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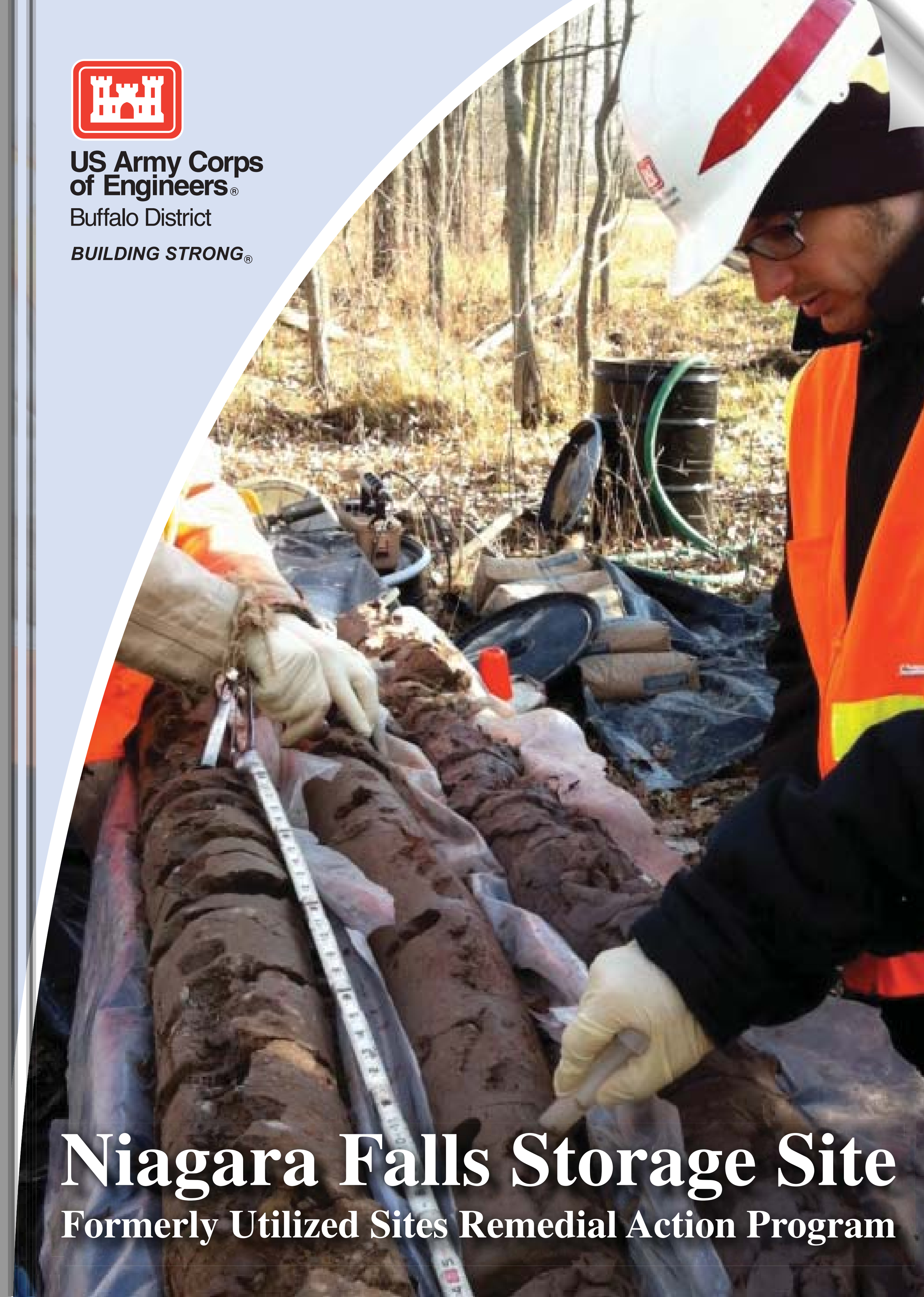


Niagara Falls Storage Site

Formerly Utilized Sites Remedial Action Program

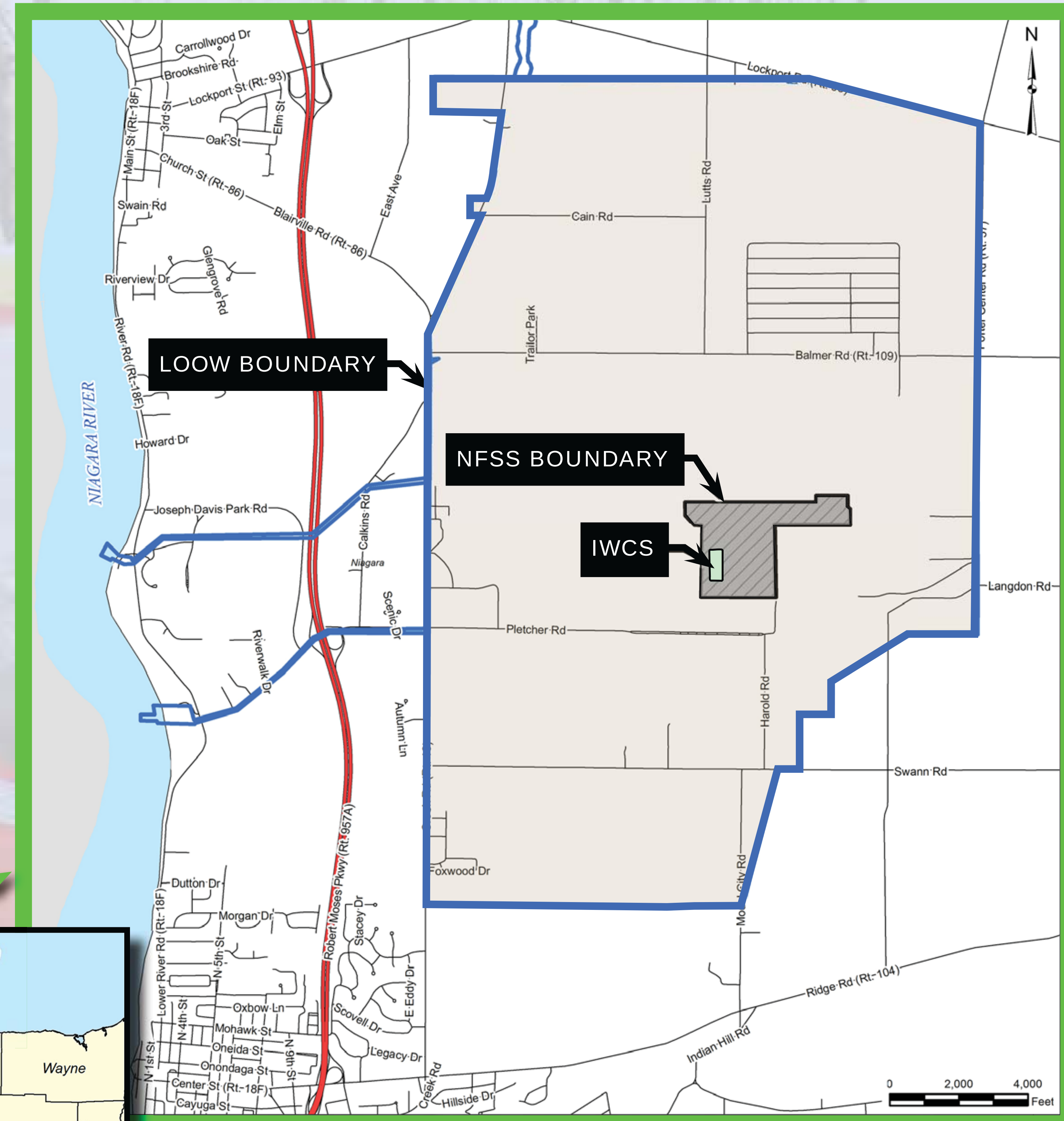
Balance of Plant Field Investigation

Background

The Niagara Falls Storage Site (NFSS) is located on a portion of a 7,500-acre former Department of Defense site called the Lake Ontario Ordnance Works (LOOW). Located in the towns of Lewiston and Porter, New York, LOOW was built for the purpose of manufacturing trinitrotoluene, or TNT, to be used during World War II.

During and after WWII, the Manhattan Engineer District contracted with processing facilities in various parts of the country to extract uranium from ore to create the uranium metal needed to develop atomic bombs. The unused ore material that remained after the extraction process is called residue. These residues contained small amounts of uranium and greater amounts of other naturally radioactive elements. Some of these radioactive residues and wastes from uranium ore processing were stored in the southern portion of the LOOW production area by the Manhattan Engineer District and the Atomic Energy Commission.

Between 1982 and 1986, the U.S. Department of Energy consolidated radioactive materials into a 10-acre Interim Waste Containment Structure (IWCS) on the 191-acre NFSS.

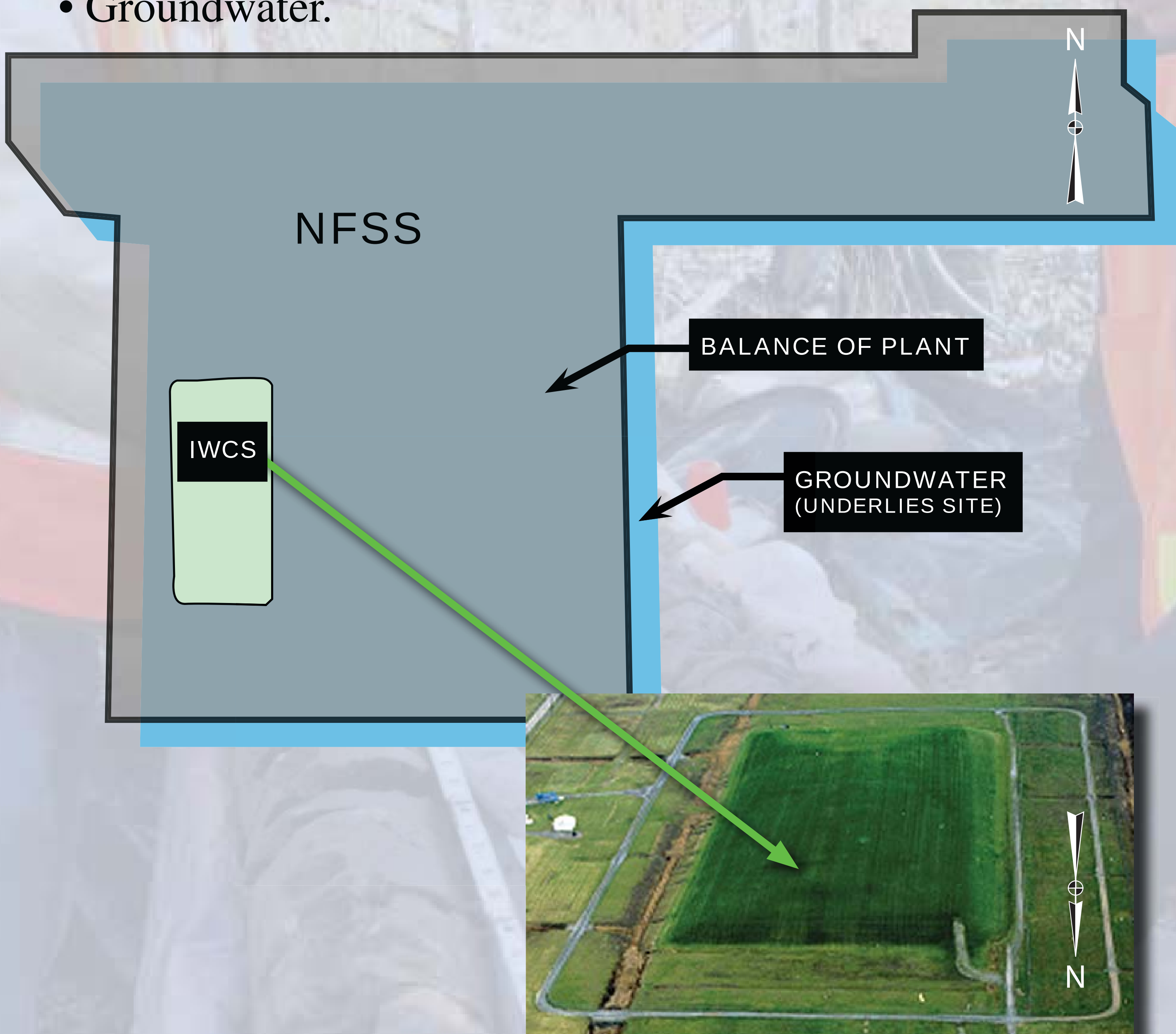


Operable Units

The U.S. Army Corps of Engineers Buffalo District is addressing NFSS under the Formerly Utilized Sites Remedial Action Program.

NFSS is divided into three operable units:

- IWCS,
- Balance of Plant (the site's soils and infrastructure), and
- Groundwater.



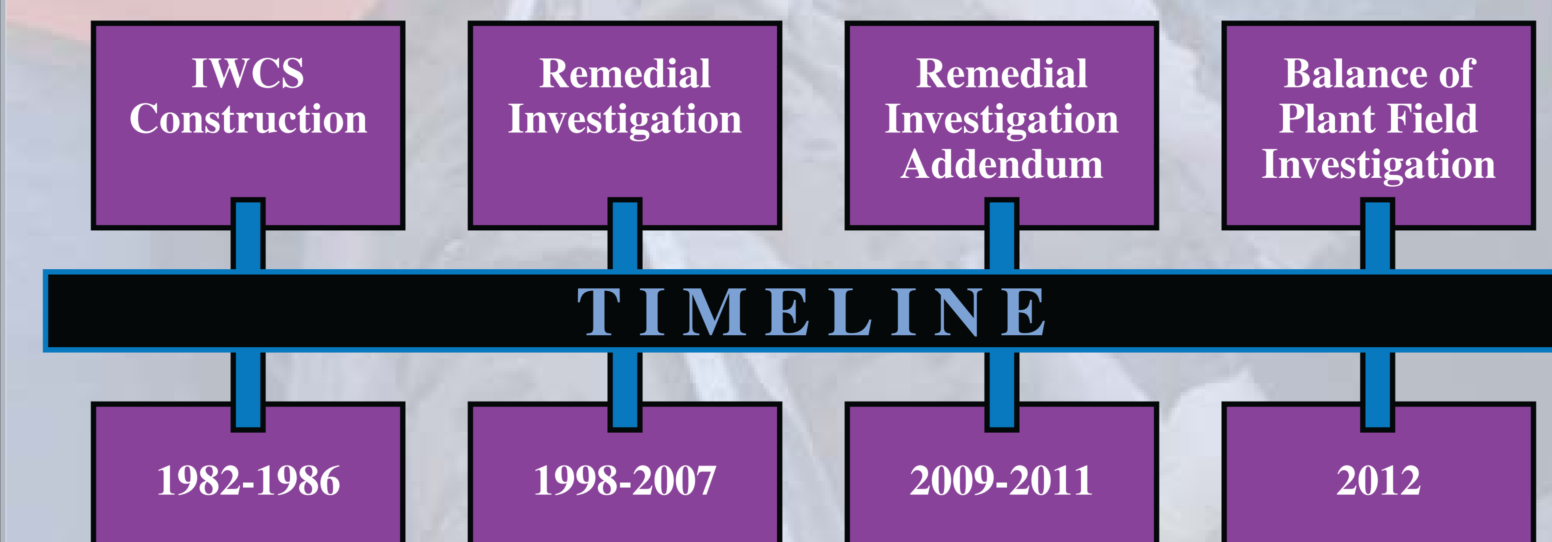
Timeline

The Corps completed a Remedial Investigation to determine the nature and extent of contamination on the NFSS in 2007. The Remedial Investigation Report also evaluated the fate and transport of contaminants through site media (i.e., soil, groundwater) and assessed potential human health and ecological risks resulting from contaminants in the environment.

An addendum to the Remedial Investigation Report was completed in 2011. The Addendum further investigated the extent of on-site contamination.

The Corps conducted a field investigation from October - December, 2012, to:

- Obtain additional information to support the development and evaluation of potential remedial alternatives for the Balance of Plant Operable Unit Feasibility Study
- Address community and stakeholder questions concerning areas south of the IWCS, pipelines, and uranium concentrations in groundwater monitoring well OW11B



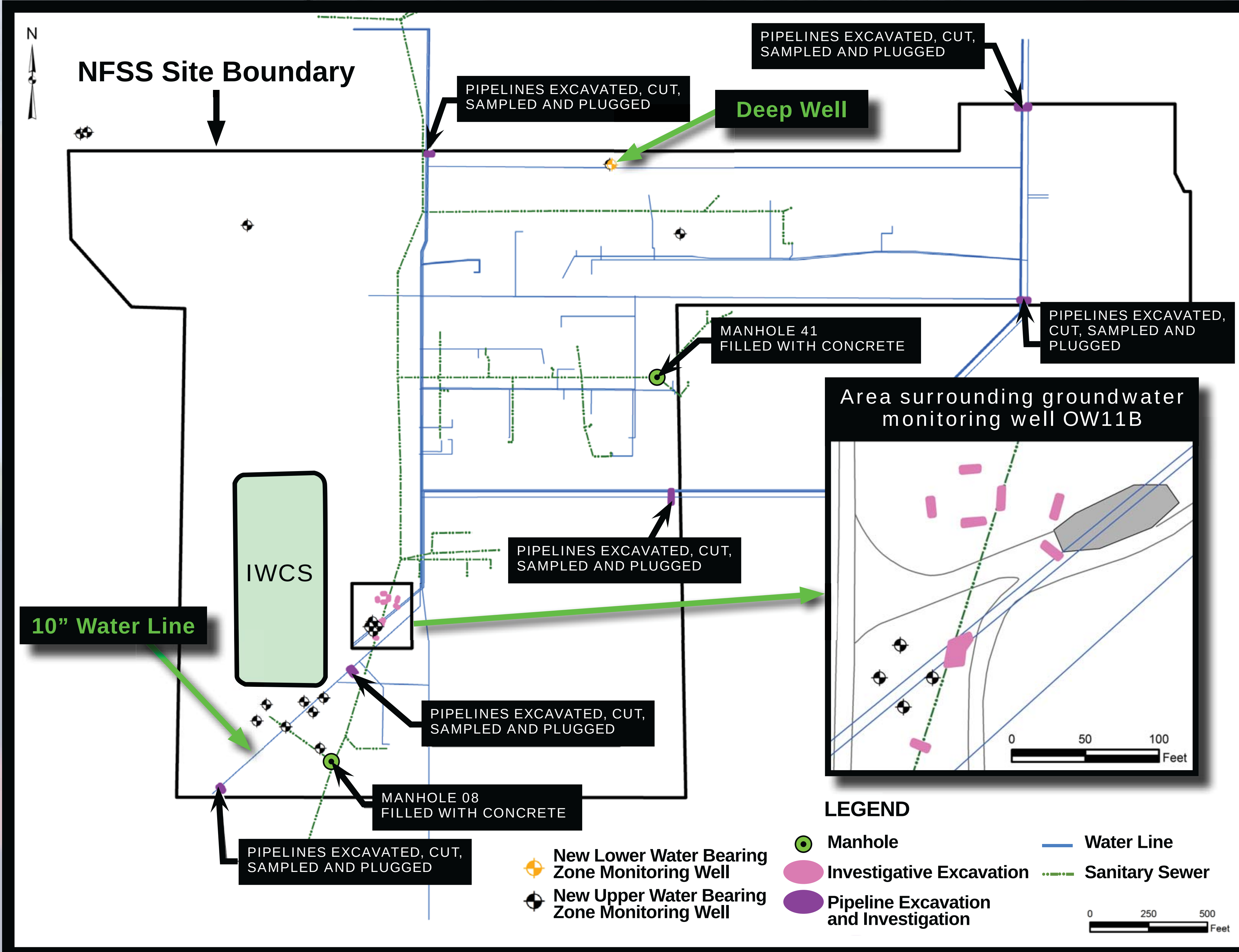
Balance of Plant Field Investigation

The scope of work for the Balance of Plant Field Investigation included the installation of 17 groundwater monitoring wells and the excavation of eight trenches. Sixteen of the groundwater monitoring wells were shallow wells. One of the wells installed during this investigation was a deep groundwater monitoring well.

In addition, 17 pipelines at six locations were excavated, cut, sampled, and plugged; two manholes also were filled with concrete.

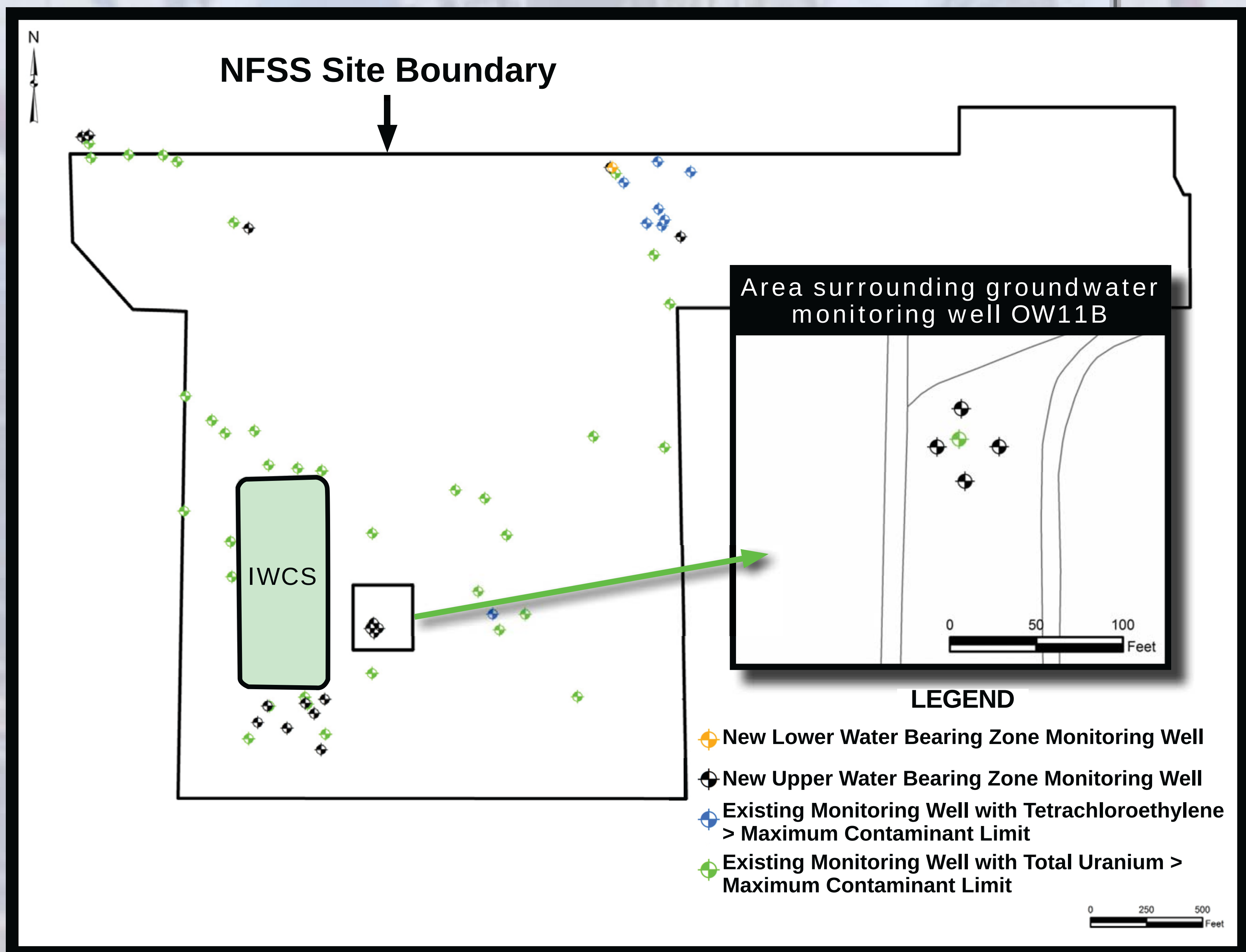
The objectives of this field investigation were to:

- Delineate groundwater contamination in the northern portion of the site and around the southern portion of the IWCS,
- Identify the source of increasing uranium concentrations in groundwater in monitoring well OW11B,
- Eliminate potential pathways for off-site migration of groundwater via the former LOOW subsurface pipelines, and
- Evaluate potential groundwater contamination along the 10-inch water pipeline near the southeast corner of the IWCS and eliminate the water line as a potential pathway.



Groundwater Monitoring Well Locations

This map shows the location of the new Balance of Plant Field Investigation groundwater monitoring wells in relation to existing monitoring wells that have contaminants exceeding maximum contaminant levels (drinking water criteria).



Geophysical Survey

A geophysical survey was performed to locate subsurface utilities and other features that could potentially interfere with well drilling and excavation.

Drilling a Monitoring Well

Each borehole was started manually with a hand auger down to a depth of five feet to identify and avoid subsurface structures and utilities.

A hand-augered soil sample was retrieved from the hole and provided to the geologist for analysis.

Removed soil (investigation derived waste) was placed in drums.

Drummed investigation derived waste was sampled, analyzed and properly disposed.

A rotosonic drill rig was used to install the wells during this field investigation.

Cones and markers were used to maintain a safe working area during equipment operation.

The drill rig used both rotational and vibratory action to drive a steel core barrel into the ground where the well was going to be placed. The steel core barrel is hollow and soil accumulates inside as it is driven into the ground.

The length of the core barrel is underground in this picture.

Soil Core Retrieval

The core barrel was retrieved and the soil from inside the barrel was removed and inserted into a plastic sleeve. Soil cores were four inches in diameter and up to five feet long.

The core barrel was advanced incrementally until the desired monitoring well depth was reached. Once the core barrel was removed from the ground and the soil core was encased in the plastic sleeve, the soil core was then brought to a separate area for examination and classification by a geologist.

Soil Core Geologic Classification

Soil cores were placed on a surface lined with plastic and the plastic sleeve was cut open. These side by side soil cores came from different depths in the same borehole.

The geologist measured and classified the different layers of soil in the soil core.

Both gray and brown clay layers are visible in this soil core.

This soil core contains broken cobble commonly found in glacial till.

Radiologic Scanning of Soil Cores

The cut in the top of the pictured soil core marks a one-foot scanning interval for the radiation detectors.

A Pancake Geiger Mueller Detector was used to scan for radiation in each one-foot interval of the core.

Four soil samples were collected from the soil cores where each of the 17 monitoring wells were installed during the Balance of Plant Field Investigation:

- One sample was taken from the top six inches of soil,
- One sample was taken from a one-foot interval within the approximate middle of the future well screen,
- One sample was taken from a one-foot interval that exhibited the highest radiological scan measurement on the soil core, and
- One sample was taken from a one-foot interval that exhibited the highest radiological scan measurements based on the down-hole gamma reading. (If the highest down-hole gamma reading and the highest radiological scan measurement were recorded for the same one-foot interval, the sample was collected from the soil core at the depth of the second highest down-hole gamma reading.)

Installing a Groundwater Monitoring Well

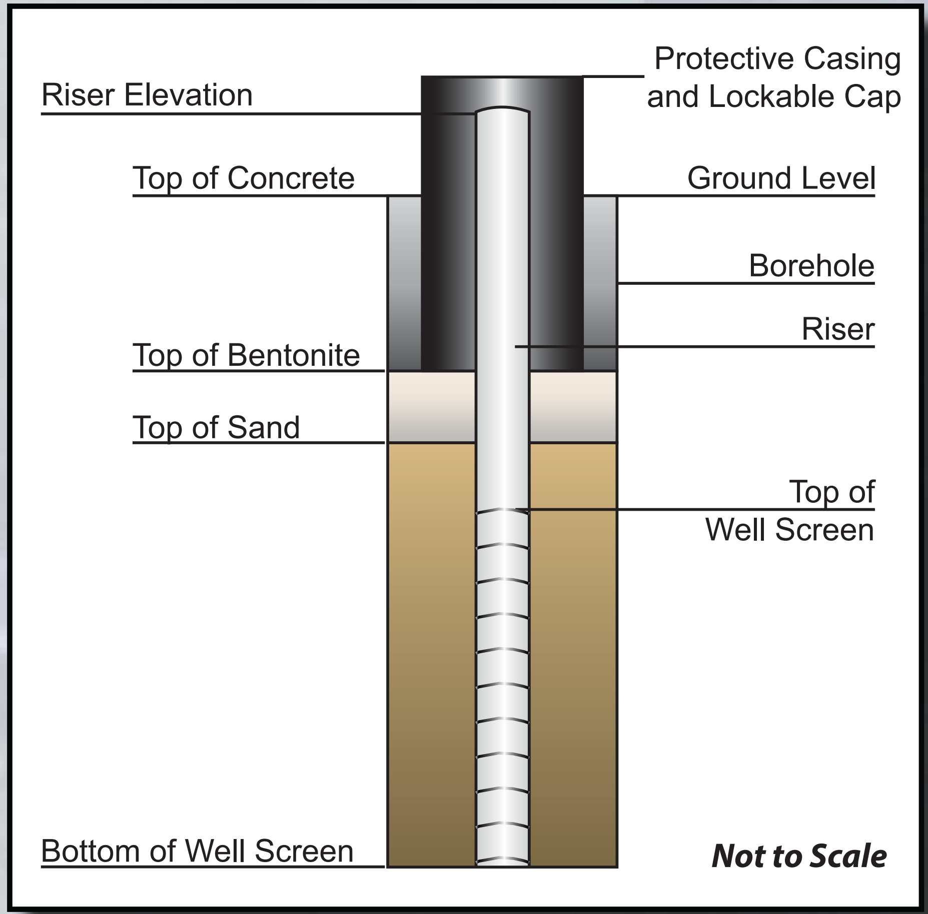
The white plastic tubes are temporary well casings that were lowered into the borehole; these acted as a protective sleeve to allow a radiation scan within the borehole of the well.

A down-hole radiation scan was performed by lowering a radiation detector into the temporary casing to the bottom of the borehole and slowly retracting it while gamma measurements were recorded at six-inch intervals.

This is a closer view of the radiation detector that was lowered into the borehole.

After the gamma scan was completed, the temporary casing was removed from the hole and a monitoring well was built.

This diagram depicts the construction of a groundwater monitoring well.



The PVC tube in the geotechnician's hand is a well screen. It is two inches in diameter and has parallel slits in each side to allow groundwater to penetrate the PVC tube.

This is a close up of a well screen. The depth for well screen placement was based on the soil zone being monitored and the depth to the water table. Groundwater from the target zone will enter the monitoring well through the slotted well screen.

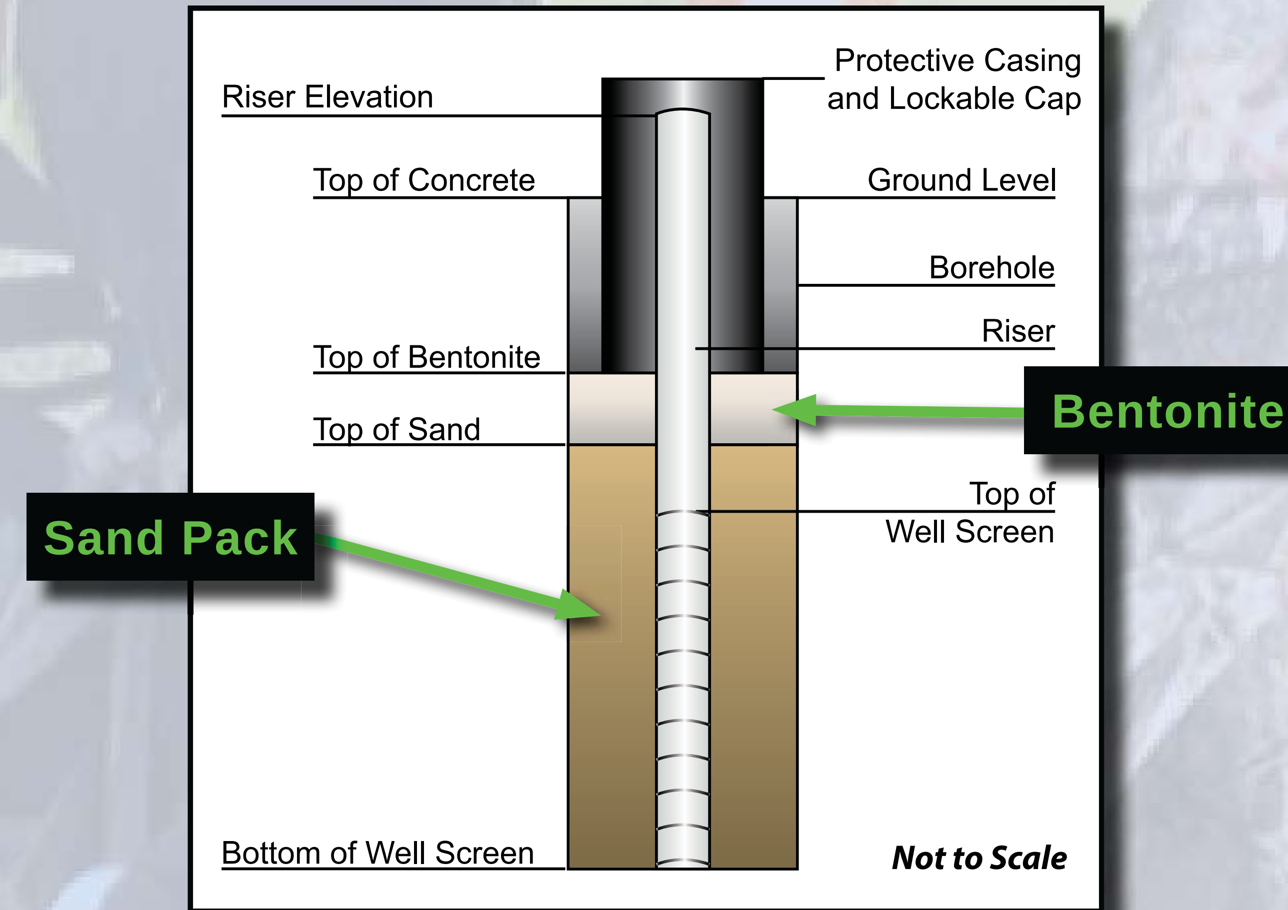
A well riser casing was attached to the top of the screened portion and lowered into the hole to construct the monitoring well.

The orange plug remains on top of the riser and is removed during well sampling.

Finishing the Groundwater Monitoring Well

A sand pack was installed around the screened interval to allow water to flow freely into the monitoring well, while keeping soil out.

The grain size of the sand pack was compatible with the slot openings in the well screen and the surrounding soil. A ruler was used to measure the depth of the sand pack.



Once the sand pack was placed around the screen, bentonite (i.e., absorbent clay) chips were used to fill the remaining area between the riser and the ground until ground surface was reached.

The bentonite chips were moistened and swelled to form a clay seal around the riser. This process ensures only water from the desired screened interval enters the well, and not water above the screened interval (i.e., from a higher water bearing zone or from the surface itself).

A frame for a concrete pad was constructed for each well.

Workers placed the frame at the base of the monitoring well.

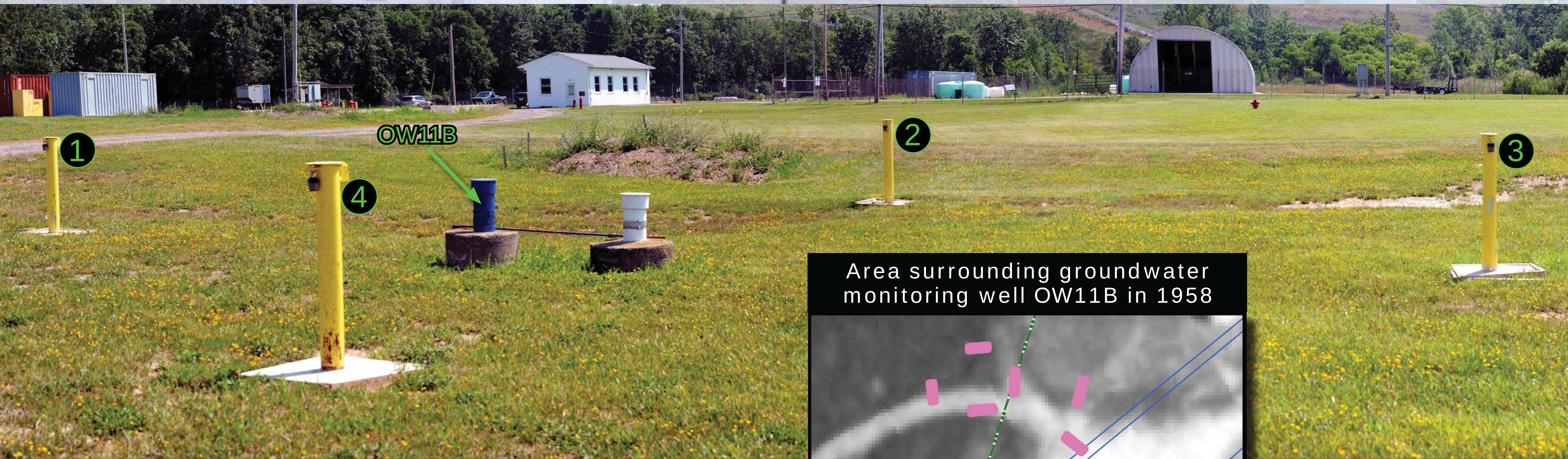
A protective steel casing two inches larger in diameter than the well riser was placed over the well riser.

Once the steel casing was in place, about one to two feet into the ground, a concrete pad was poured around it to keep it secure.

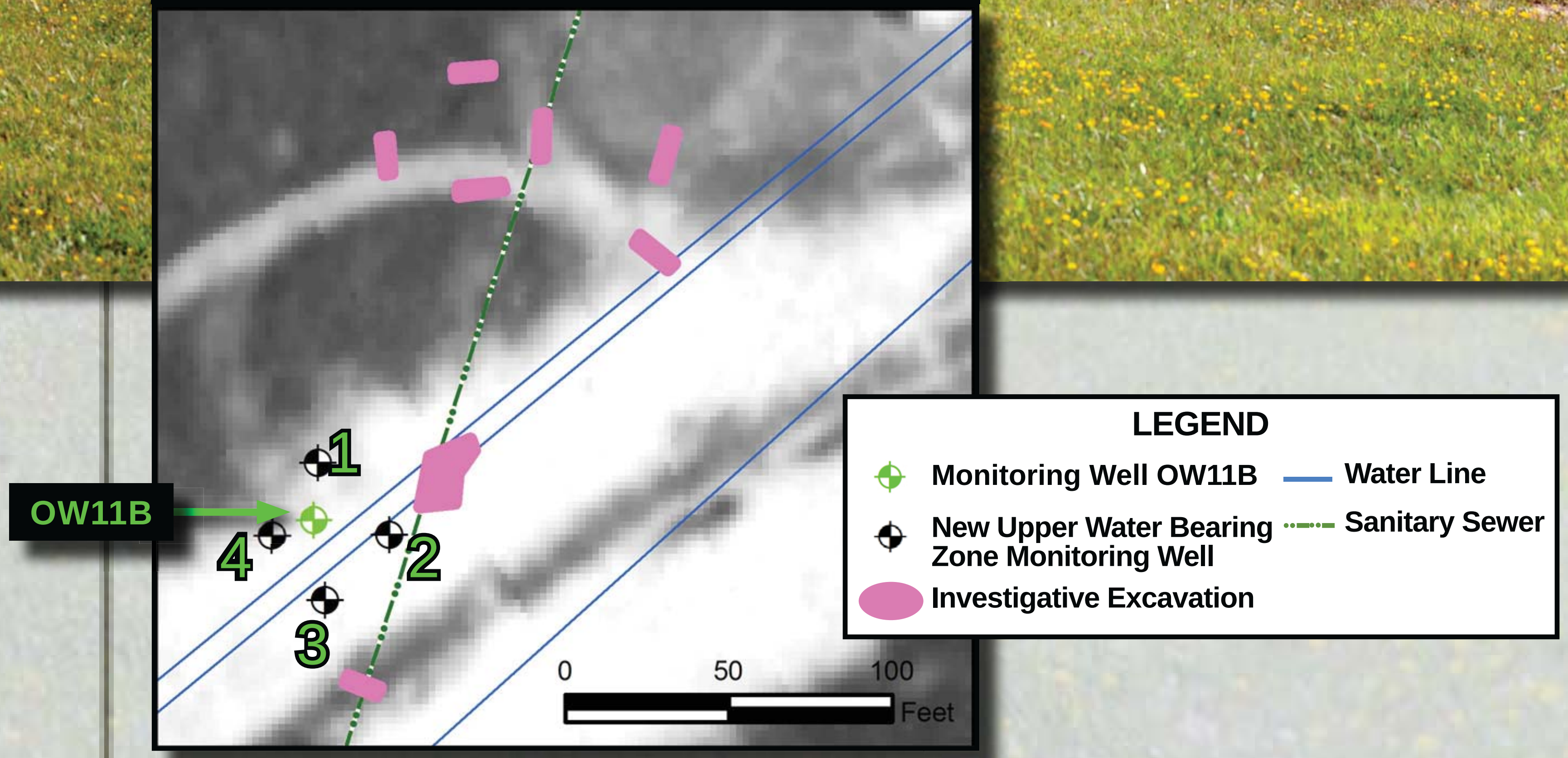
The surface of the concrete pad was made smooth to shed rain water.

Below are the completed monitoring wells surrounding the existing groundwater monitoring well OW11B.

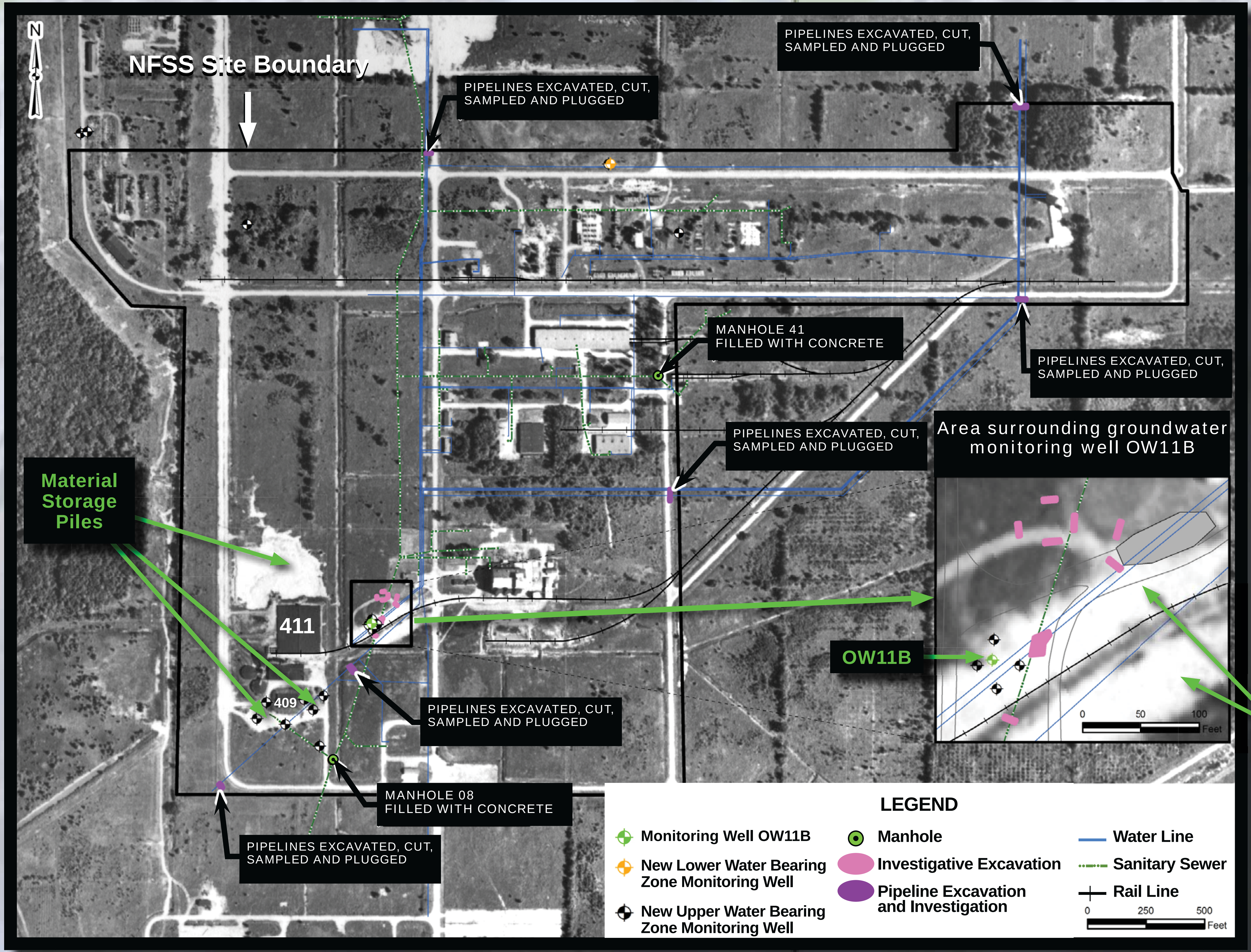
The dirt mound behind the wells was an investigative excavation area.



Area surrounding groundwater monitoring well OW11B in 1958



Historic Activity

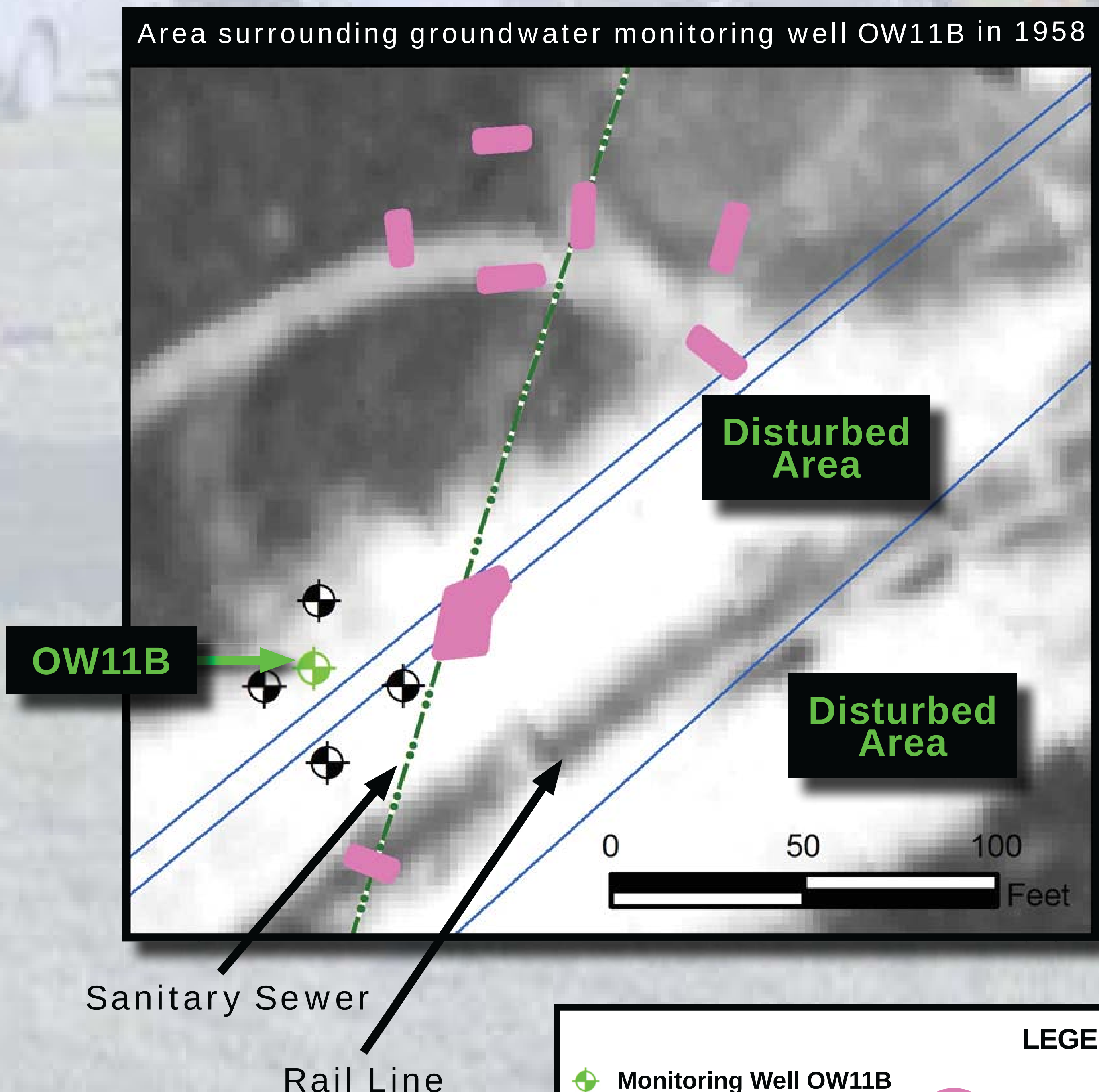


This is an aerial photograph of the site taken in 1958.

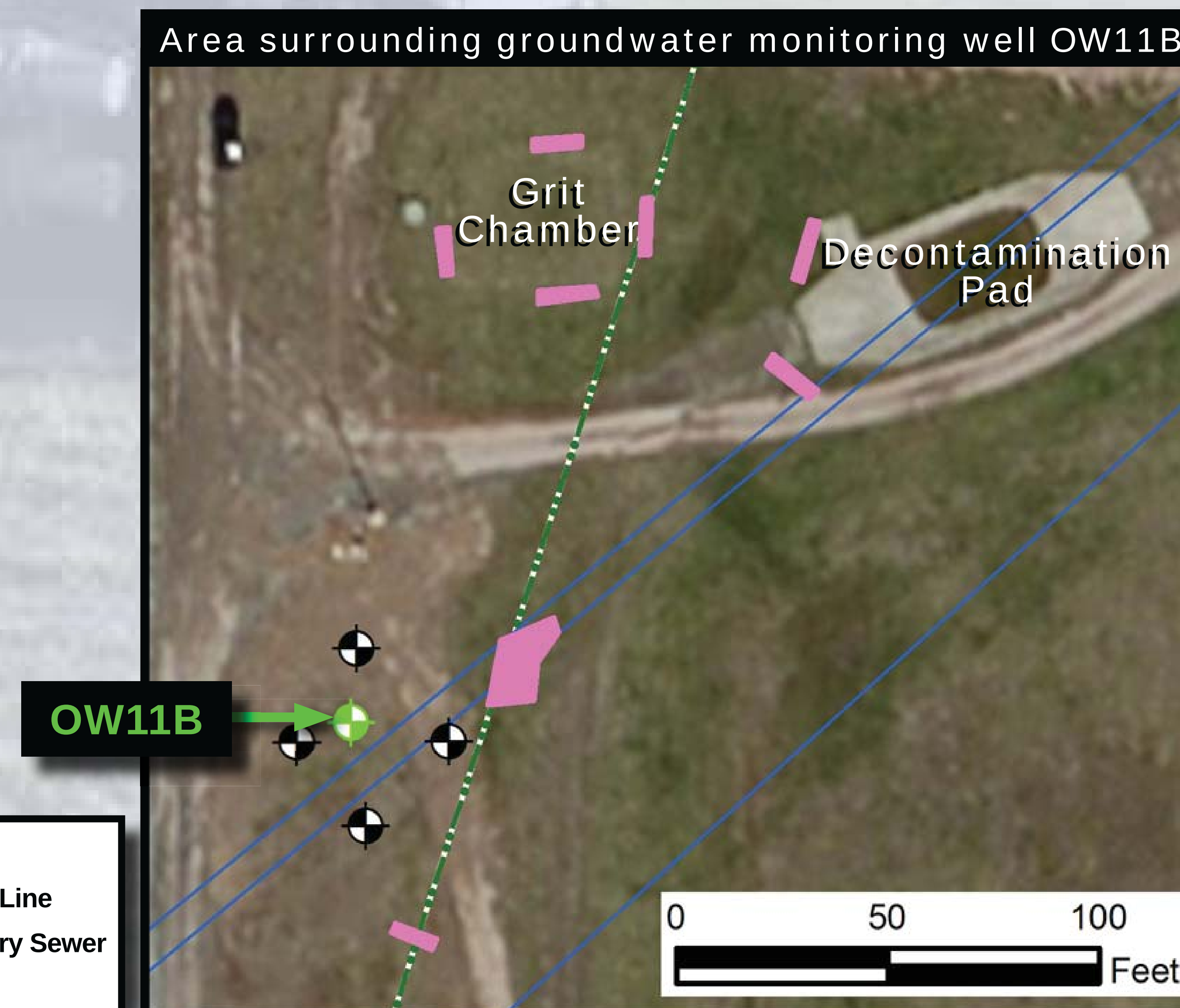
Ground scarring (white areas) in this historic photograph show that there was a great deal of activity (earth moving, stockpiling of material, traffic) in the area surrounding groundwater monitoring well OW11B, including a railroad track.

Disturbed areas (white areas) are evident along the rail line and material storage piles are seen north of Building 411, east of Building 409, and south of Building 409.

Disturbed areas along the railroad track are evident in this enlarged view of the area surrounding groundwater monitoring well OW11B from the historic aerial. These areas are adjacent to an apparent railcar decontamination/off-loading zone.



When the IWCS was constructed by the U.S. Department of Energy during the 1980s, the decontamination pad and the grit chamber were also located in this area. The former decontamination pad was used to power wash contaminated vehicles and equipment before they were moved to a non-contaminated area. Water from the decontamination pad drained into the grit chamber and was subsequently pumped into a building for treatment. The view below highlights the investigative excavation areas in relation to these historic activities.



LEGEND

- Monitoring Well OW11B
- New Upper Water Bearing Zone Monitoring Well
- Investigative Excavation
- Water Line
- Sanitary Sewer

Image Credit: World Imagery

Investigative Excavation

Radiological measurements for gamma radiation were taken from the sidewall and floor of each investigative trench with the radiation detector.

Soil from the excavation was also classified, scanned, and sampled.

A trench box was placed inside the excavation to maintain stable sidewalls to allow personnel to safely enter the trench to radiologically scan and sample.

Excavated soils were stockpiled next to the trench location on plastic sheeting, laid out in the order of removal (to facilitate classification, radiological scanning, and sampling) and then placed back into the trench.

Subsurface Pipeline Sampling

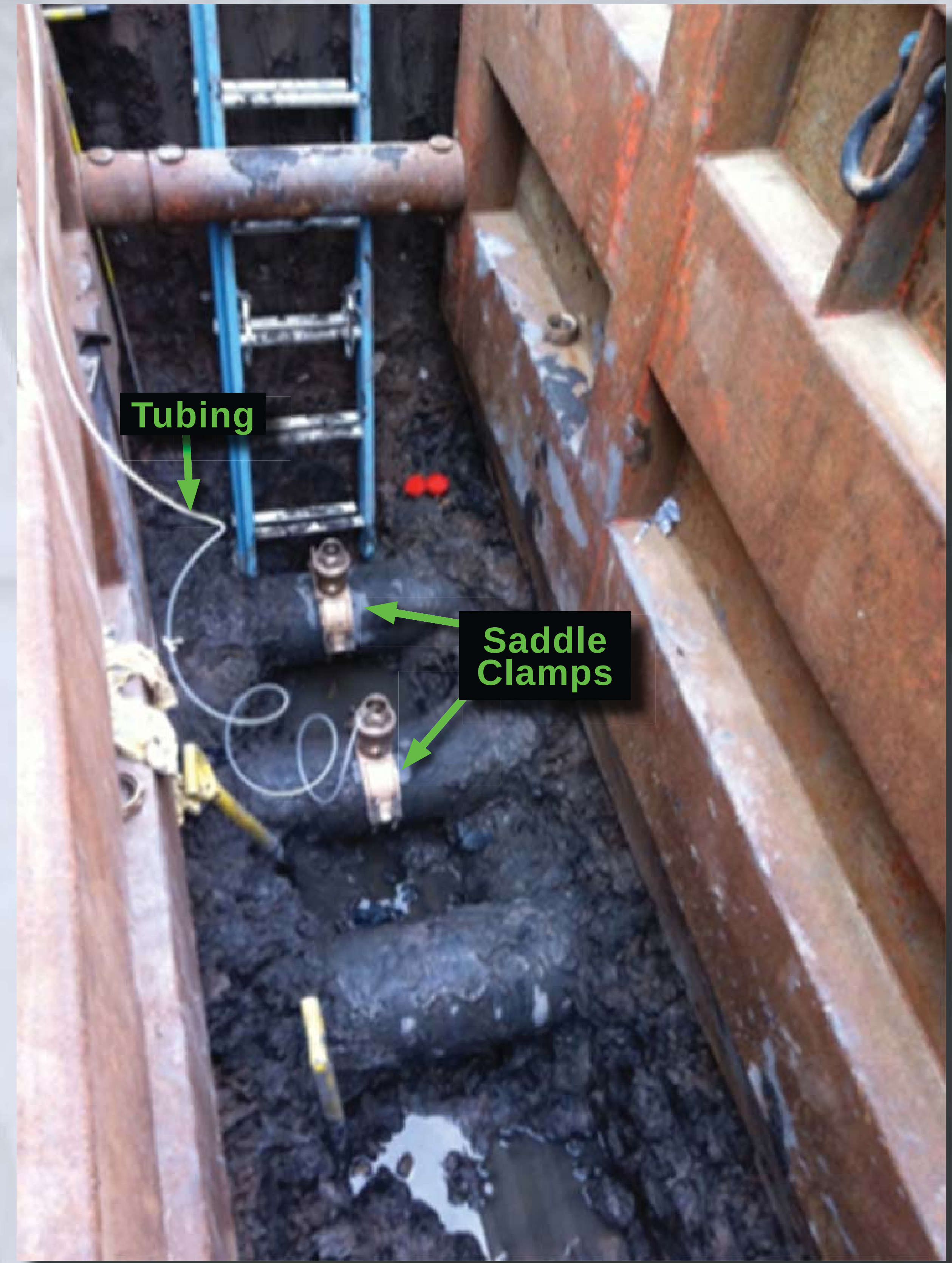
The 10-inch water pipeline was opened to gain access to the interior for the collection of samples and plugging. The “hot tap” method was used to drill a hole into a possibly pressurized water line. A ball valve is used to control water flow from pressurized pipes. In this instance, the 10-inch water pipeline was not pressurized.

The photo ionization detector in the bottom right monitored the breathing zone air quality.

The drill bit was removed so that water samples could be taken from the pipe. There was no coarse-grained (sandy) bedding material around historic LOOW subsurface pipelines. Groundwater flow along the outside of the pipelines is not a preferential pathway since the historic LOOW pipelines are surrounded by native clay.

The blue tube was attached so that water could be pumped out of the 10-inch water pipeline for sampling.

Saddle clamps are visible on two of the exposed pipes within the trench box. Tubing was connected to a pump so that water samples could be collected from the middle pipe.



Pipeline water was sampled for potential radiological and chemical contaminants.

This pipeline water sample was collected to test for volatile organic compounds.

The 10-inch water pipeline was cut open for sediment sampling and then filled with concrete at the southern boundary of the site.

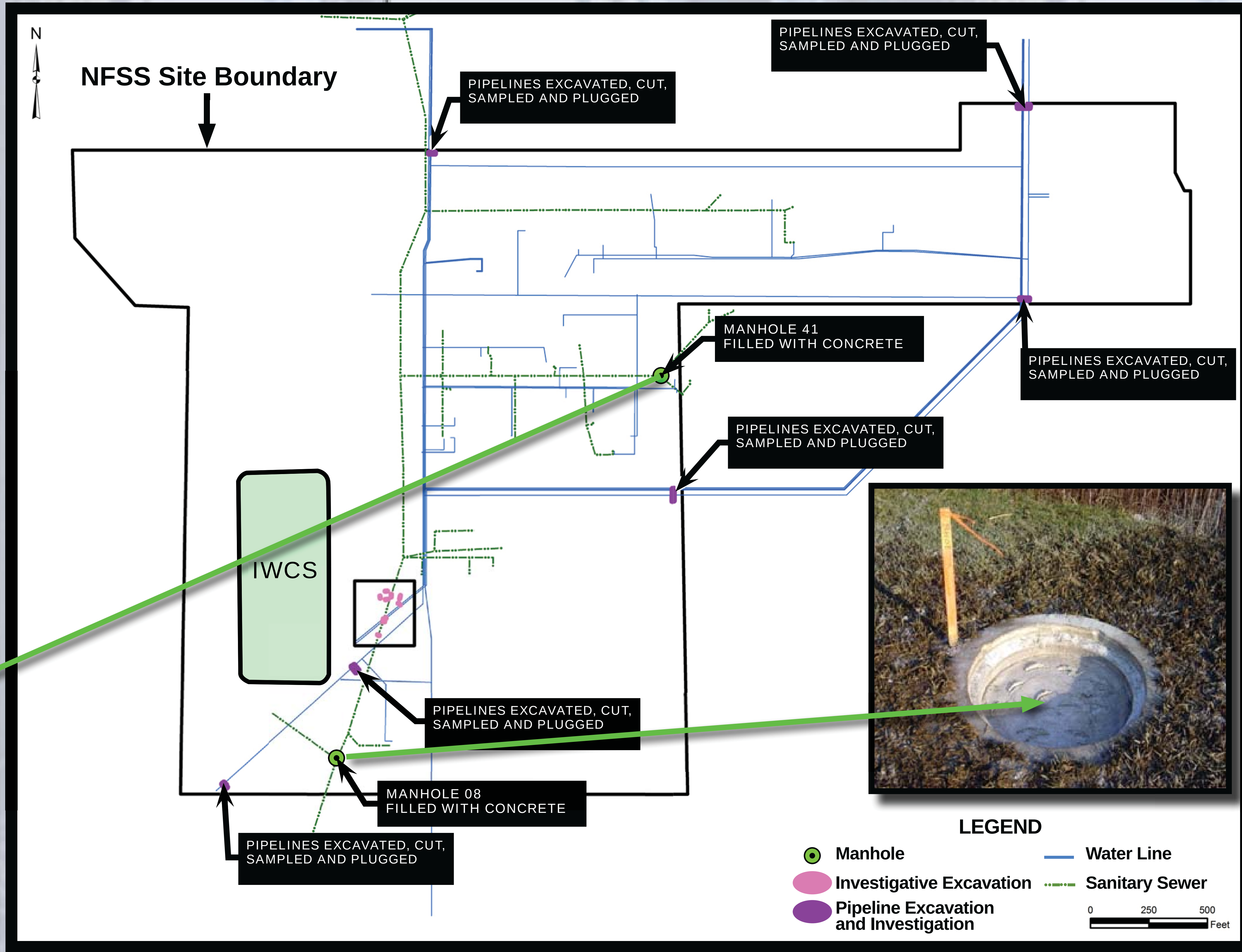
Plugging Pipelines

A 36-inch pipeline was filled with concrete at the northern property boundary.

The pipes were filled with concrete and plugged, a bentonite/concrete mixture was placed in the bottom of the excavation to enhance the natural clay's inhibition of groundwater flow along these historic LOOW subsurface pipelines.

Filling Manholes

Manhole 08 and Manhole 41 were filled with concrete to eliminate this potential pathway for transport of contamination.



Final Steps

Liquid investigation derived waste was drained into a waste water tank truck.

The container was scanned for alpha and beta radiation and then it was released for transport and disposal off-site.

Drummed investigation derived waste was sampled, analyzed, scanned for radiation, labeled, and loaded onto a truck for disposal off-site.

Results

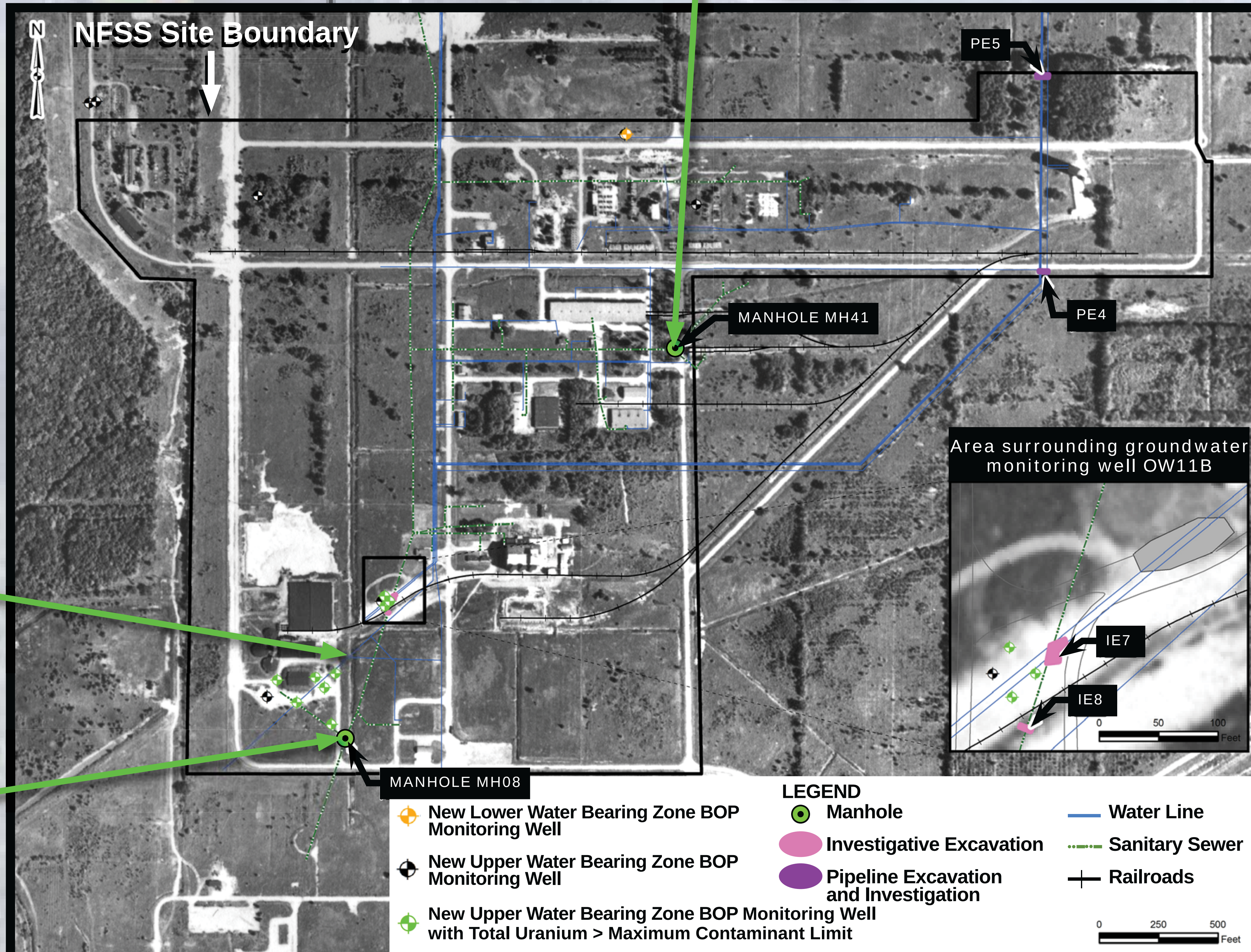
On this map are the sampling results from the recently installed groundwater monitoring wells in comparison to drinking water criteria. Additional findings from the field investigation are listed below:

There was no pipeline bedding material noted at any of the locations associated with former LOOW activities. The natural silty clay backfill around the pipes inhibits groundwater migration along these older historic pipelines. The effect of this clay material is that there is no preferential path-way for groundwater contamination to move through the soil surrounding the pipeline.

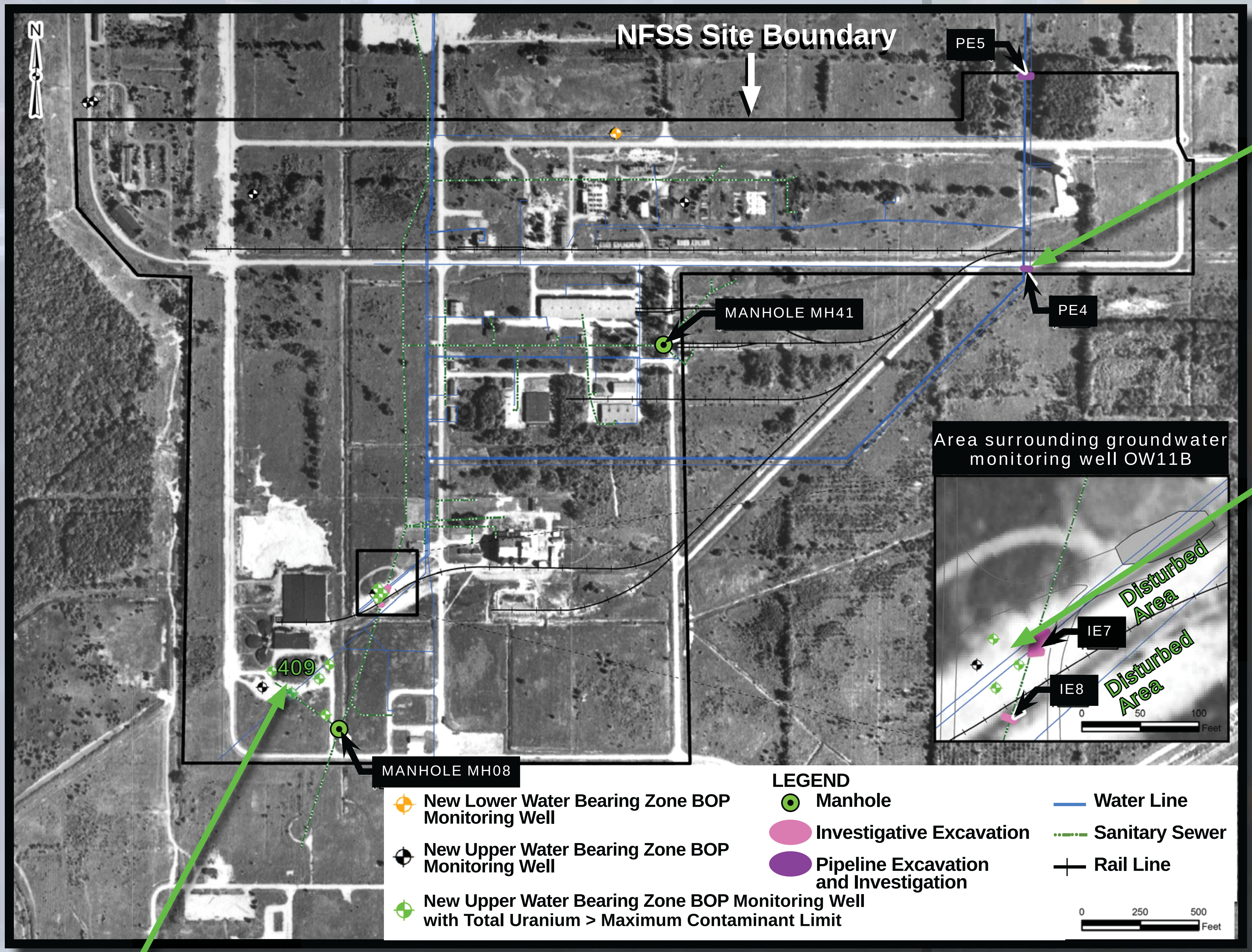
There was no radiological contamination detected in the soil surrounding the 10-inch water line or in the pipeline.

Uranium concentrations above criteria were detected in the sediment and water samples from MH08.

No radionuclides were detected at concentrations exceeding criteria in MH41 sediment or water.



Results (Continued)



There was no radiological contamination detected in soil samples taken from the ground surrounding the water pipeline or water sampled from any of the water pipelines included in this field investigation, except in Pipeline Excavation (PE) 4 and PE5. Radium-226 was detected slightly above the drinking water criterion of 3 picocuries per liter (pCi/L) in water samples from inside the pipelines at PE4 and PE5 (i.e., 5.31 pCi/L and 4.45 pCi/L, respectively).

Uranium concentrations in groundwater were detected above criteria north, south, and east of groundwater monitoring well OW11B and in Investigative Excavation (IE) 7 and IE8. The concentrations at these locations are consistent with historic operational corridors (e.g., rail line), past practices (e.g., decontamination activities during IWCS construction), and soil analytical results. Uranium soil impacts are near the surface and absent in deeper soils.

Uranium concentrations in groundwater were detected above criteria in wells east and south of the former Building 409. These concentrations are consistent with the material storage piles shown on the historical aerial photograph and soil analytical results. Uranium soil impacts are near the surface and absent in deeper soils.

The low permeability of the soils limits vertical migration of uranium impacts in the soil column. The average horizontal groundwater flow velocity at NFSS is 11 inches per year. It would take hundreds of years for a contaminant on site to reach the perimeter of the site.

Summary Table

Objectives	Results	Conclusions
Identify and delineate groundwater contamination in the northern portion of the site.	Only one of the six groundwater monitoring wells installed in the northern portion of the site produced enough groundwater to sample. No exceedances were detected in this deep monitoring well.	The absence of groundwater in the newly installed shallow wells confirms that groundwater flow in the upper water bearing zone is discontinuous in some areas, which suggests that groundwater contamination is not migrating in the northern portion of the site.
Identify and delineate groundwater contamination in the southern portion of the IWCS	Of the seven shallow groundwater monitoring wells installed south of the IWCS, six exceeded the drinking water criterion for total uranium.	Current and newly installed monitoring wells delineate the estimated extent of groundwater contamination south of the IWCS.
Identify the source of increasing uranium concentrations in samples from groundwater monitoring well OW11B	Of the four shallow groundwater monitoring wells installed near groundwater monitoring well OW11B, three exceeded the drinking water criterion for total uranium.	The report concludes that uranium contamination in groundwater south of the IWCS and in the vicinity of groundwater monitoring Well OW11B is due to historic storage practices and to activities performed during the construction of the IWCS.
Eliminate potential pathways for off-site migration of groundwater via the former LOOW subsurface pipelines	There was no bedding material noted at any of the excavated pipeline locations associated with former LOOW activities.	Known potential pathways for off-site transport of groundwater contaminants were eliminated by plugging all known former LOOW subsurface pipelines entering or exiting NFSS. The absence of bedding material surrounding the historic LOOW pipelines indicates the pipelines do not provide a preferential pathway for groundwater contamination.
Evaluate potential groundwater contamination along the 10-inch water pipeline near the southeast corner of the IWCS and eliminate the water line as a potential pathway	There was no radiological contamination detected in the soil surrounding or in the 10-inch water pipeline. There was no bedding material noted at any of the excavated pipeline locations associated with former LOOW activities.	No further investigation of the 10-inch water line is warranted.

Addressing Community and Stakeholder Concerns

The Balance of Plant Operable Unit Field Investigation suggests and is consistent with previous results and interpretations that:

- Groundwater and soil contamination came from historic activities.
- Groundwater contamination is not migrating along the former LOOW subsurface pipelines.
- The Interim Waste Containment Structure at the NFSS is performing as designed and remains protective of human health and the environment.

The groundwater monitoring wells installed during this investigation were added to the Environmental Surveillance Program for the NFSS.

The final report for the Balance of Plant Field Investigation is available at: http://www.lrb.usace.army.mil/Missions/HTRW/FUSRAP/NiagaraFallsStorageSite.aspx in the Reports section.

The U.S. Army Corps of Engineers Buffalo District will conduct an additional investigation of the NFSS Balance of Plant to further define the extent of soil contamination in the Operable Unit. This information will be used to support the detailed comparative evaluation of potential remedial alternatives in the Balance of Plant Operable Unit Feasibility Study.

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