LESSONS LEARNED FROM DESKTOP OPTIMIZATION EFFORT FOR FUDS

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PROBLEM STATEMENT

- Many Formerly Used Defense Sites (FUDS) Ground Water (GW) Sites
  - ~ 200 ground water remediation sites (small and large)
  - Represent large % of portfolio costs with long “tails” and high uncertainty
- HQ objective to “move the needle” on accelerating closure, reduce cost-to-complete
- Traditional optimization studies relatively slow, expensive
  - Justified for some projects
  - USACE optimization process: Remediation System Evaluation (RSE)
- Looking for faster process to assess progress of full portfolio of FUDS ground water sites

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OPTIMIZATION PROGRAM PROCESS – STARTED FY18

- Selected 20 sites from two largest FUDS Districts based on discussions with Division & District Program Managers
- Small team (2 person, senior engineers and geologists)
  - Developed standard checklist
  - Gathered key documents (Decision Document, RI, more recent treatment and sampling data, cost)
  - Brainstorm – "kitchen sink" approach to recommendations
  - Kick-off meeting or call with PM/project team
  - Rapid assessment, brief (2-4 page) memo on findings and recommendations (peer review for consistency)
- Follow-up meetings/calls with District
- May recommend RSE if justified
- Identify common/systemic barriers to progress for HQ

OPTIMIZATION PROGRAM PROCESS

Sites considered

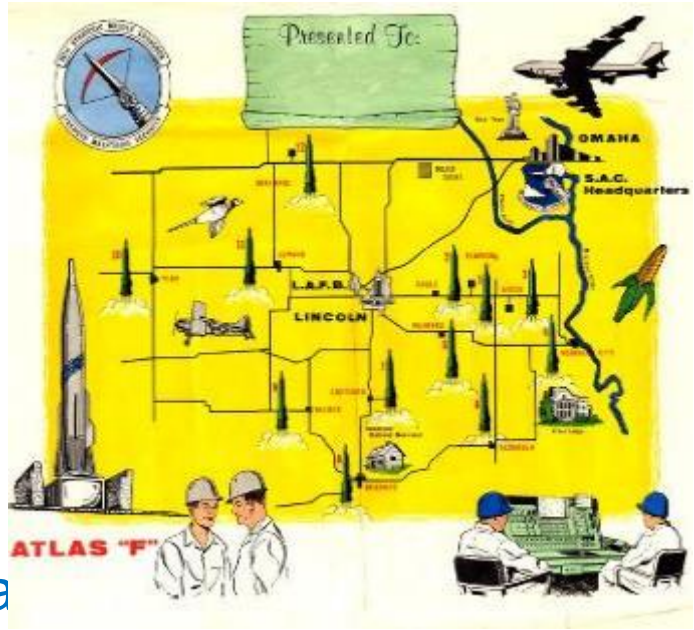
- Mostly former intercontinental ballistic missile sites (Atlas, Titan)
- Former munitions manufacturing site
- Former Air Force radar site

Contaminants

- Chlorinated solvents
- Explosives

Existing remedies

- In-situ bioremediation, chemical oxida
- Pump & treat at manufacturing site
- Monitored natural attenuation



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KEY RESULTS AND RECOMMENDATIONS

- Sites mostly making progress towards RAOs, in some cases quite substantial progress
- Many sites believed to have overly optimistic “Response Complete” dates and inadequate or no timeframe projections
- Contractors taking varied approaches to amendment injection with varied success
  - Direct injection (vertical wells, direct push) most common
  - Ground water recirculation for one site

KEY RESULTS AND RECOMMENDATIONS

- Issues with adequate treatment of “hot spot” areas
  - Additional (high resolution) characterization or vertical profiling to target treatment
  - Need for more aggressive initial technologies and/or treatment trains (prior to reaching “plateau/tail” conditions)
  - Ground water recirculation not utilized frequently, and considered option to accelerate cleanup for P&T and injections
- Program level recommendations
  - Follow-up encourages implementation of recommendations
  - Tracking recommendations, implementation for assessing full benefit of effort
- Costs ~ $5,000 per site

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KEY RESULTS AND RECOMMENDATIONS

- Common to continue active treatment after reaching plateau/tail conditions
  - Resulting recommendation to transition to MNA or try one or two more injection events max
  - Develop interim metrics for ending active treatment and remedy/MNA transition (measure of “plateau/tail” condition)
- Difficulties treating fine-grained heterogeneous lithology
  - Address with aggressive technology and better characterization
  - Consider need for alternative RAOs
- Monitoring optimization recommendations

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ISSUES IDENTIFIED

- All DDs had an “aquifer restoration to MCLs” RAO
  - Several impacted units arguably not suitable for potable use (e.g., perched aquifers or low yield shallow unit)
  - Barrier to achieving “Response Complete” by FY21 or accelerated timeframe
  - Consider need for alternative RAOs
  - Recognize need to continue long-term management & monitoring of sites (MNA, LTM, ICs)
- Others (PBCs, funding flexibility, existing remedy components, need for Amended DDs)
- Planning ~20 sites per FY over 6 years

CASE STUDY – MISSILE FACILITY IN NE

COCs: TCE and daughter products

RA: Enhanced Reductive Dechlorination (ERD)

Single injection event/MNA evaluation

RAOs: Restore aquifer to DWS shallow and deep

Issues:

- Large off site plume
- Right-of-entry (RoE) limitations
- Irrigation wells/residences adjacent to the site
- MNA will not meet MCLs by FY2021

Recommendations:

- Use GW recirculation option for off-site plume
- Second on-site ERD injection event if rebound occurs
- Gain RoE to off site monitoring wells
- Optimize monitoring program

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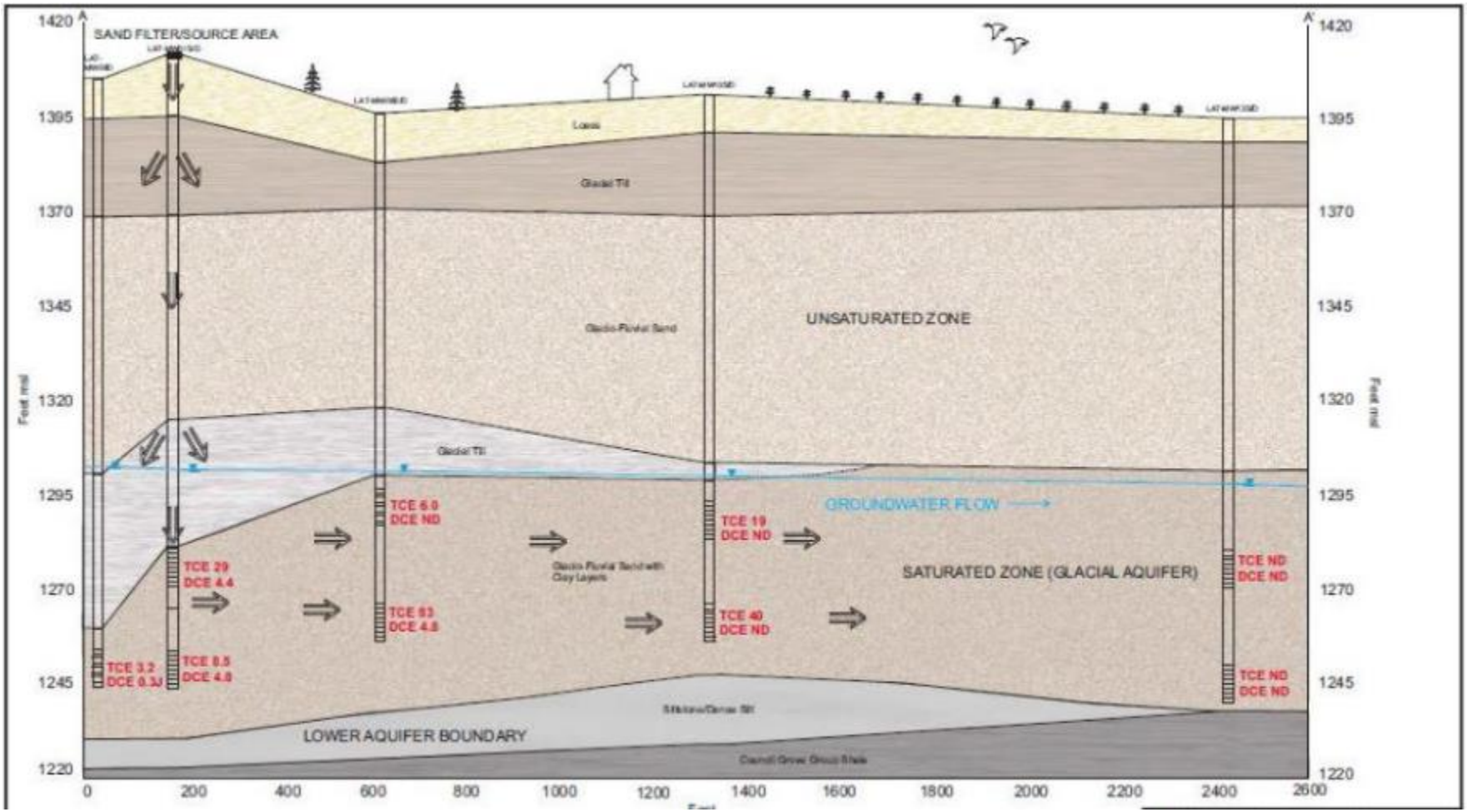
CASE STUDY #1 – GEOLOGIC CROSS-SECTION



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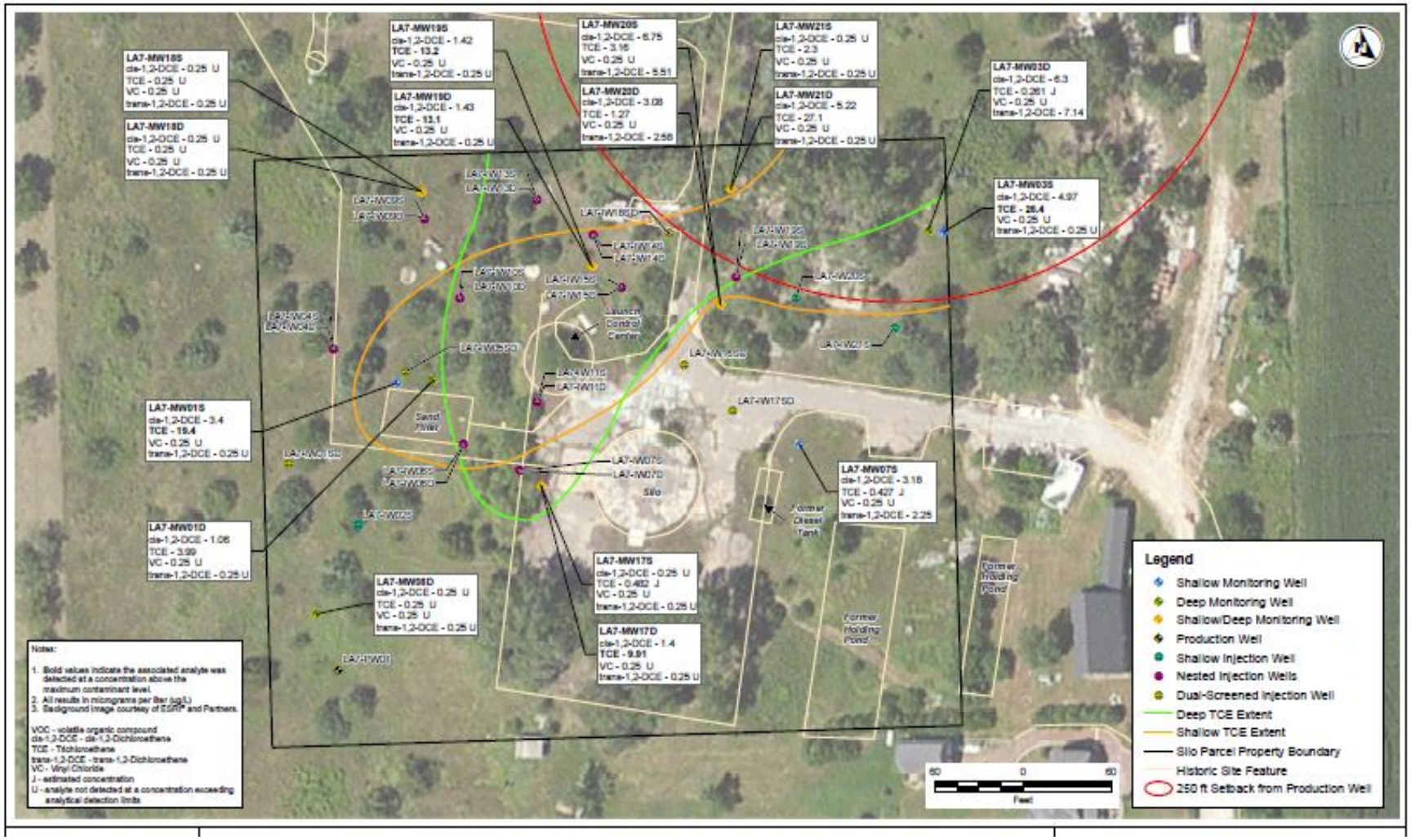
CASE STUDY #1 – 2015 TCE PLUME MAP



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CASE STUDY #2 – MISSILE FACILITY IN CO

COCs: TCE and daughter products

RA: Hybrid ZVI/reductive dechlorination (ERD) w/hydraulic fracturing in perched sandstone unit (50 to 80 ft bgs)

RAOs: Aquifer restoration to MCLs

Issues:

- Inconsistent to no influence at mid-plume MWs
- TCE/DCE rebound and some VC at multiple MWs
- Complex geology contributes to high uncertainty
- Treatment/MNA will not meet MCLs by FY2021

Recommendations:

- Closer borings in “hot spots”/permanent injection wells
- HRSC in mid-plume (multi-level testing; MBTs-CSIA)
- Tracer testing for amendment injections
- Consider alternative RAOs/gwater RGs

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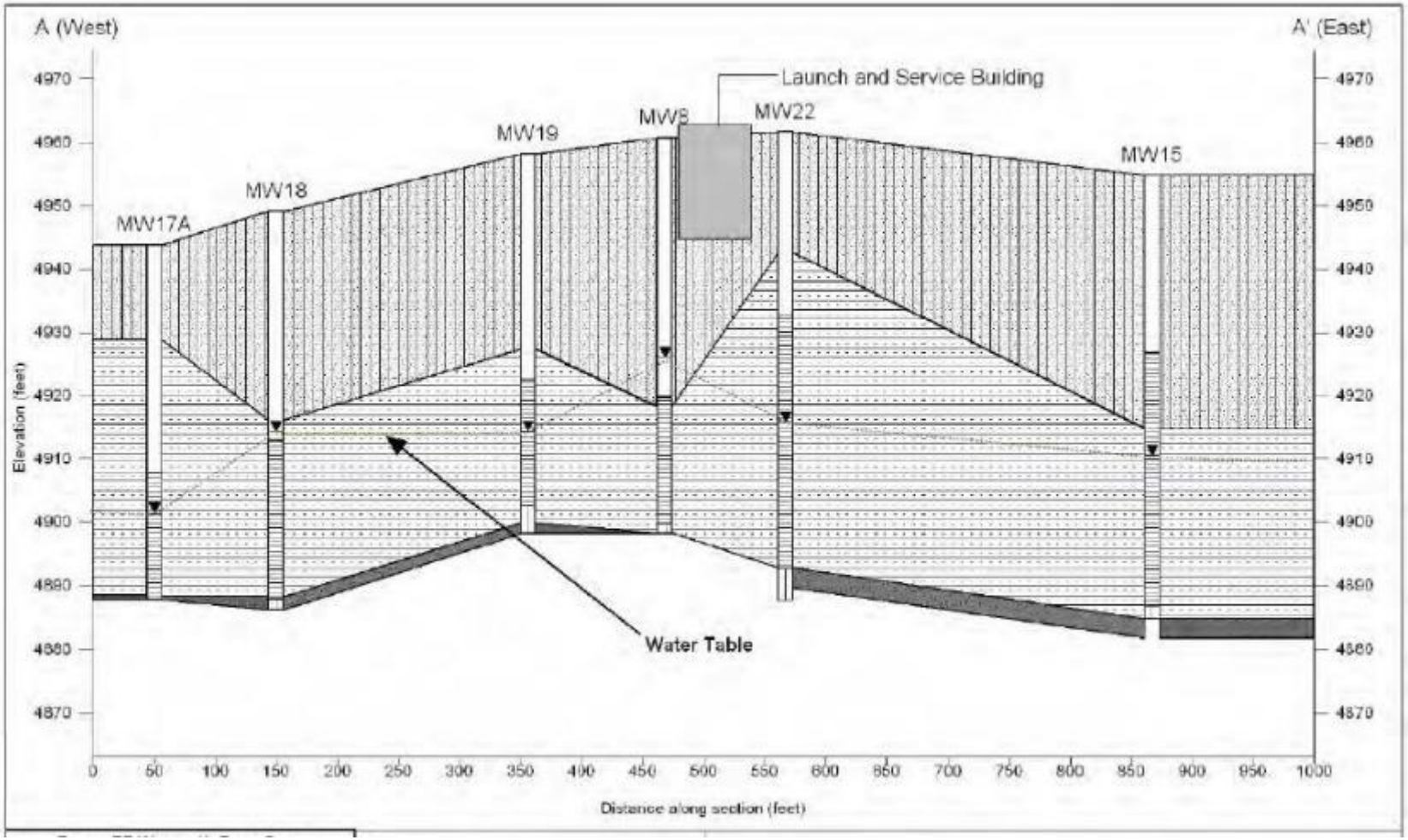
CASE STUDY #2 GEOLOGIC CROSS-SECTION



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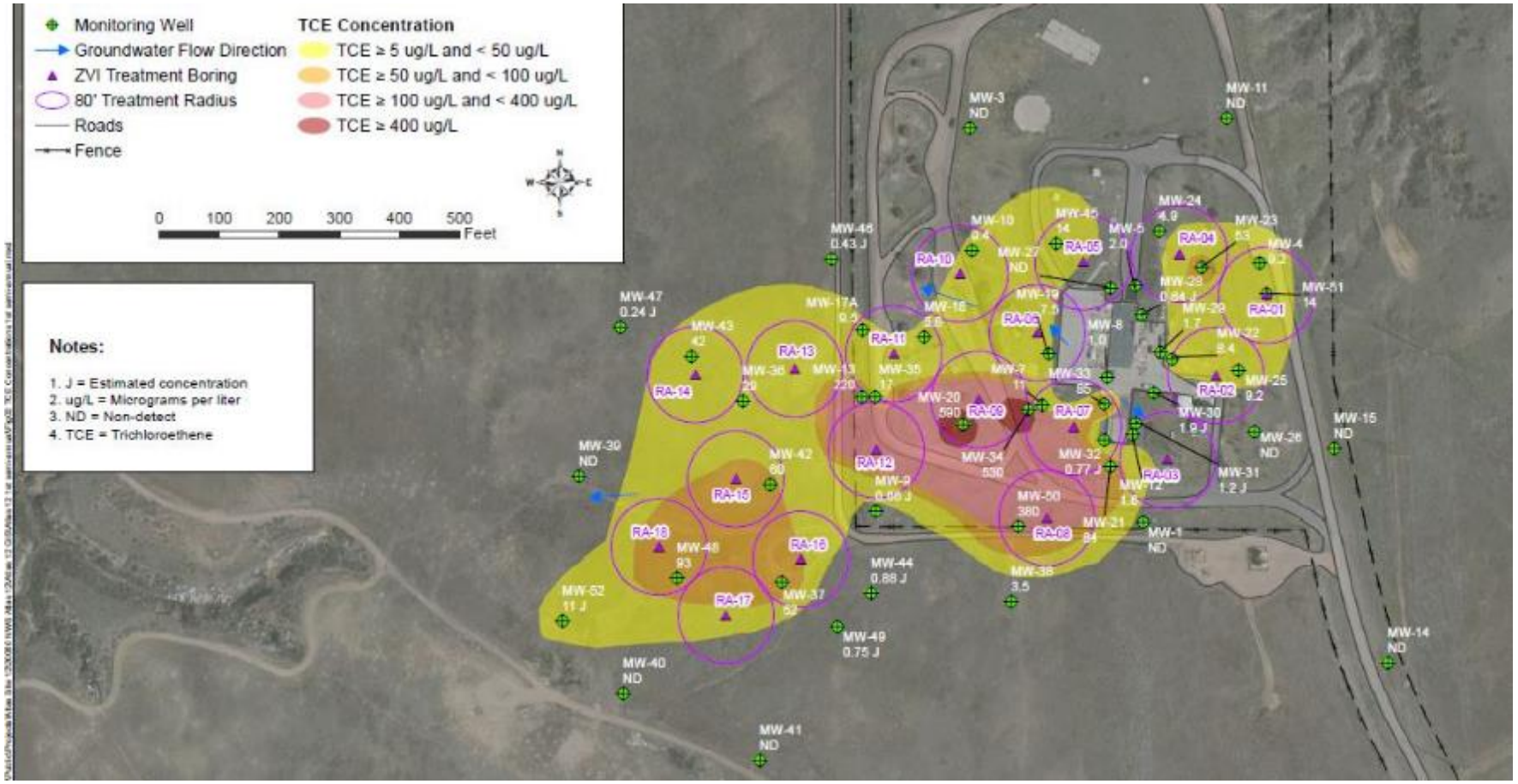
CASE STUDY #2 RECENT PLUME/INJECTION MAP



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