



Getting the Last 1% for Closure



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Learning Points

- Take Care of Your Capital – You May Need It Longer Than You Planned
- Modify Your Systems as Conditions Change
- Utilize New Technologies When You Have a Clear Objective(s)

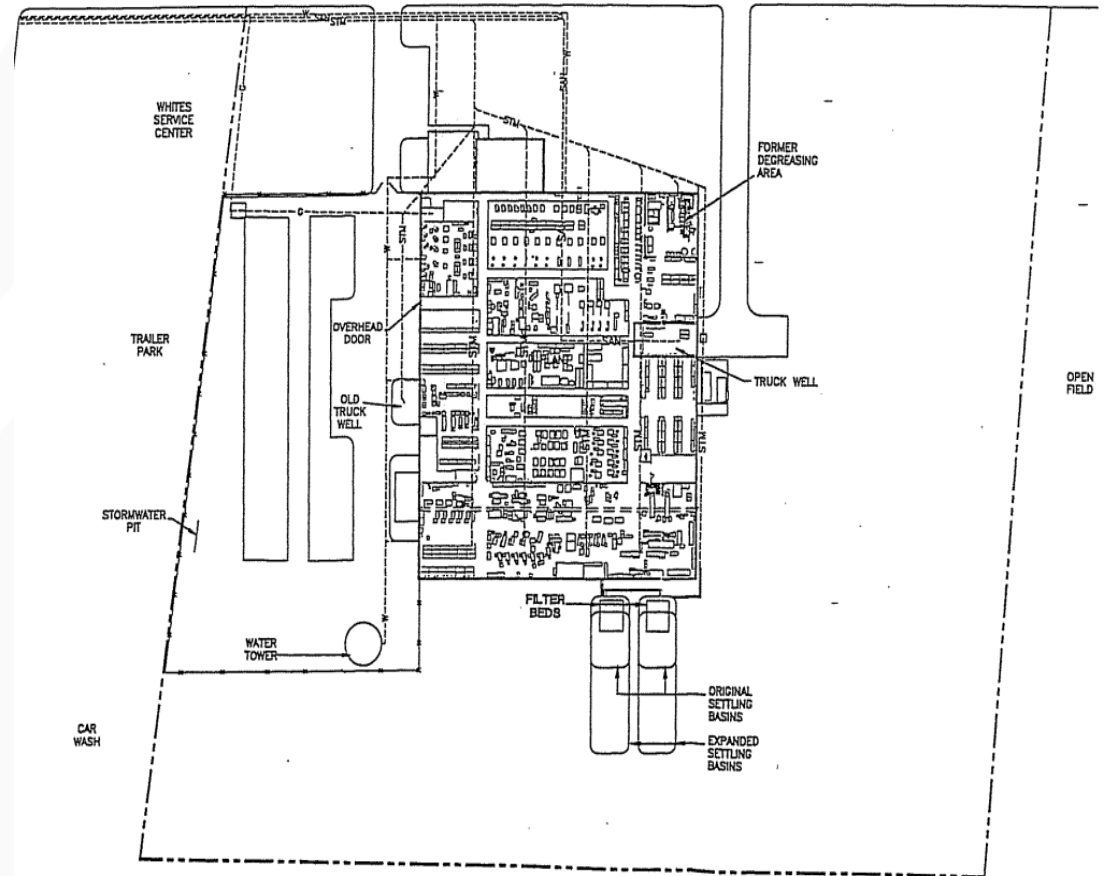


Site Background

- Facility constructed in 1956 on 11-acre property
- TCE and 1,1,1-TCA use until early 1990's
- Facility shutdown in 2009
- Assessments work began in 1989
- Source areas including plating & degreasing areas, outdoor drum storage and unlined wastewater lagoons



Facility Layout (1960s)



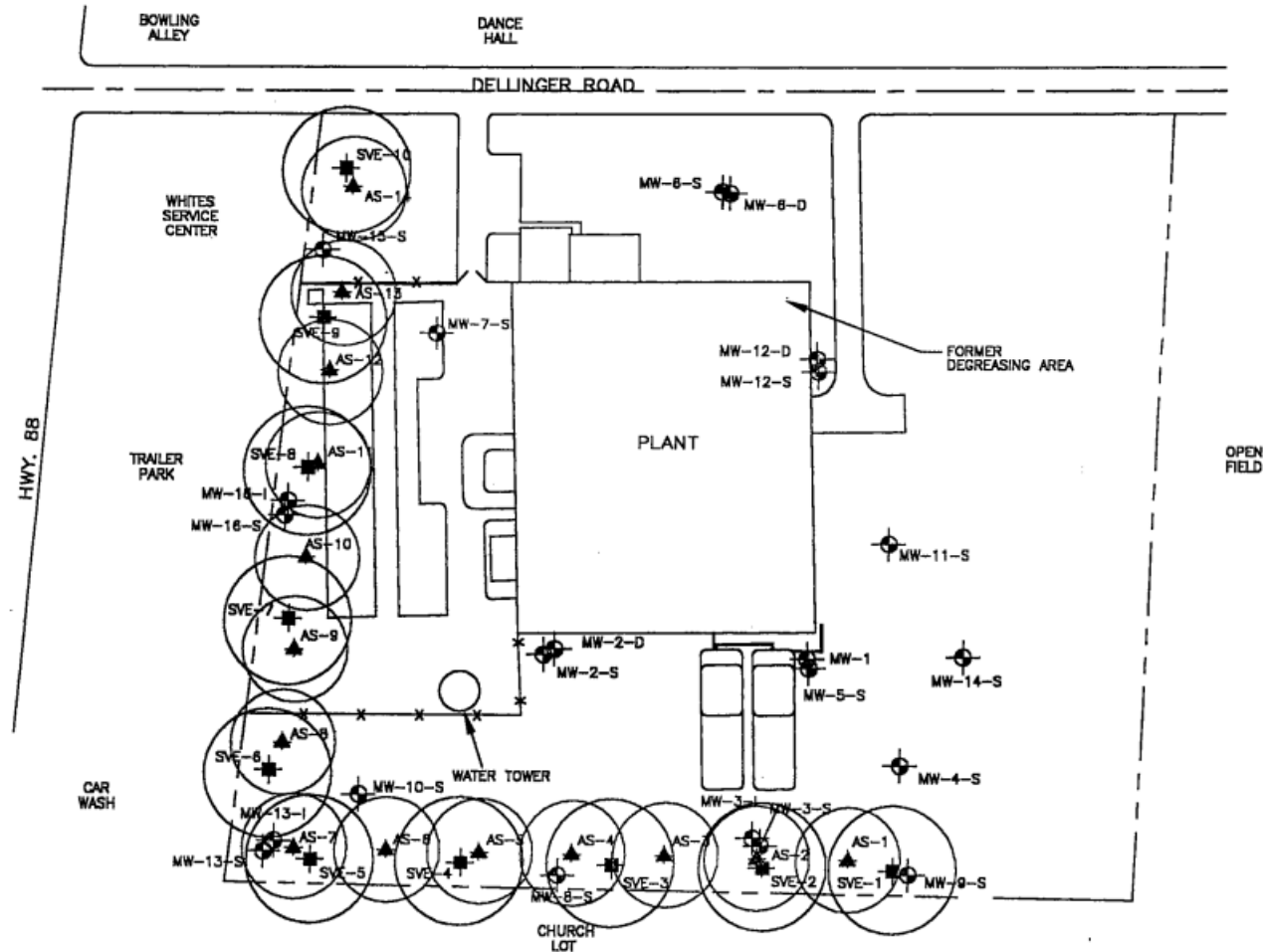
Geology & Hydrogeology Overview

- Regional glacial till overtop a thick outwash (boulders, cobbles and sand)
- Regional groundwater seepage velocity was calculated to be up to 40 ft/day
- On-site seepage velocity was estimated to range from 0.5 to 1 ft/day due to greater fines being present in the outwash
- On-site depth to water was 20-30 feet
- Perched water was present in the former lagoons
- Flow is south/southwest on-site



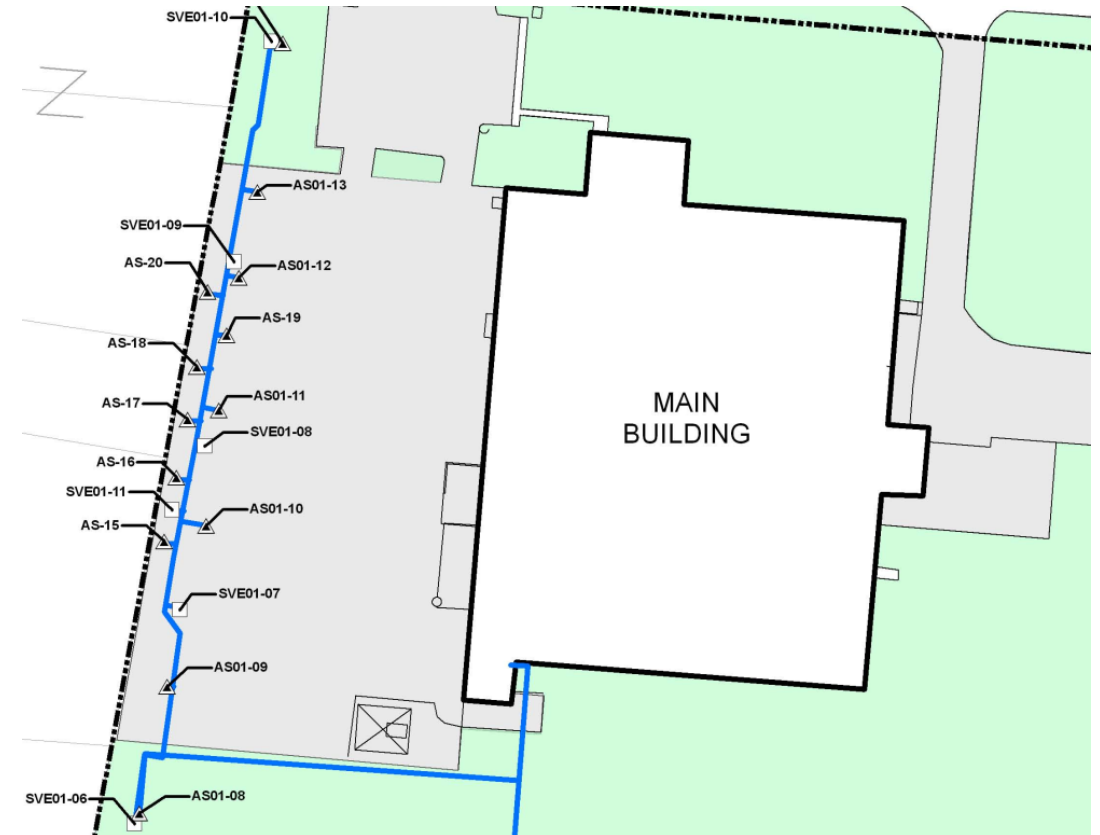
Initial Remediation

- Groundwater - Perimeter Air sparge and vapor extraction system installed in 1998
 - 13 AS wells w/ 90 ft spacing
 - Screened at bottom of the aquifer (60-65 ft)
 - 10 SVE wells w/ 150 ft spacing
 - Screened across the unsaturated zone of the outwash
- Soil - Insitu thermal desorption



Initial Enhancements 2007

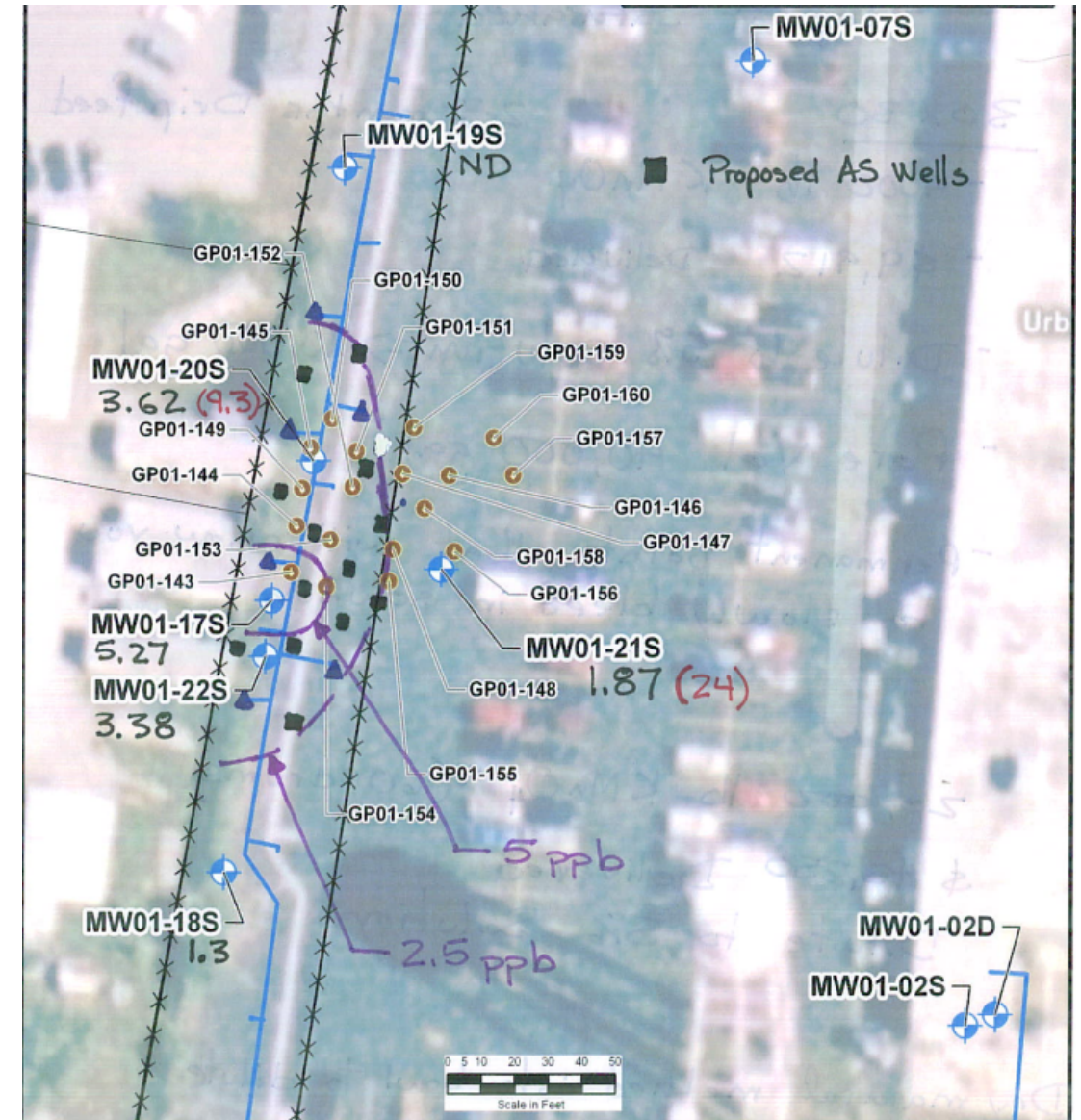
- Perimeter compliance wells below GWQS while system is on
- AS well temp shutdown
- Southern property line leg shutdown
- Western property line wells rebound during shutdown
- Six (6) new AS wells & 1 SVE well added
 - New AS spacing reduced by half to 45 ft



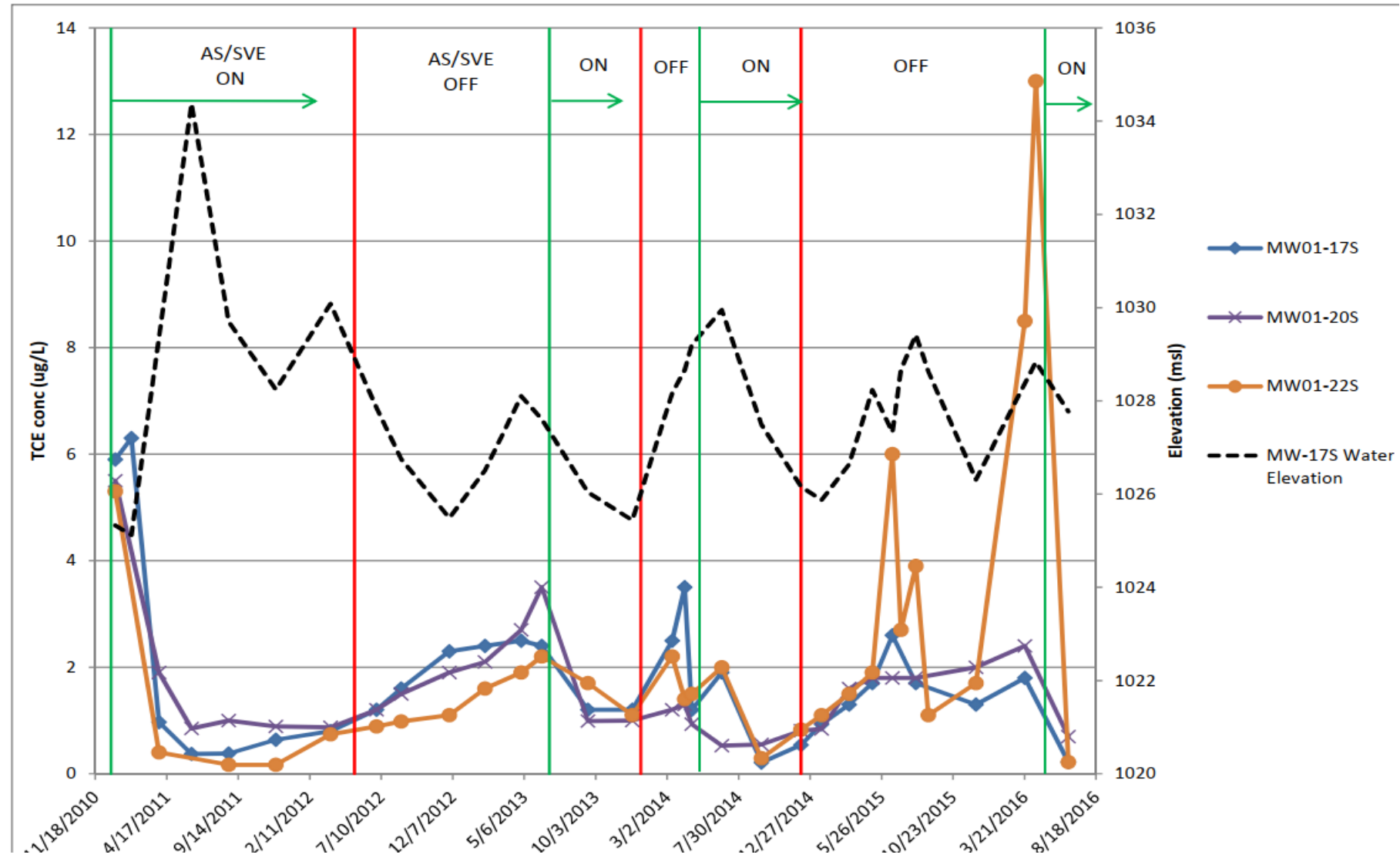
Enhancements 2010

3 wells to go

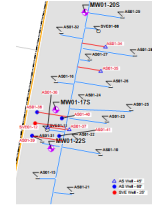
- Vertical profiling using MIP-HPT performed – but no obvious source was identified
- The AS well network was further intensified by adding 13 new wells
 - Well spacing was now reduced to 20-25 ft
 - Switched to micro-porous sparge points
- Depth of AS was changed to 40-46 feet since deeper aquifer was below GWQSs
- System operation was also altered – splitting the wells into A and B, pulsing the system (A on/B off & A off/B on)



Rebounding Continues – 2010 to 2018



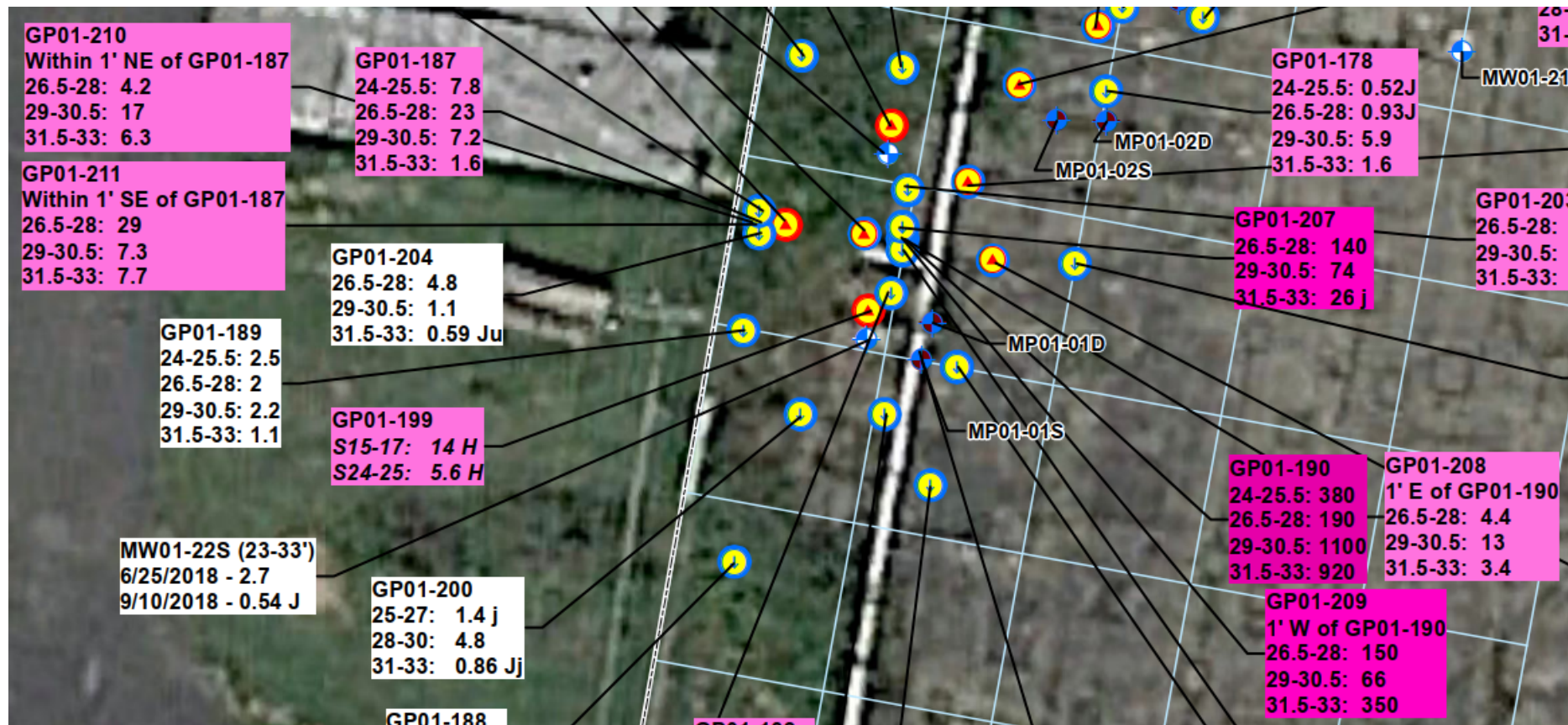
Enhancements 2018 – One Well to Go!



- The technology is working and the capital equipment is still good
- So we tighten the AS well network one more time
- Eight more AS wells and 1 SVE well (screened just above the water table?)
- We've got this!

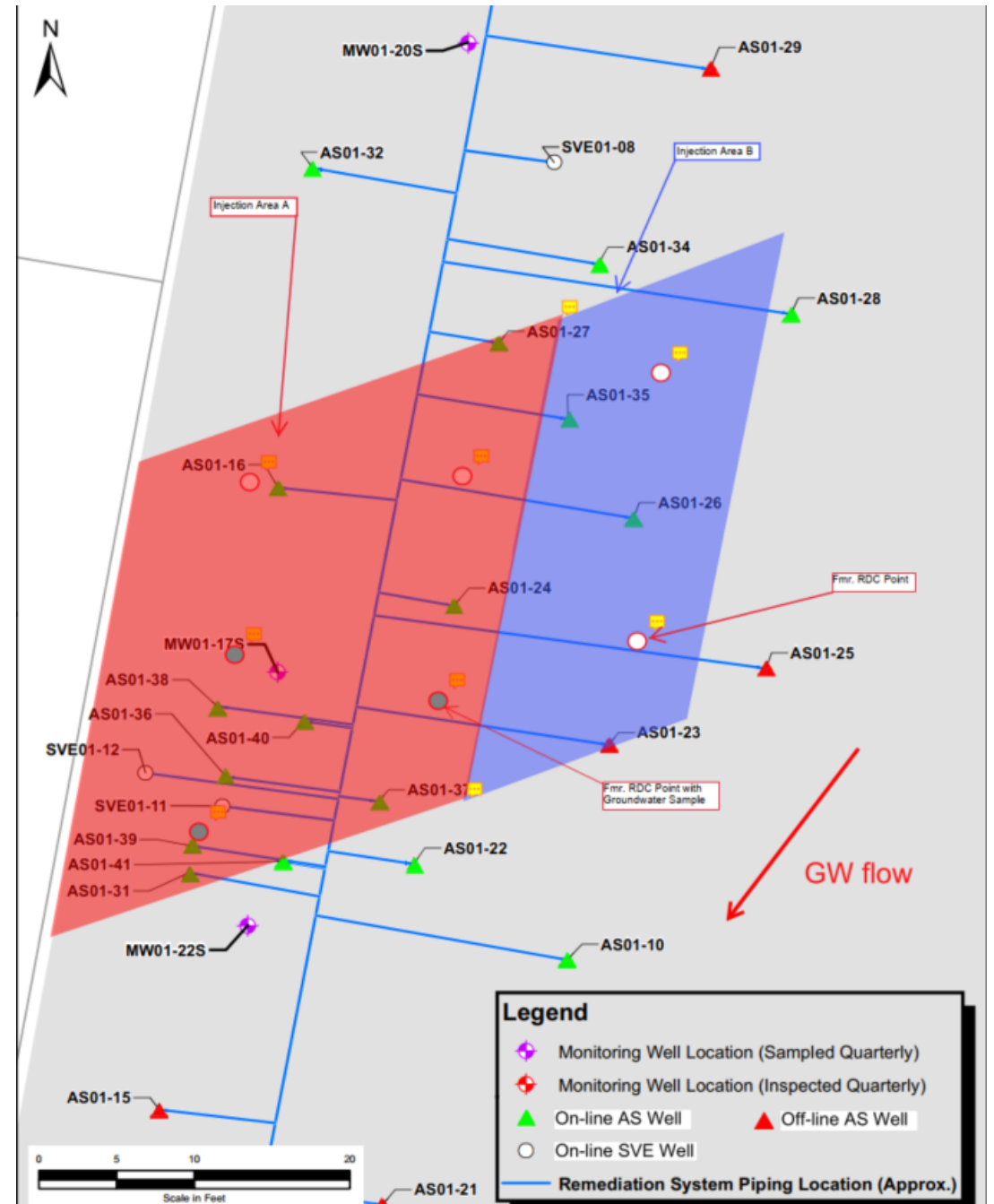
Two Years Later

- Ugh, We don't have this! More vertical profiling (every 2 ft.)...Bingo!



Technology Change

- Flood the target with BOS-100 (activated carbon impregnated with nano-scale metallic iron)
- Treatment area 1,200 sf, two different treatment depths
- A triangular 7.5 ft grid pattern with injections every 2 vertical feet within the saturated zone and seasonally saturated zone.
- Post-injection confirmation sampling at 30, 60 and 90 days predominantly non-detect



Summary

- AS/SVE was an excellent technology for the site conditions and project goals
- Site characterization data collected post-installation allowed for intelligent system optimization decisions
- Technology success and well maintained mechanical equipment allowed the project team to squeeze the most out of the system
- A technology change was only made once a clear source area was identified and could be targeted



Questions?

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