits & cesspools. No unacceptable levels of contamination in surface water and sediment.

History of OU1 Past Actions

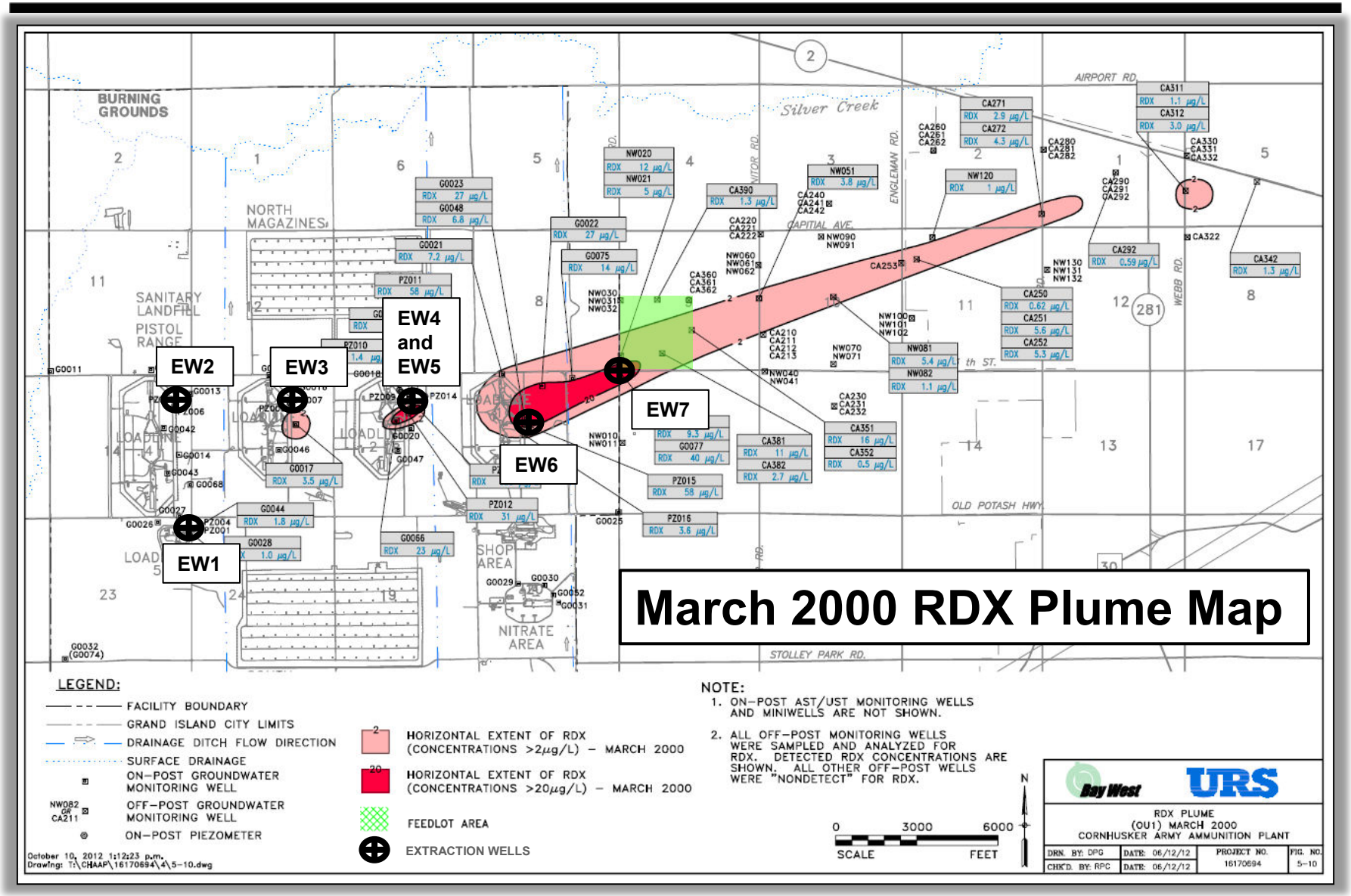
- **Annual Groundwater Monitoring (On- and Off-Post Plume)**
  - Initiated in 1994, includes measuring of site wide water levels and sampling of monitoring wells throughout the explosives plumes. Results are presented in annual reports and presented at annual stakeholder meetings. Annual reports are available in the Administrative Records at the Grand Island Public Library, 1124 W 2nd Street, Grand Island, Nebraska.
- **Groundwater Extraction and Treatment (On-Post Plume)**
  - Operation began in December 1998. The groundwater extraction system included extraction well (EW) 1 through EW6, with a total extraction rate of 750 gallons per minute (gpm). An additional extraction well (EW7) was installed in March 2000. Groundwater is pumped from the ground, run through the treatment system, and the treated water is discharged to the ground so that the water returns to the aquifer. Discharge water is sampled to ensure the water is safe to release.

Granular Activated Carbon Treatment Units

Effluent Piping

On-Post Extraction Well House

History of OU1 Past Actions



History of OU1 Past Actions

- **Implement Monitored Natural Attenuation (Off-Post Plume)**
  - In 2000, Monitored Natural Attenuation (MNA) remedy for the Off-Post plumes was proposed by the Army in the OU1 Record Of Decision document and was approved by the Regulators.
  - MNA is a passive treatment which includes a variety of natural processes that degrade the explosives without any human interaction.
- **Implement Institutional Controls (On- and Off-Post Plumes)**
  - In 2000, to eliminate the possibility of the contamination affecting human health, institutional controls (ICs) were implemented as part of the OU1 ROD document. Controls will remain in place until groundwater cleanup in completed.
  - On-Post controls – restrictions to prevent the consumption of groundwater and deed restrictions to prevent the property's use for non-industrial purposes.
  - Off-Post controls – restrictions to prevent the consumption of groundwater and prevent the installation and use of new private drinking water wells.

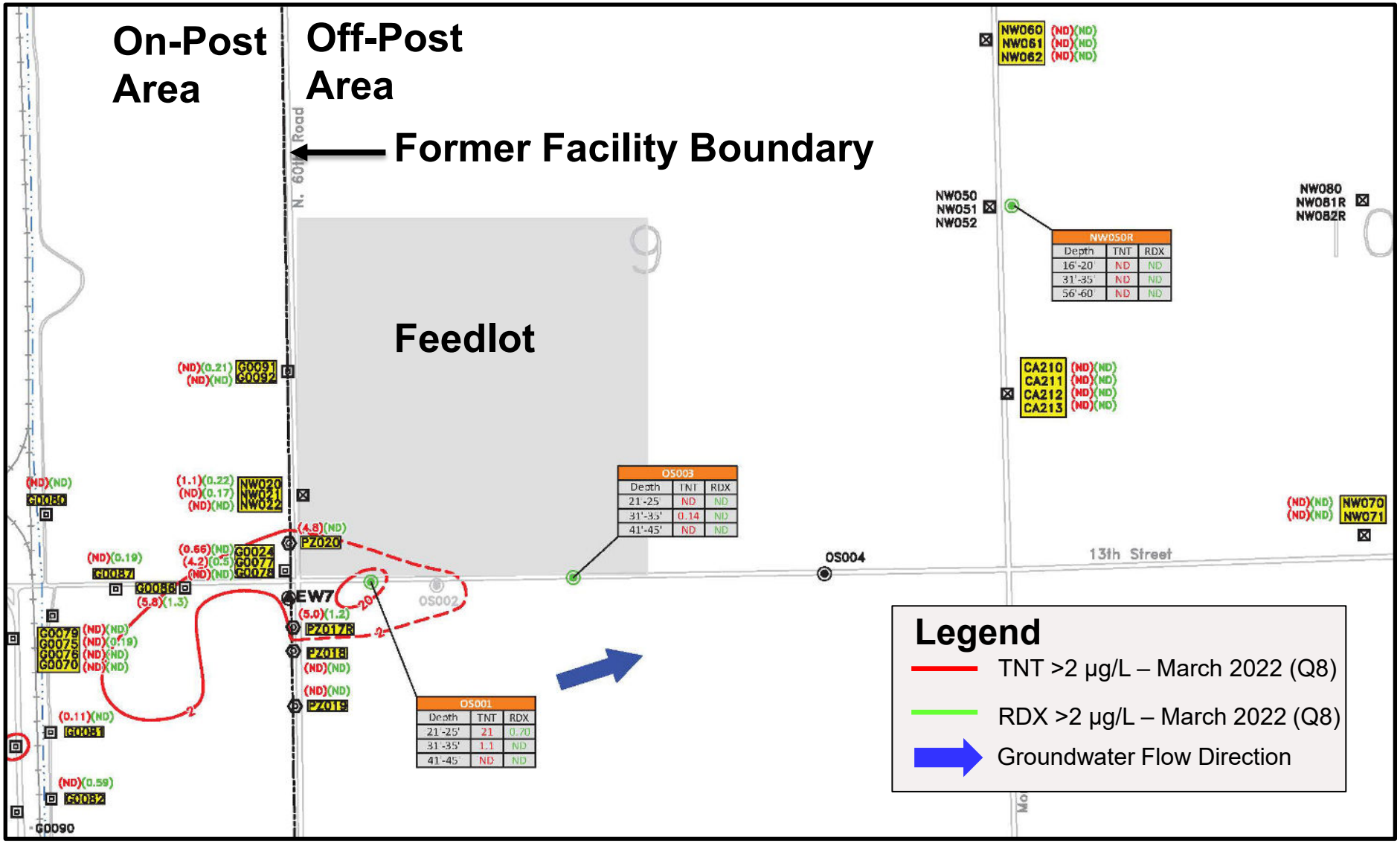
History of OU1 Past Actions

- **Subsurface Injection**
  - Began in the spring of 2007 and was performed through 2016; and again in 2019 and 2020 as part of the Rebound Study. Research has shown that certain natural microorganisms will feed off certain contaminants and cleanup [remediate] contaminated groundwater. By injecting an amendment in the aquifer, the microorganisms flourish and consume the contamination. Based on several studies, the Army injected a molasses-based food grade amendment. These injections remediated the explosive plumes 5 to 10 times faster than the pump and treatment system. This saved time and taxpayer dollars and resulted in the shutdown of the treatment system as the plume shrunk substantially.

History of OU1 Past Actions

- **Rebound Study**
  - Decreasing explosives concentration trends and numerical modeling simulations suggested that On-Post groundwater extraction/treatment was no longer needed to prevent Off-Post plume migration.
  - A common issue when you stop pumping is plume concentrations increase over time and the plume begins to migrate. To ensure these things did not occur, a Rebound Study was initiated in Oct 2019. It included eight (8) quarterly Groundwater Monitoring Events. Baseline event was completed in October 2019 and final quarter 8 event was completed in February/March 2022.
  - Temporary shutdown of all extraction wells and the pump and treatment system occurred in Nov 2019 and remains in standby status.
  - Rebound Study results indicated the plume core is shrinking, statistical analysis (Mann-Kendall Test) show concentrations are declining, and there has been no further plume migration downgradient (further Off-Post). All permanent Off-Post wells sampled as part of the OU1 Rebound Study remain below the USEPA HALs of 2 µg/L. In Quarter 8 Technical Memorandum, the Army recommended continued annual groundwater monitoring and proceeding to the next phase of the cleanup process. USEPA and NDEE concurred.

March 2022 (Q8) Rebound Study Results



- Rebound Study results indicate plume is stable and not migrating

Historical Explosives Concentrations

- **Historical Explosives Concentrations in Groundwater**
  - Maximum historical **On-Post** explosives concentrations were between 1,000 and 5,000 µg/L (1980s) due to proximity to source areas.
  - Maximum historical **Off-Post** explosives concentrations were much lower:
    - RDX – 70 µg/L (1985); Heath Advisory Level = 2 µg/L
    - TNT – 53 µg/L (1985); Heath Advisory Level = 2 µg/L
    - HMX – 10.2 µg/L (1992); Heath Advisory Level = 400 µg/L
  - Current (2022) maximum **Off-Post** explosives concentrations:
    - RDX – 0.7 µg/L; Heath Advisory Level = 2 µg/L
    - TNT – 21 µg/L; Heath Advisory Level = 2 µg/L
    - HMX – 0.2 µg/L; Heath Advisory Level = 400 µg/L
  - Estimate of explosives degradation rate (half-life) in groundwater:
    - RDX – 7.3 years
    - TNT – 5.7 years

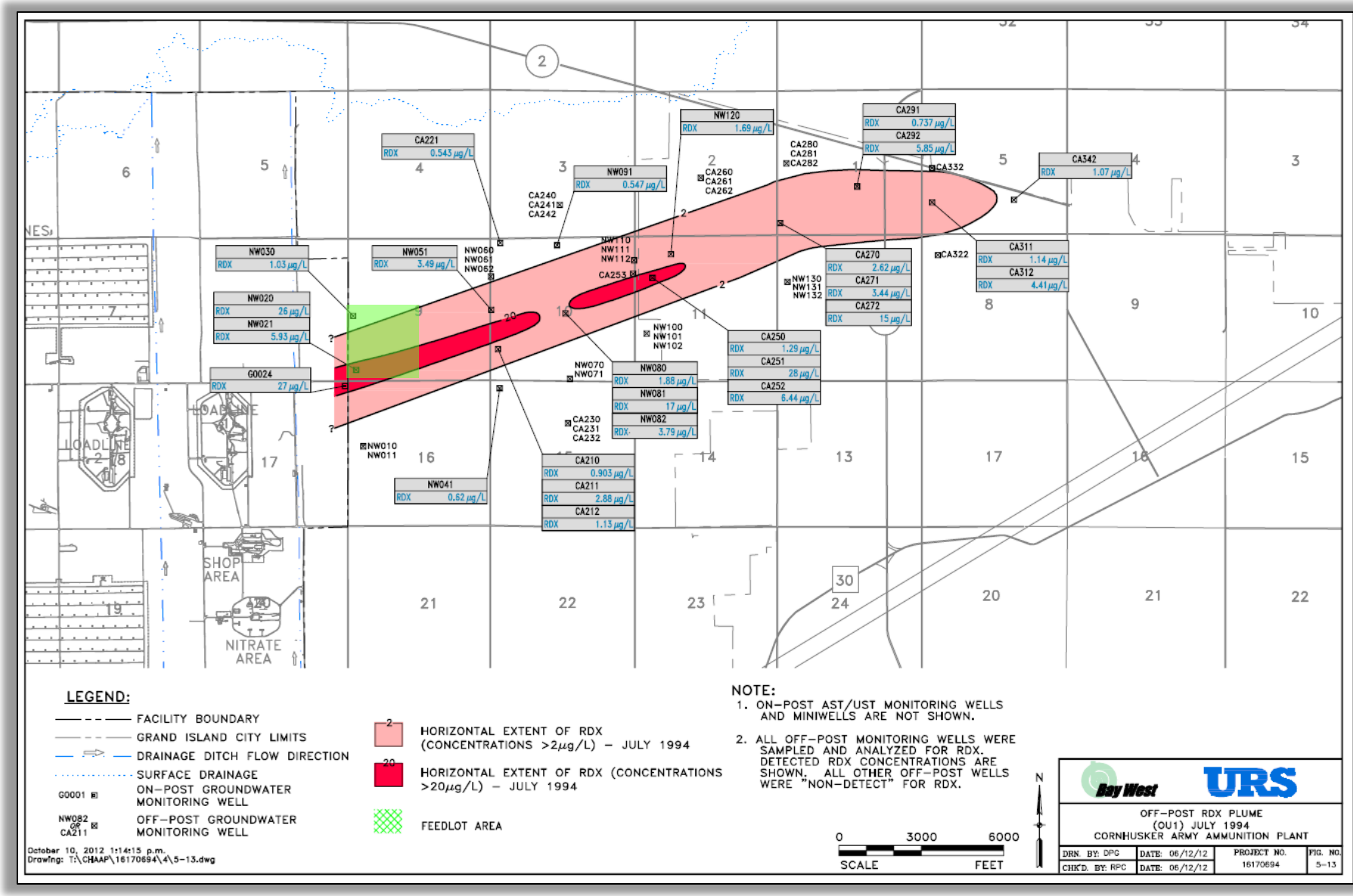
Setting and Explosives Properties

- **Aquifer Beneath CHAAP**
  - Soils underlying CHAAP are sands and gravel. Groundwater flow velocity is fast (approximately 300 feet/year).
  - Shallow aquifer (10 to 15 feet below ground surface) underlying CHAAP (Ogallala).
  - The natural attenuation processes is slow but can be enhanced by adding organic carbon to the aquifer (e.g., subsurface injection).
  - Feedlot directly west of CHAAP has high amounts of organic carbon so the natural attenuation process is enhanced.
- **Physical Properties of Explosives Chemicals**
  - RDX, TNT and HMX are soluble, but attach to soil and degrade (naturally attenuate) regularly. Therefore, these compounds do not migrate long distances.
  - RDX is the most mobile, which is why only RDX migrated approximately 5 miles Off-Post. TNT and HMX did not migrate beyond the adjacent feedlot.

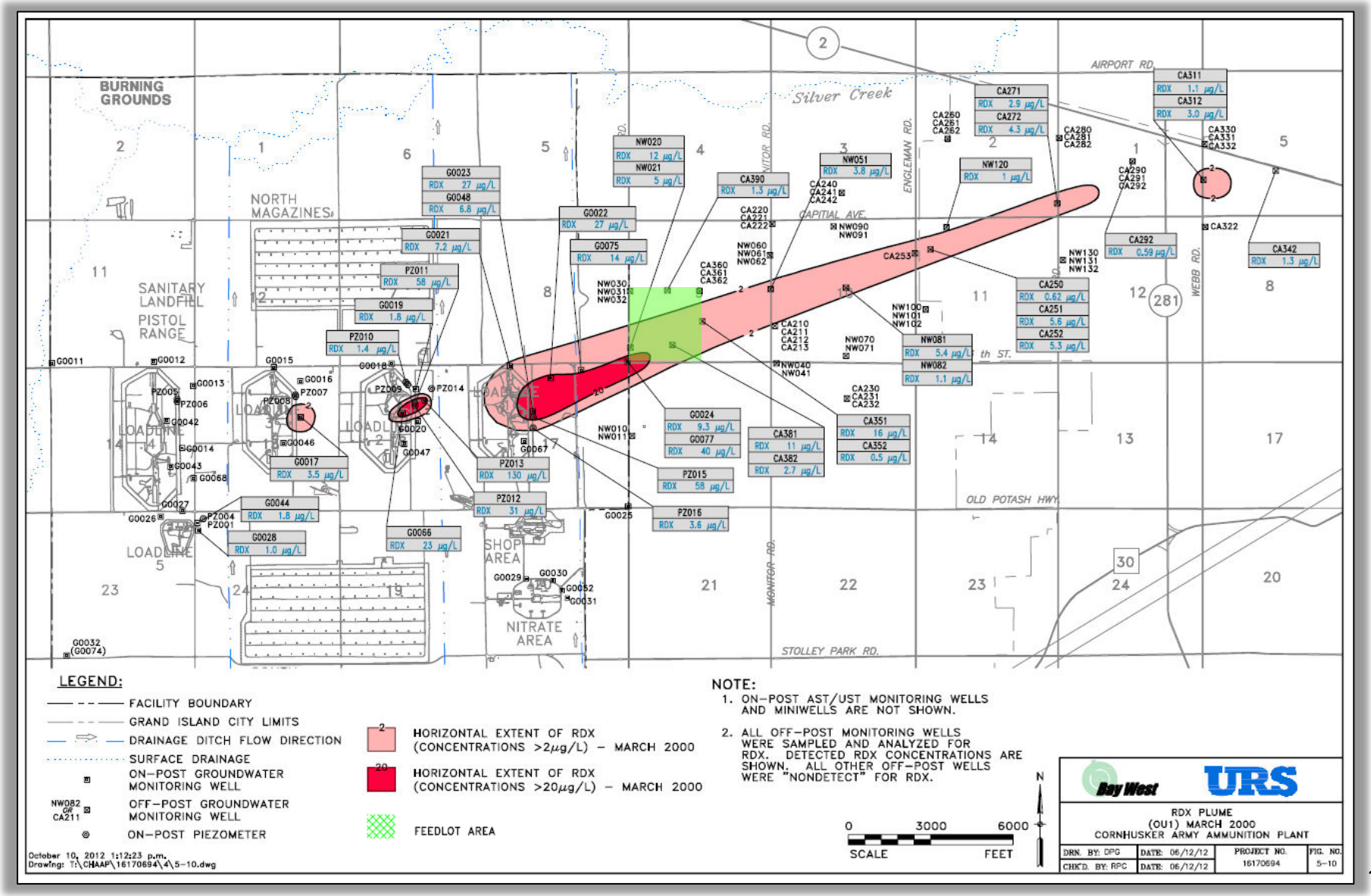
Historical Extent of Explosives Plume

- **The extent of the explosives plume has been significantly impacted over the years by previous actions including (soil) source removal, pump and treatment of groundwater, and subsurface injections, resulting in the following:**
  - Cleanup of the Off-Post plume
  - Shrinking of the On-Post plume
  - Declining explosives concentrations in groundwater throughout the entire site
  - Shut down of the pump and treatment system
  - Resume use of On-Post groundwater for irrigation purposes
  - Property transfer for industrial use
  - Reduced taxpayer dollars being spent on remediation efforts

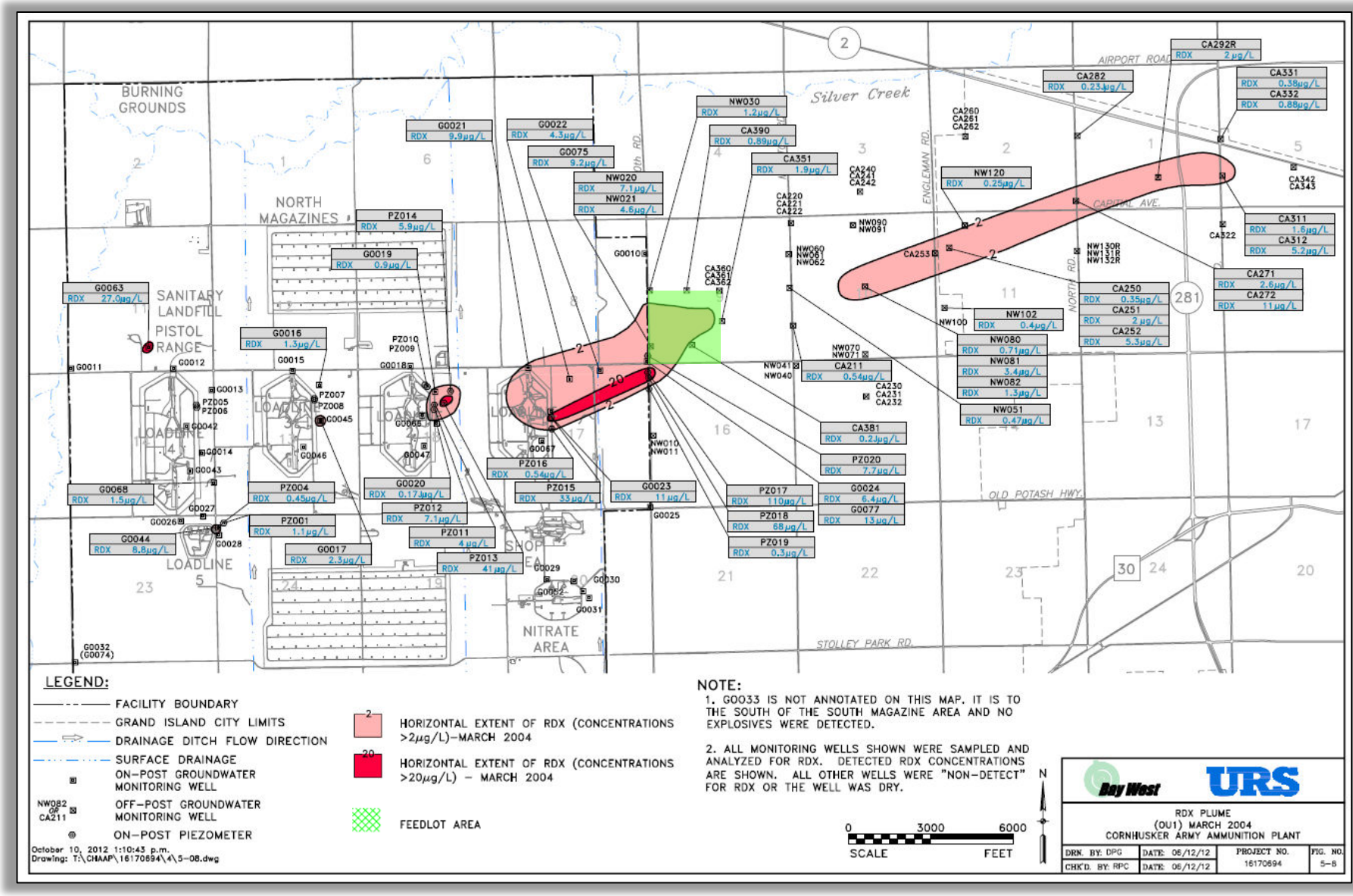
1994 RDX Off-Post Plume



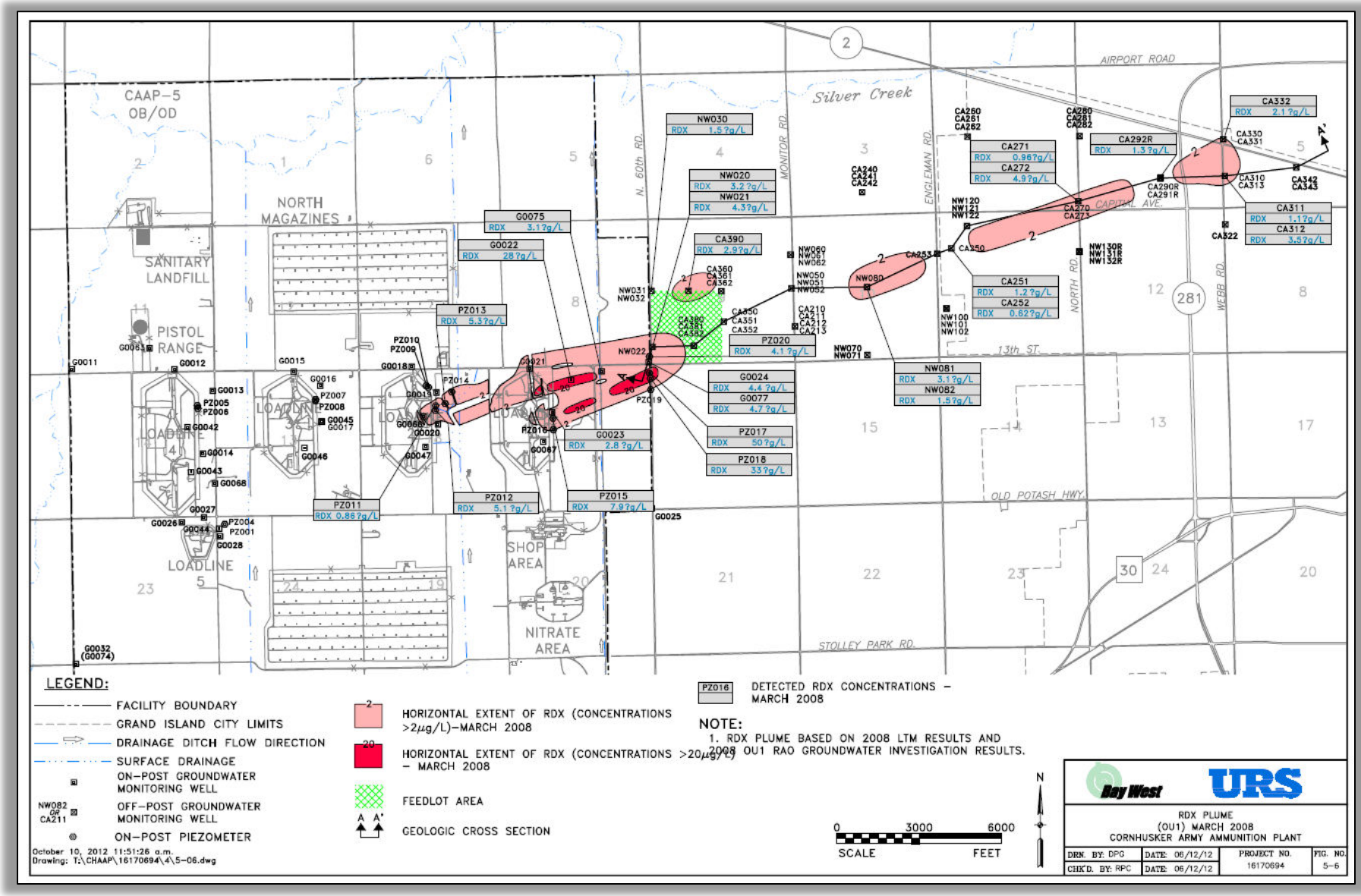
2000 RDX Plume



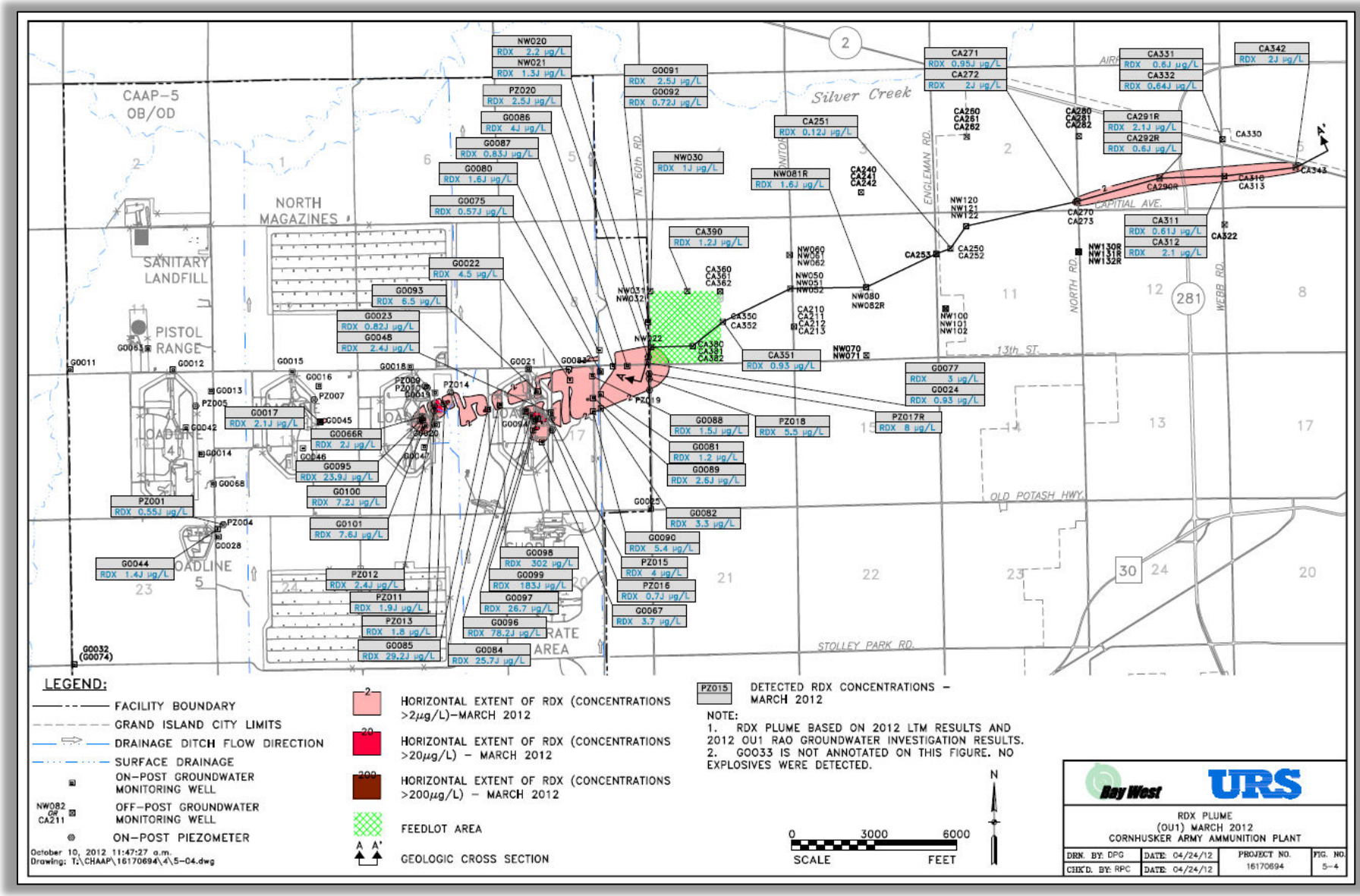
2004 RDX Plume



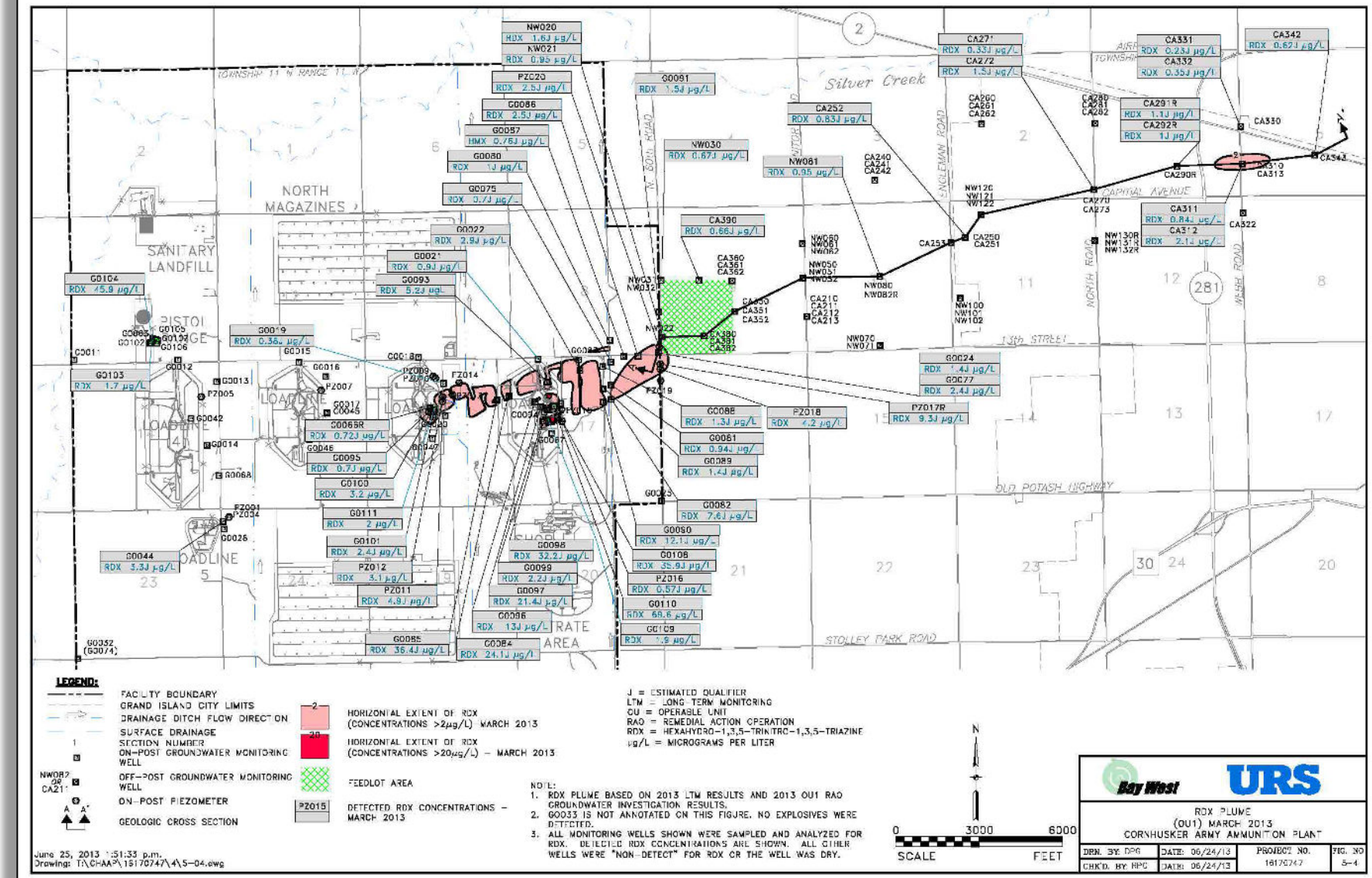
2008 RDX Plume



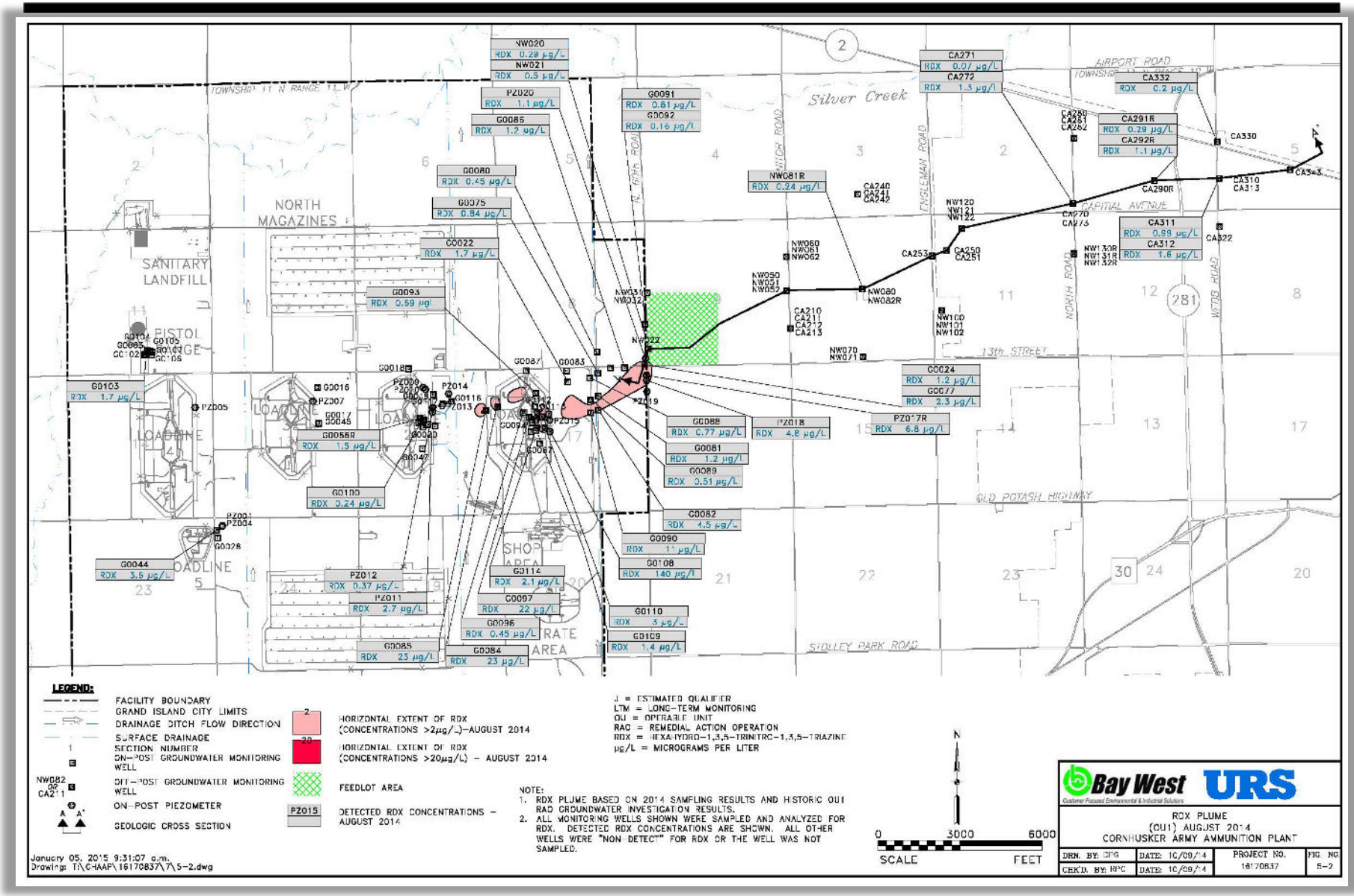
2012 RDX Plume



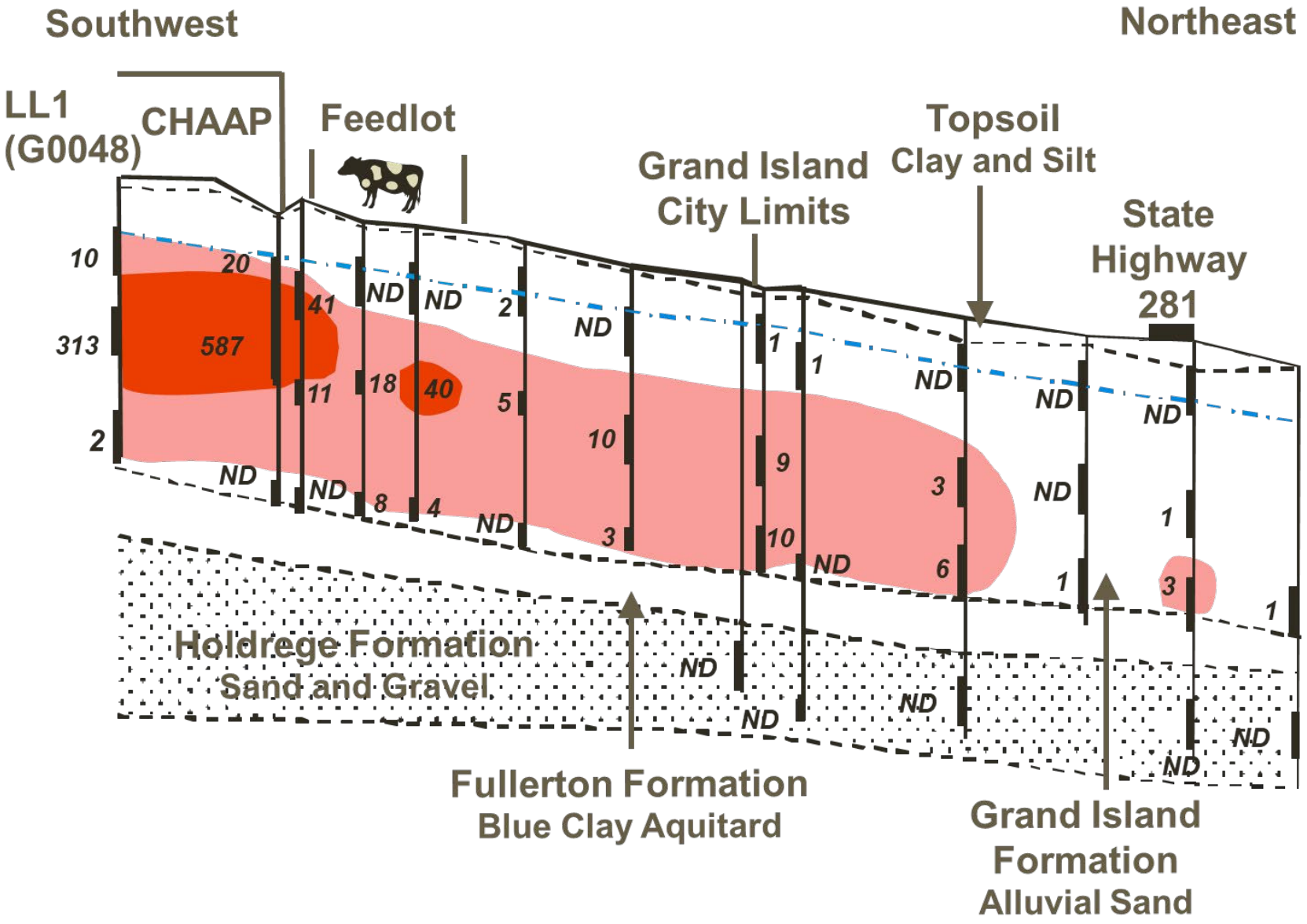
2013 RDX Plume



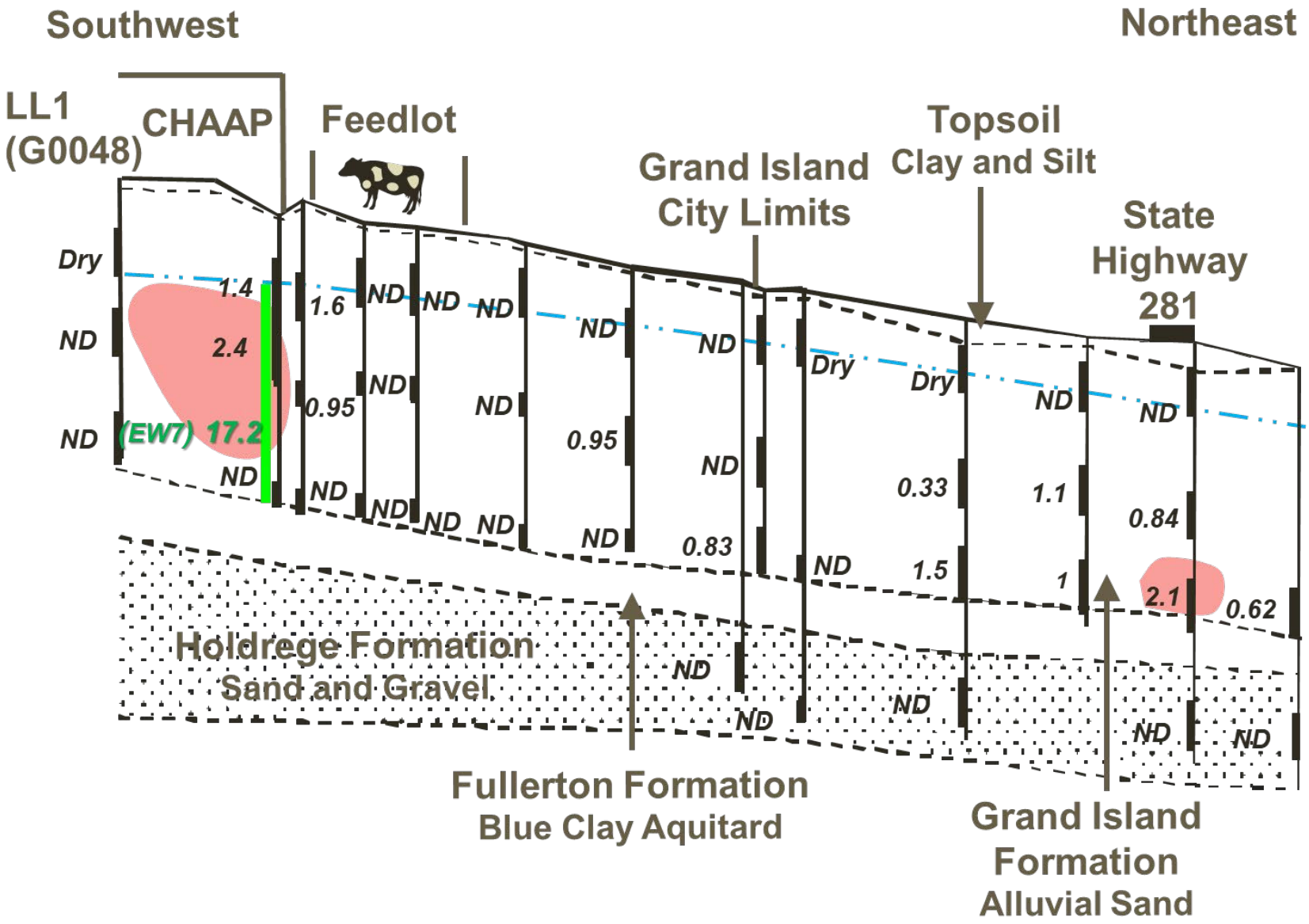
2014 RDX Plume



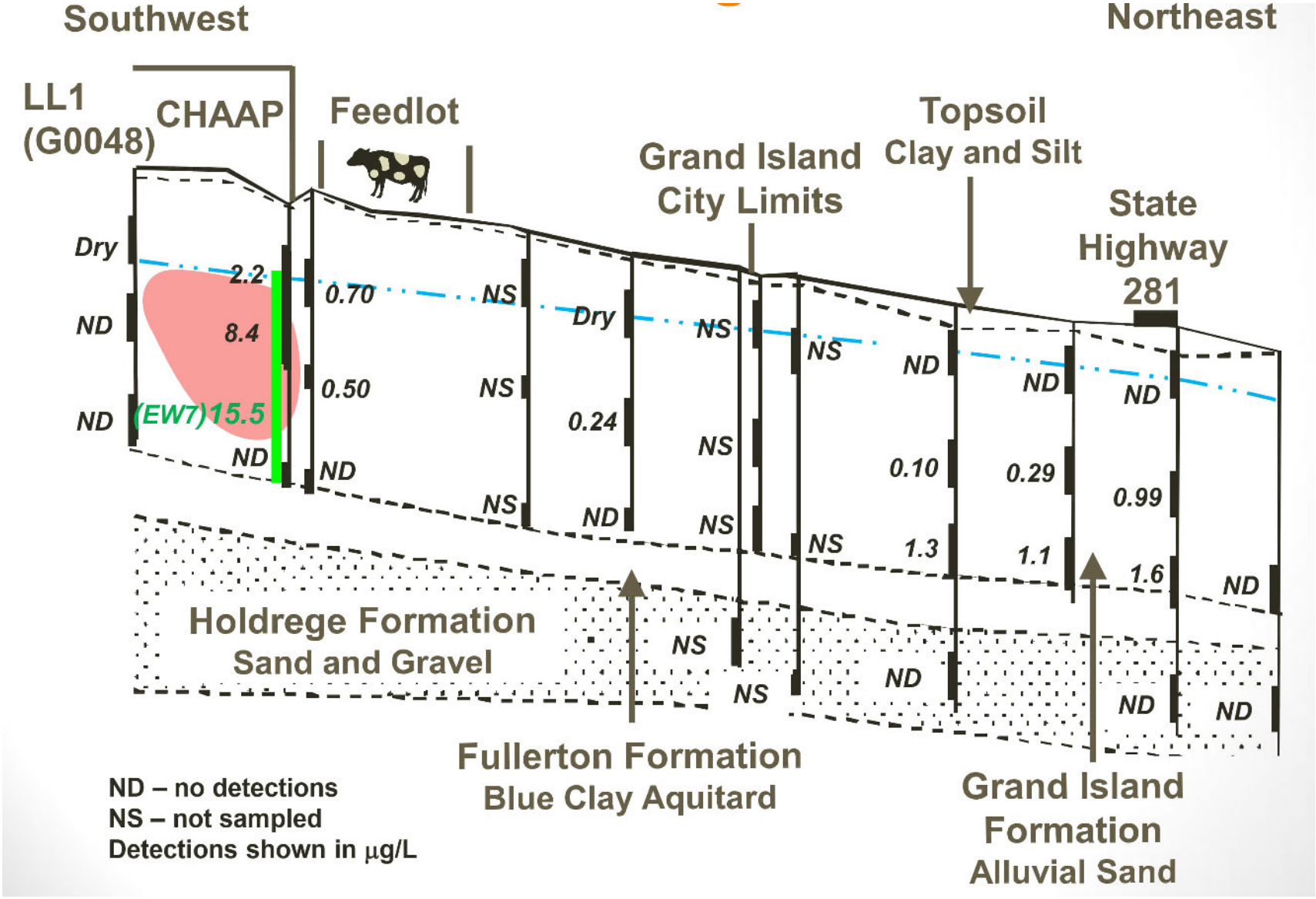
Geologic Cross-Section - RDX Plume Centerline March 2000



Geologic Cross-Section - RDX Plume Centerline March 2013



Geologic Cross-Section - RDX Plume Centerline March 2014



Current OU1 Program

- **Actions Completed from 2019 to 2022**
  - OU1 Rebound Study
  - OU1 Subsurface Injection
  - Annual OU1 Groundwater Long-Term Monitoring (LTM)
  - Evaluate Effectiveness of Remedy
  - Focused Feasibility Study (FFS)
- **Up Next for 2023 and Beyond**
  - Annual OU1 Groundwater LTM
  - Evaluate Effectiveness of Remedy
  - Proposed Plan (PP) and Public Meeting
  - ROD Amendment


Subsurface Injection


Groundwater Sampling

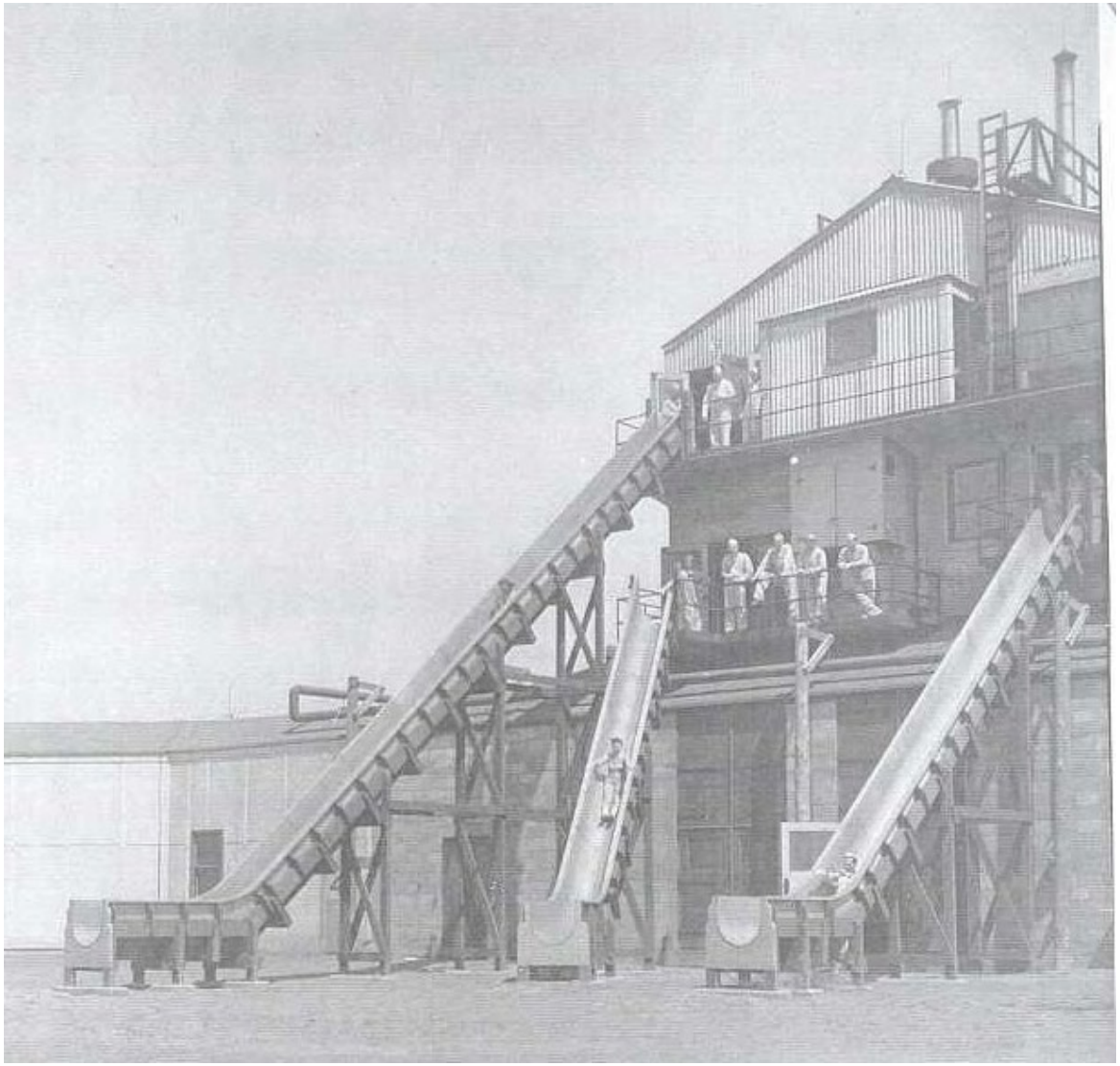
OU1 Path Forward

- **Next Phase of Cleanup for On-Post Plumes includes the preparation of the following documents:**
  - **Focused Feasibility Study:** develops and evaluates various remedial alternatives (cleanup strategies) to make sure they are protective of human health.
  - **Proposed Plan:** selects the preferred remedial alternative (cleanup strategy) for the On-Post plume and includes a public meeting and public comment period. The Army invites and encourages public participation. The Proposed Plan phase provides an opportunity for the public to voice their support or concerns of the Army's proposed actions. If you provide your name and email address, the Army will let you know when the public comment period begins and where the documents can be reviewed. Otherwise, the announcement will be published in the local newspapers.
  - **Record of Decision Amendment:** officially modifies the remedial alternatives (cleanup strategies). This document is signed by Army and USEPA.

Questions?

Bomb Production (1942 to 1945)

Site Photos (1944)



Site Photos (2022)