300 Area Uranium Sequestration

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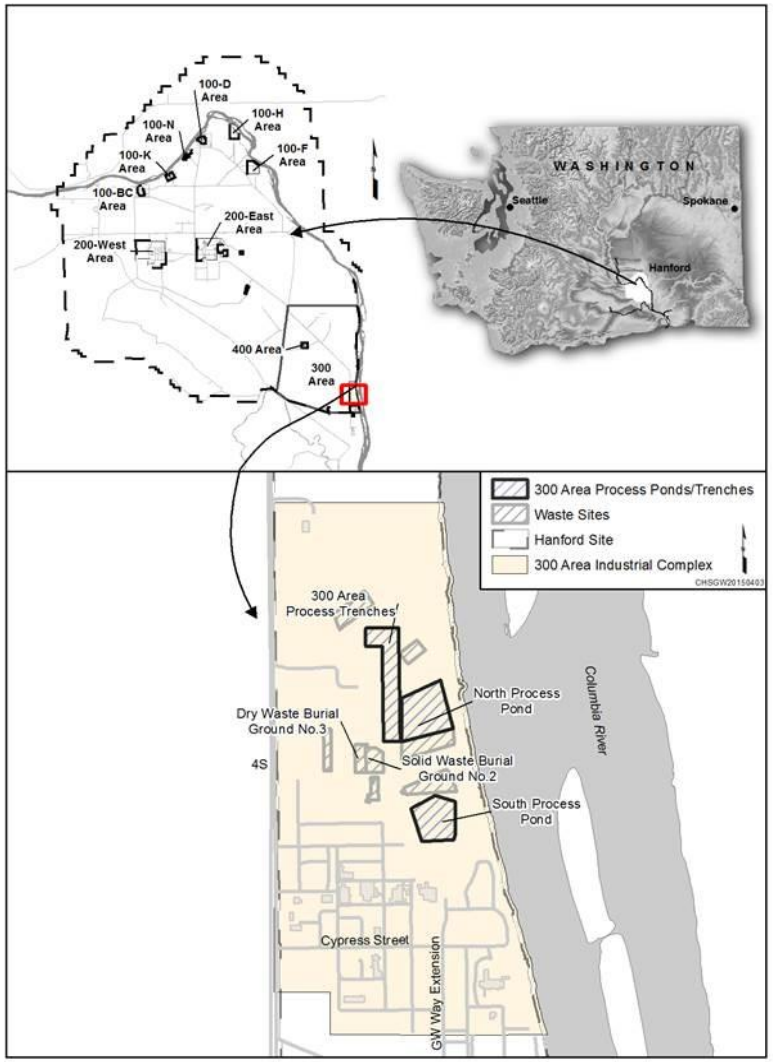
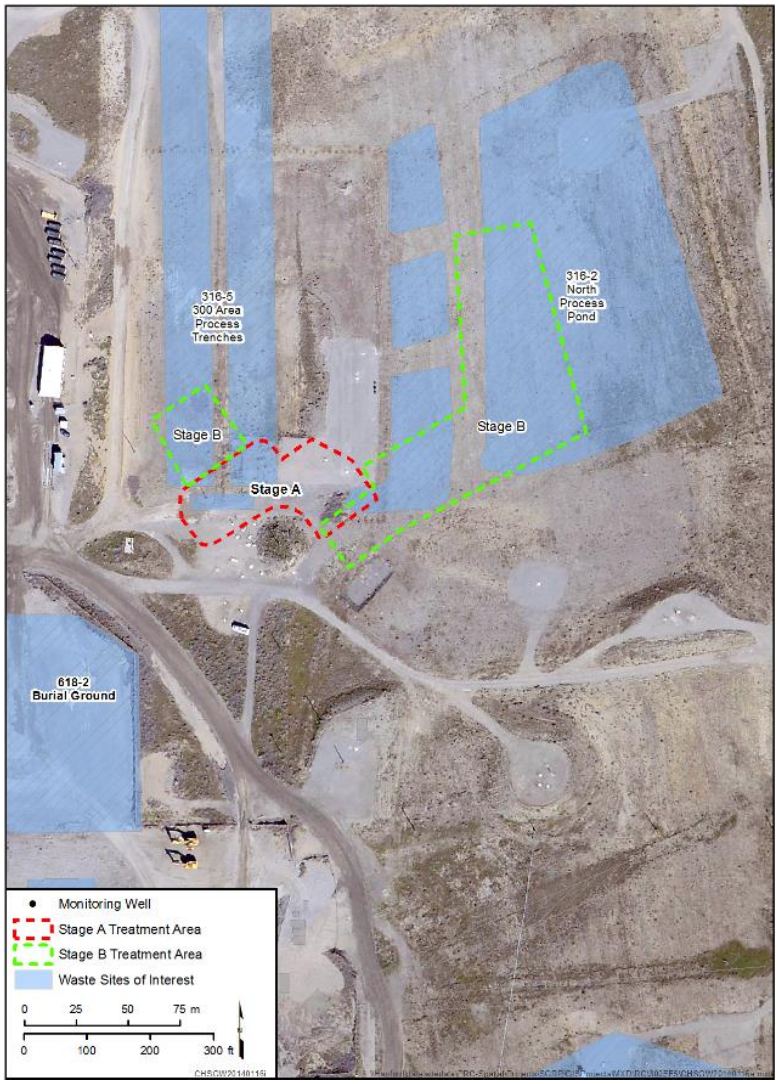
U.S. DEPARTMENT OF ENERGY

300-FF-5 Operable Unit



- The 300 Area is adjacent to the Columbia River in the southern portion of the Hanford Site.
- It contained several facilities and waste disposal sites which supported uranium fuel production and research and development (R&D) activities.
- Contaminant releases at the waste disposal sites resulted in persistent uranium contamination within underlying groundwater which comprises the 300-FF-5 Operable Unit.
- The 300 Area Record of Decision (EPA and DOE, 2013) established the remedial actions for the 300-FF-5 Operable Unit.

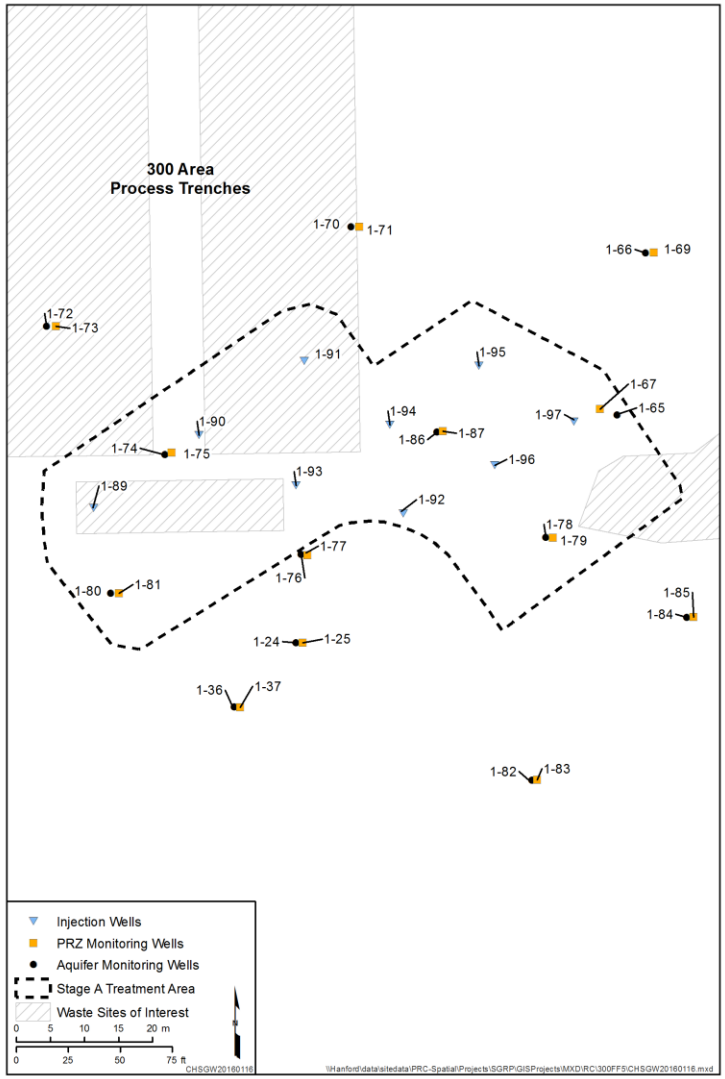
300-FF-5 Stage A & B



- Uranium sequestration will occur in two sequential stages, Stage A and Stage B.
- Phosphate solutions will be infiltrated and injected into the vadose zone, periodically rewetted zone, and groundwater to precipitate phosphate bearing minerals that coat uranium bearing sediments and bind uranium present in soil.
- Stage A was implemented in a 0.75 acre area of high residual uranium contamination in November 2015.
- Stage B will address the remaining 2.25 acres and is in the planning phase.

300-FF-5 Stage A Layout

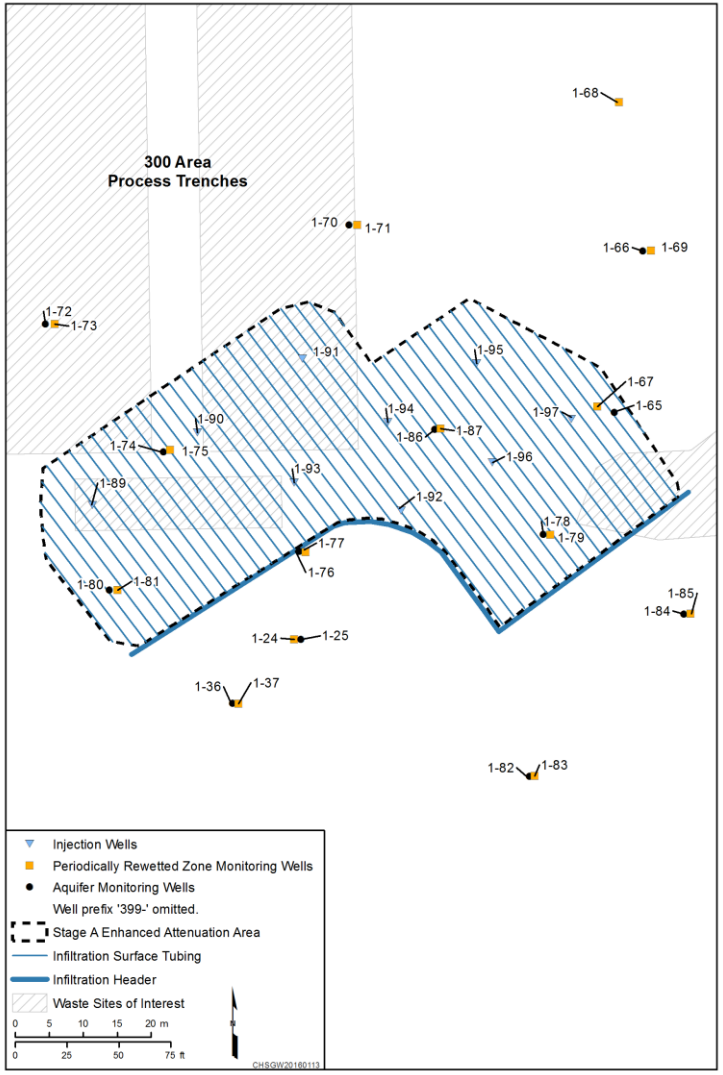
300-FF-5 Stage A Injection Wells (9)



300-FF-5 Aquifer Injections

GOAL	OBSERVATIONS	STAGE B PROPOSED CHANGE
Sequester any uranium mobilized to groundwater as a result of infiltration.	• Increase in phosphate concentrations observed in the monitoring wells located within Stage A • No increase in uranium concentrations detected in down-gradient wells.	Higher and more persistent spikes of phosphate concentrations in the top of aquifer resulted from periodically rewetted zone injections as compared to direct injection into the aquifer.

300-FF-5 Infiltration System



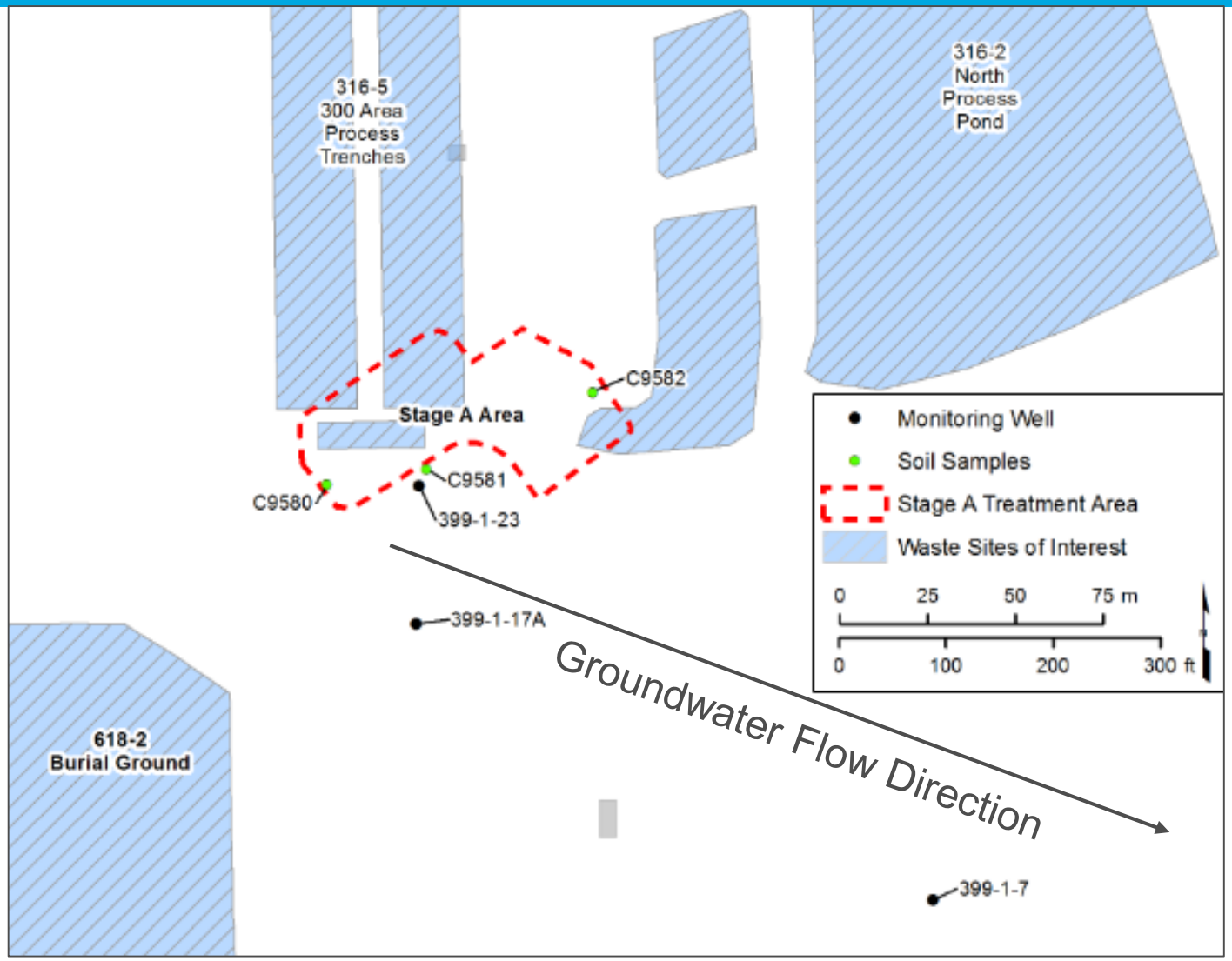
300-FF-5 Infiltration System

GOAL	OBSERVATIONS	STAGE B PROPOSED CHANGE
Deliver phosphate to vadose zone and periodically rewetted zone to sequester uranium.	• Wetting front was well distributed laterally and vertically • Wetting front rate of downward movement varied from 0.75 – 3 meters per day (m/d) • Local temporary increase in uranium concentration observed in monitoring wells • Higher phosphate concentrations in upper vadose zone in 2 of the 3 post-treatment boreholes	Eliminate surface infiltration and inject the phosphate directly into the lower vadose zone. This will eliminate the loss of phosphate to the upper vadoze zone (mostly clean backfill) and will deliver more phosphate to the contaminated sediments in the lower vadose zone.

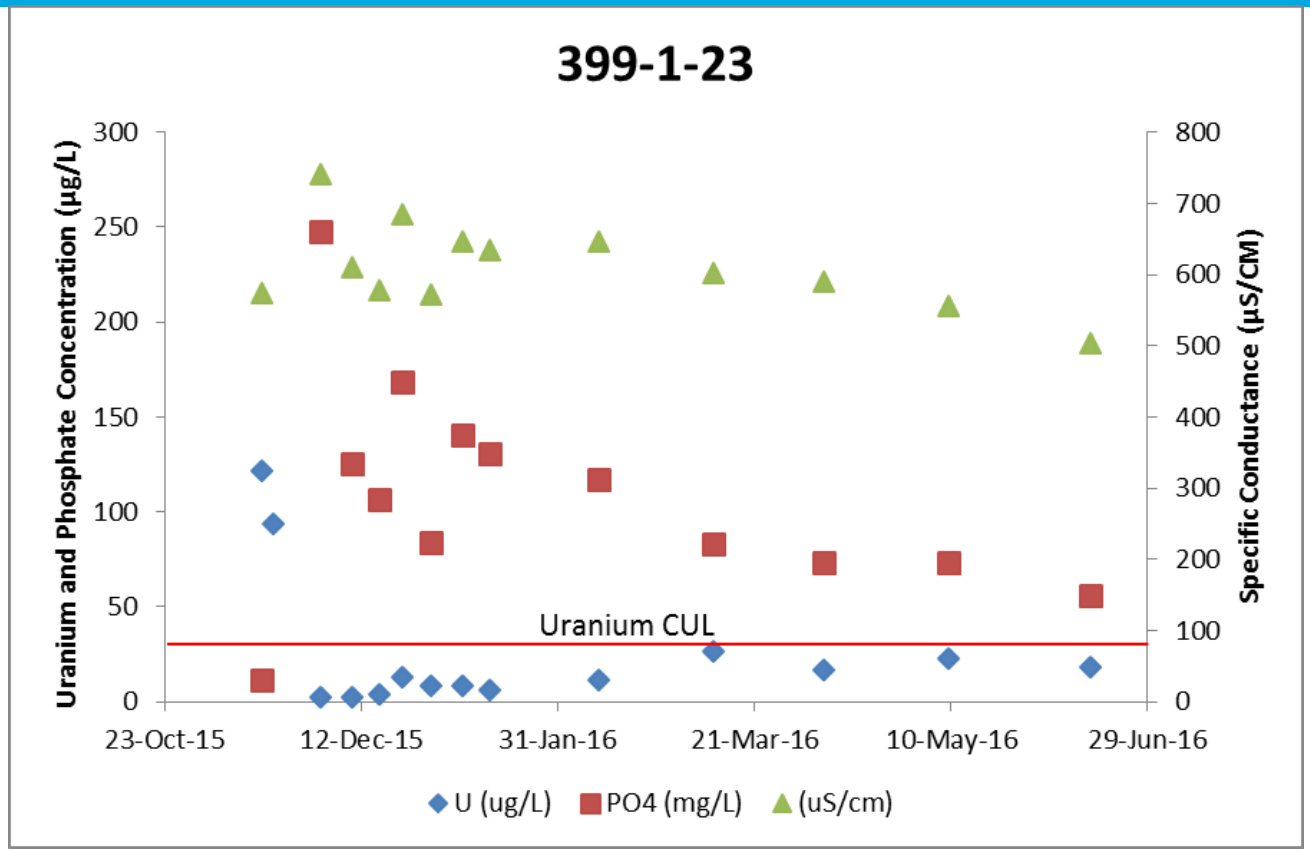
300-FF-5 PRZ Injections

GOAL	OBSERVATIONS	STAGE B PROPOSED CHANGE
Deliver phosphate to periodically rewetted zone to sequester uranium in zone	• Phosphate was detected in periodically rewetted zone monitoring wells at varying concentrations • A temporary spike in uranium in periodically rewetted zone within the treatment area was noted	Inject more phosphate (relative volume) directly into zone using either the same relative number of, or more, injection wells than were used in Stage A.

300-FF-5 Uranium Sequestration Stage A Performance
(Preliminary Results)

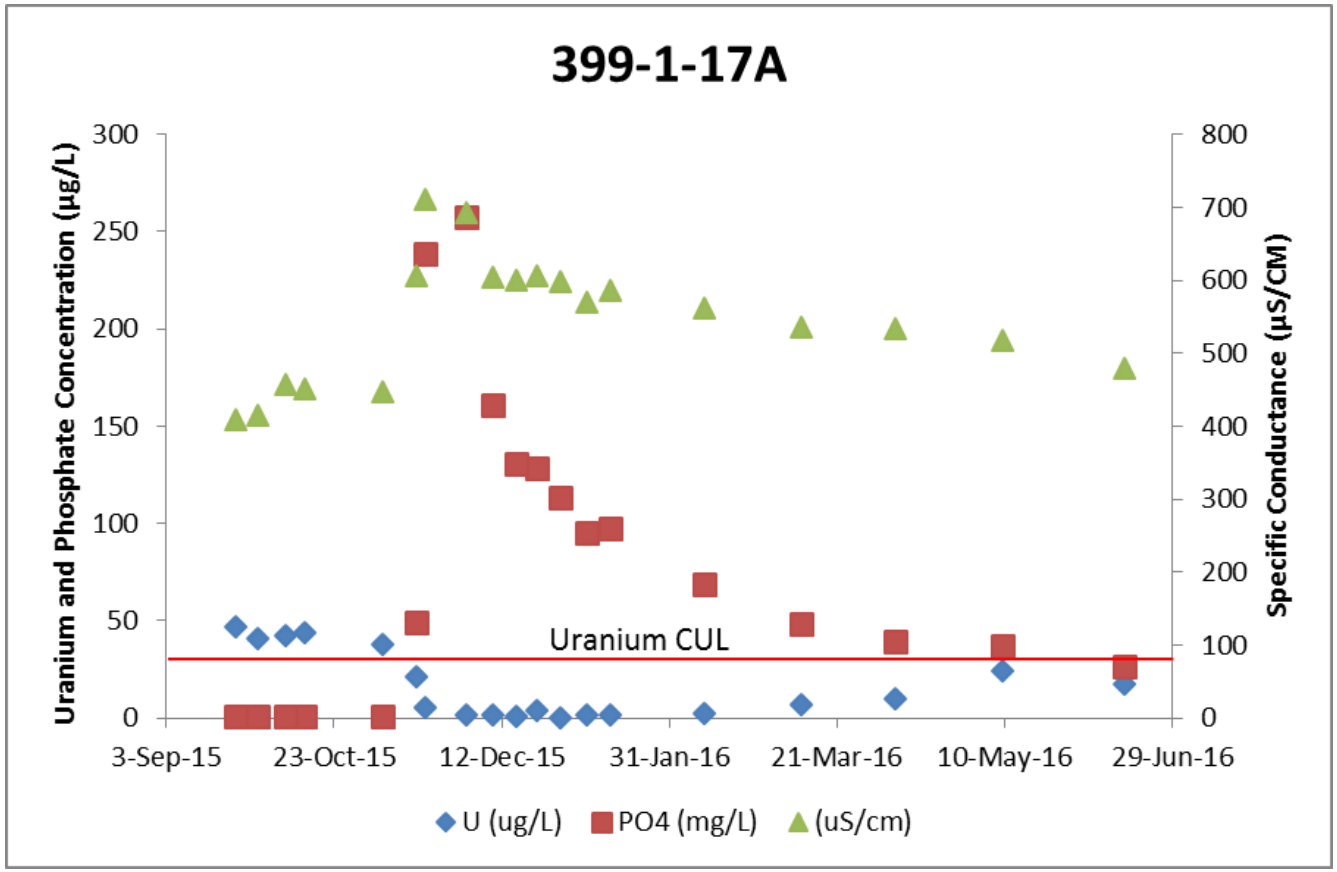


300-FF-5 Uranium Sequestration Stage A Performance
(Preliminary Results)



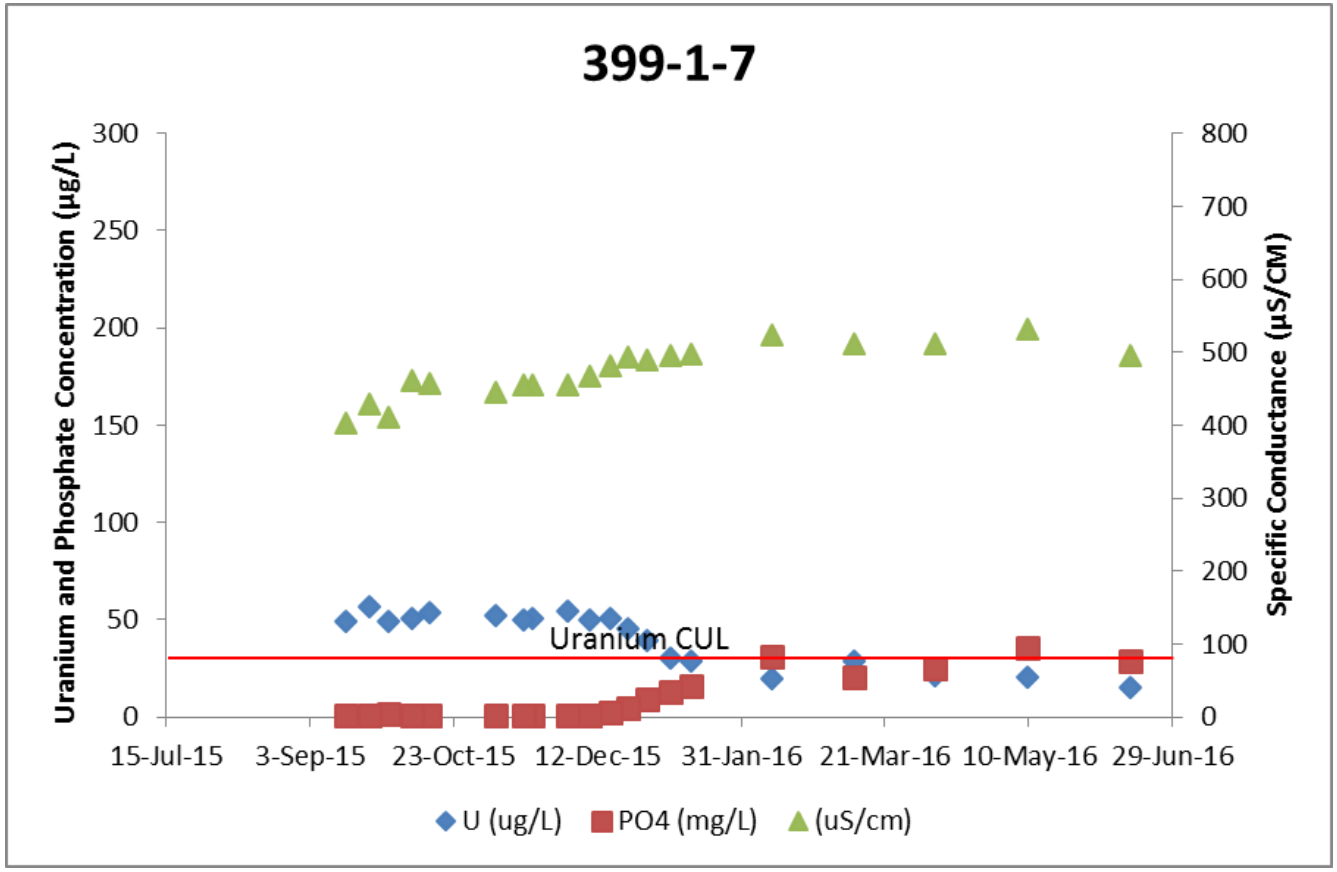
- Groundwater wells down-gradient of Stage A Enhanced Attenuation Area with long-term monitoring records show decline in uranium concentrations. The uranium concentrations remain below the cleanup level (CUL) following the Stage A remedy.

300-FF-5 Uranium Sequestration Stage A Performance
(Preliminary Results)



- Note the decline in uranium concentrations with corresponding increase in phosphate concentrations.

300-FF-5 Uranium Sequestration Stage A Performance
(Preliminary Results)



- Uranium concentrations remained below cleanup level during the observation time period following the Stage A infiltration/injection.

300-FF-5 Uranium Sequestration Stage A Performance
(Preliminary Results)

Sequestration Performance Summary (Stage A)

- Aquifer injections were not as effective at delivering sustained high phosphate concentrations as the periodically rewetted zone injections.
- Periodically rewetted zone injections effectively delivered phosphate to surrounding sediments at levels conducive to apatite (Ca-PO4) mineral formation.
- Infiltration was not effective at delivering high concentration of phosphate uniformly throughout the vadose zone.
- Uranium in 3 down-gradient monitoring wells reduced below cleanup level after treatment, based on first 6 months of monitoring.
- Observations planned in down-gradient wells through at least one re-wetting cycle (summer high water) to assess effectiveness of sequestration in the periodically rewetted zone.

300-FF-5 Propose Refinements for Stage B

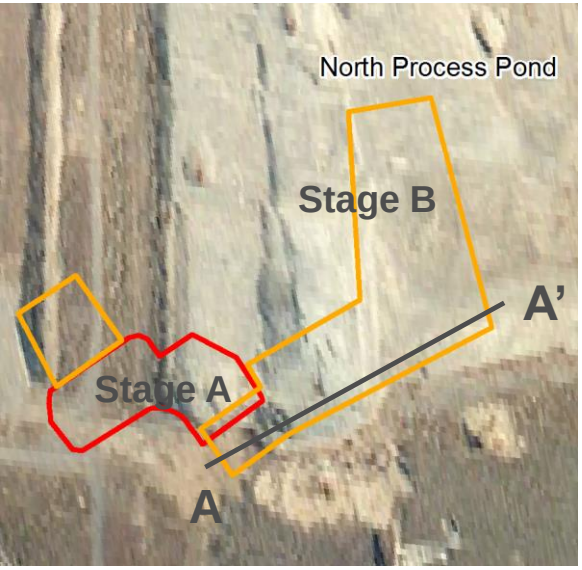
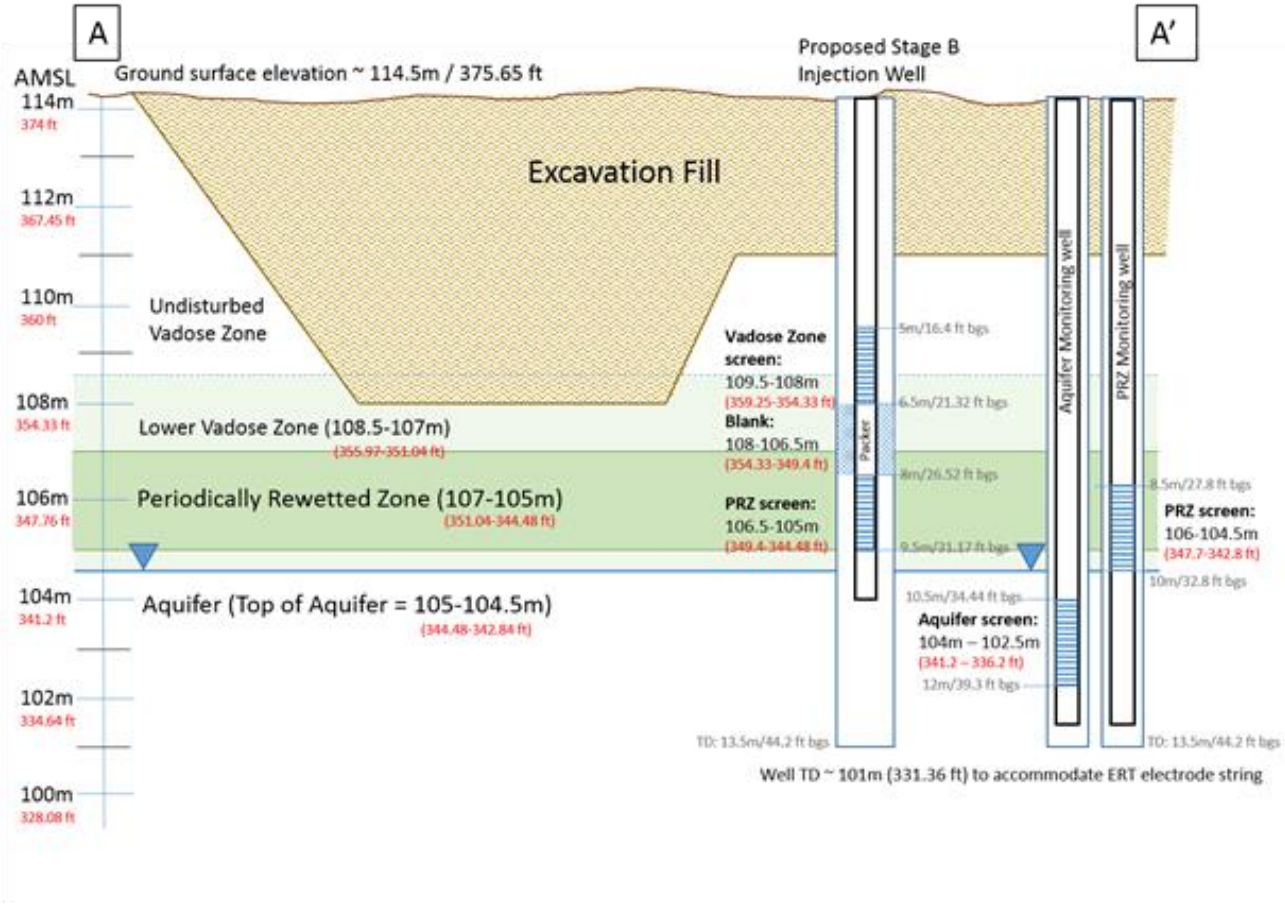
Observation: Higher and more persistent spikes of phosphate concentrations in the top of the aquifer resulted from periodically rewetted zone injections, compared to direct injection into the aquifer.

Proposal:

- Do not inject directly to the aquifer.
- Deliver phosphate to the aquifer via injection to the periodically rewetted zone before injection into lower vadose zone, allowing slower release to aquifer.
- This allows for longer contact of phosphate with sediments in the periodically rewetted zone.

Observation: Infiltration of solution was not effective at uniformly delivering high phosphate concentrations in the lower vadose zone.

Proposal:

- Do not use surface infiltration.
- Achieve infiltration objective via injection into the lower vadose zone.
- Add wells to assure effective lateral coverage of the Stage B area.

300-FF-5 Operable Unit