NAVFAC
Naval Facilities Engineering Command
MID-ATLANTIC

An Alternative Approach at a Hydrogeological Complex Site Contaminated with Chlorinated Compounds

James M. Tarr, CPG, CG
Remedial Project Manager
NAVFAC Mid-Atlantic

Federal Remediation Technologies Roundtable
General Meeting
November 14, 2012

Factors Inhibiting Groundwater Restoration

Source: Charsky, (2007)

- Hydrogeologic
- Complex sedimentary deposits
- Aquifers of low permeability
- Certain types of fractured bedrock
- Contaminant related
- Potential to become sorbed onto or lodged within soil or rock comprising the aquifer
- Difficult to locate or remove and extensive volume or limited access to contamination exists

Sites With TIW Determinations

Source: Charsky, (2007)

- TIW is one of six reasons for an applicable or relevant and appropriate requirement (ARAR) waiver under CERCLA (TIW Guidance, 1993)
- DNAPL is difficult to locate and capture due to its ability to sink to the bottom and move to deeper areas of the aquifer
- Fractured bedrock sites
- Nearly impossible to intercept and capture contamination at all fractures and openings

Basis for TIW

Source: Charsky, (2007)

- Presence of DNAPL or fractured bedrock are not by themselves sufficient to justify a TIW determination (TIW Guidance, 1993).

- The TIW determination needs to be made on a contaminant specific basis and on a media specific basis for cleanup standards contaminant-media.

NSA Mechanicsburg, PA
Background

- 1994 Placed on National Priorities List (NPL)
  - Site 3 (Burn Pits 1 & 2) used for disposal of liquid wastes from 1940's to 1977 used for disposal
    - Soil and groundwater impacted, chlorinated VOCs
    - Dye tracer testing used to confirm flow through karst conduits
- Mid to late 1990's – Removal Action
  - Excavation of burn pits and offsite disposal of 47,000 tons of source material down to bedrock surface (see next slide)
- 2000 – Post-removal action soils ROD
  - Institutional controls (deed notice and land use restrictions)

Burn Pit Excavations

Background (con't)

2004 – Site 3 Groundwater ROD signed prevent exposure to contaminants

- Prevent migration of contaminants in groundwater to surface water
- Treat/control free and residual product, unless it is deemed technically impracticable to do so
- Meet Preliminary Goals (PRGs) and Maximum Contaminant Levels (MCLs), unless it is determined technically impracticable to do so

Background (con't)

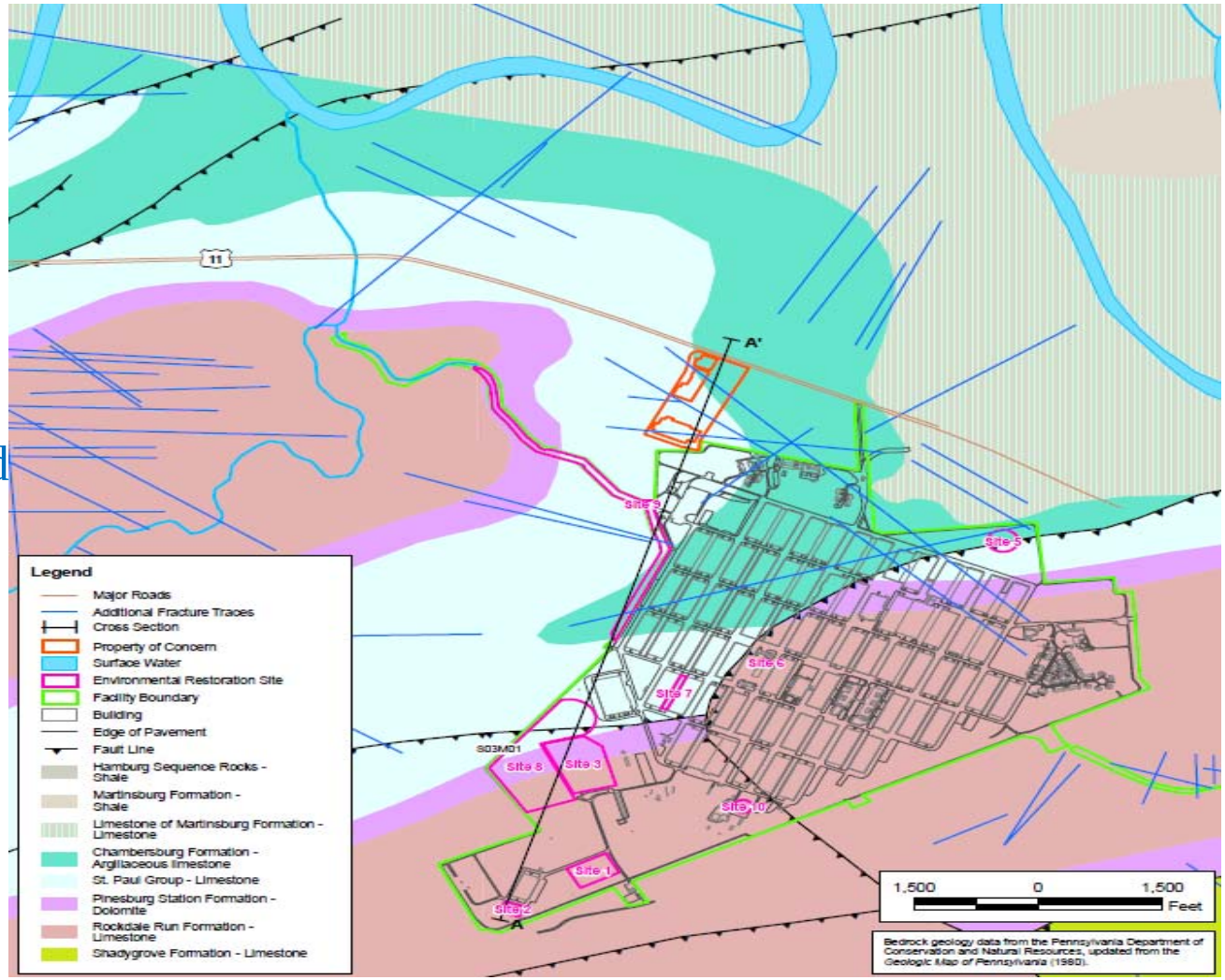
- Remedial approach selected in the ROD to address the Remedial Action Operation (RAOs) included:
  - Prohibition of groundwater use (LUCs)
  - In-situ chemical oxidation (hydrogen peroxide/chelated iron catalyst) over 40 injection points in source areas at multiple depths
  - Post-injection monitoring

- 2004 – Navy implemented two phases of chemical oxidant injection activities total of four rounds totaling 194,071 gallons

- LUCs in are place, data indicates the site/plume is stable and under Navy control within NSA Mechanicsburg boundaries

Basewide Geology

- Folded, faulted, fractured, dense microcrystalline carbonate rock
- Groundwater flow through interconnected fractures



Current Status

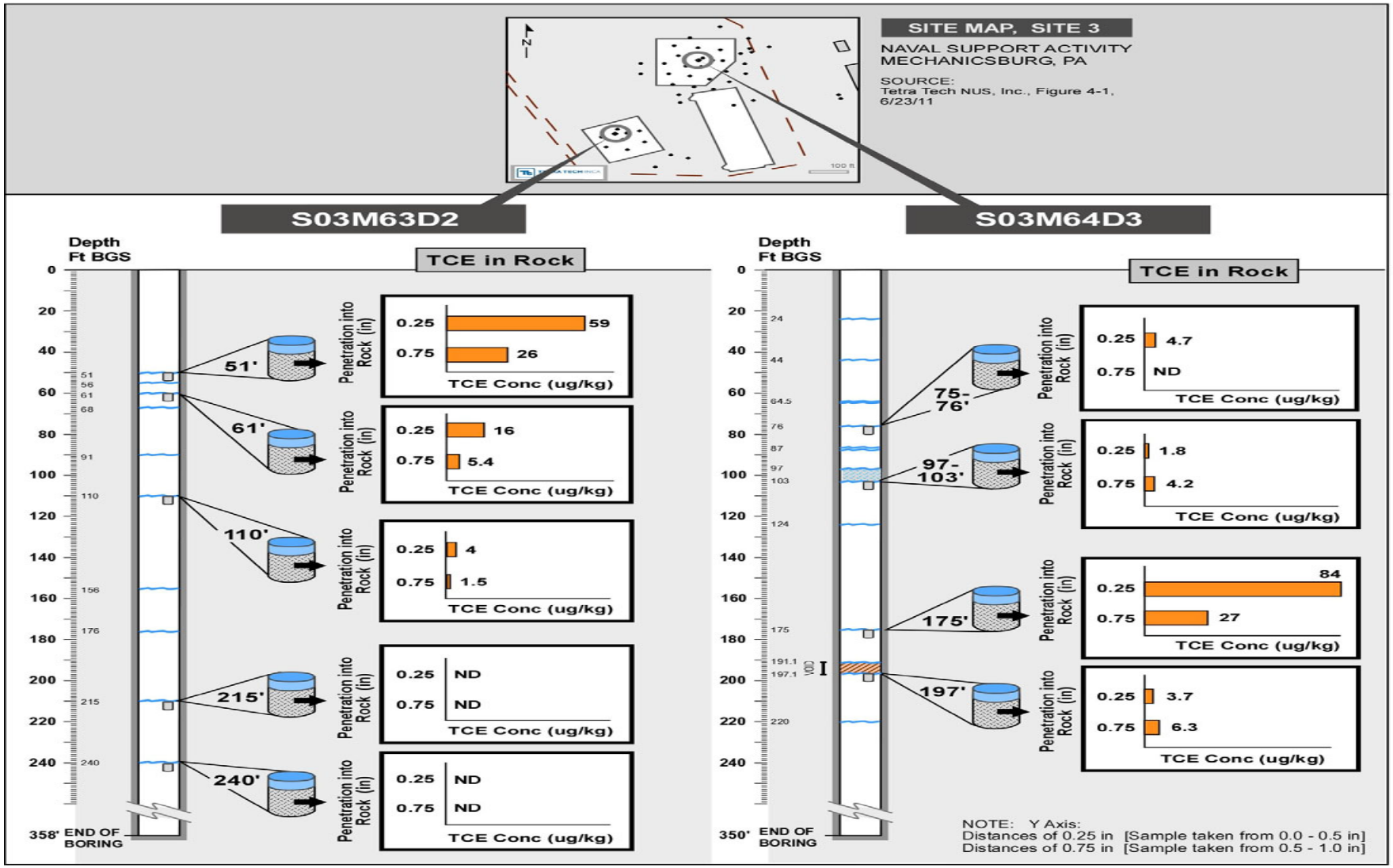
- Significant contaminant levels remain despite soil removal, and aggressive in-situ chemical oxidation program.
- Effectiveness of chem. ox. injection at Site 3 was limited
- Short-term spikes in concentrations after drilling activities suggest that pockets of NAPL are still present at depth.
- Some contamination is located in inaccessible locations, i.e. tight, dead-end fractures, and has diffused into the rock matrix at depth.

Current Status (con't)

- A long term groundwater monitoring program has been in place since 2004
- Sampling of selected wells, groundwater flow evaluation, and contaminant trend analysis
- Due to the persistent presence of VOCs at levels above cleanup goals, the partnering team is working towards a Post Implementation (TIW) for deep groundwater
  - TIW waives timeframe for attaining cleanup levels
  - TIW does not eliminate the need for plume containment

Matrix Diffusion

Source: Newell, (2012)



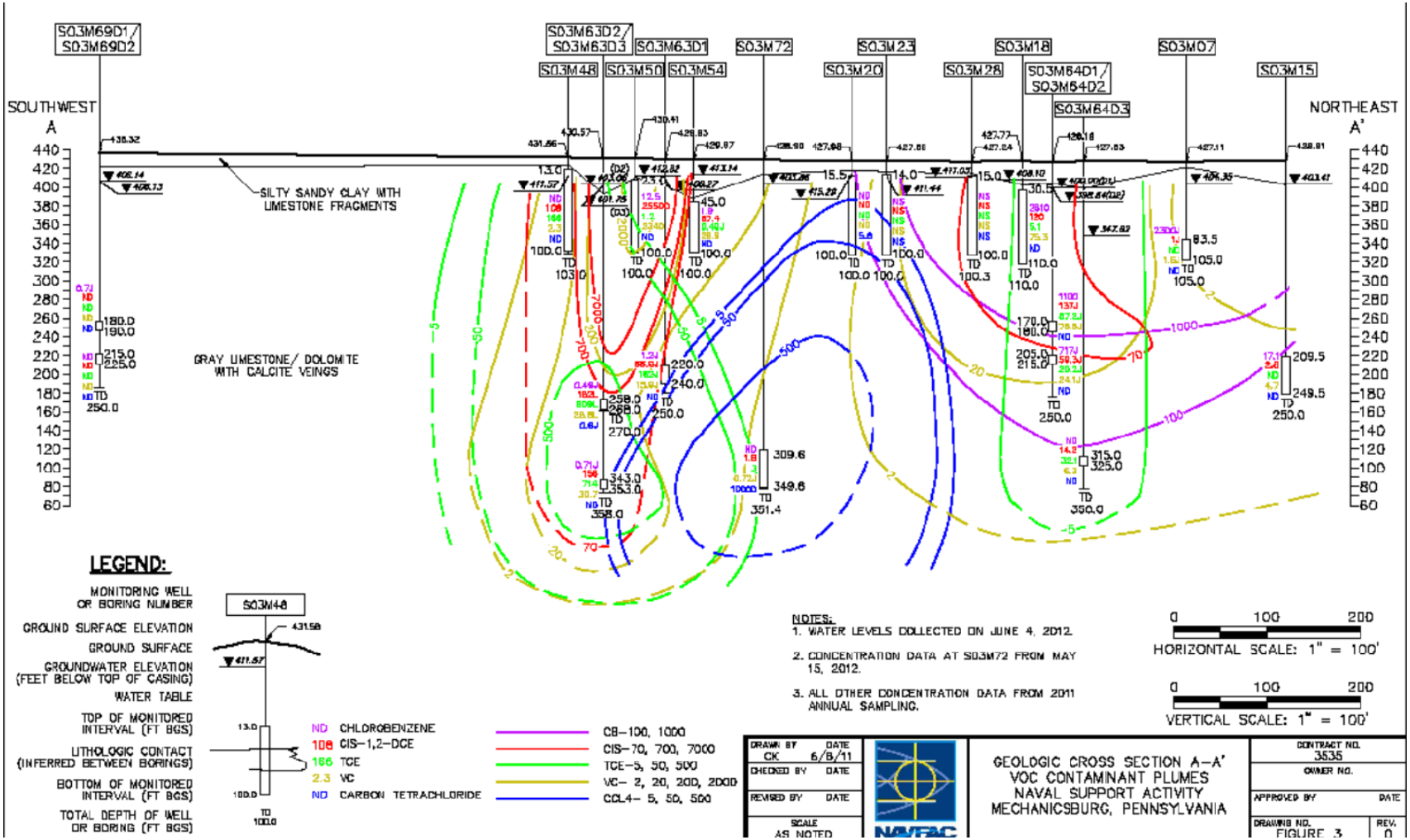
Factors Supporting a Technical Impracticability Waiver

- Complex hydrogeology: folded/faulted rock
- Bedrock generally tightly fractured, especially at depth (>300ft), limiting contaminant accessibility
- Historical/current presence of NAPL
- Persistence of contamination in source areas despite aggressive in-situ treatment
- Matrix diffusion
- Projected cleanup well past ROD estimate of 10 yrs
- Data showing stable plume footprints, and lack of sensitive receptors

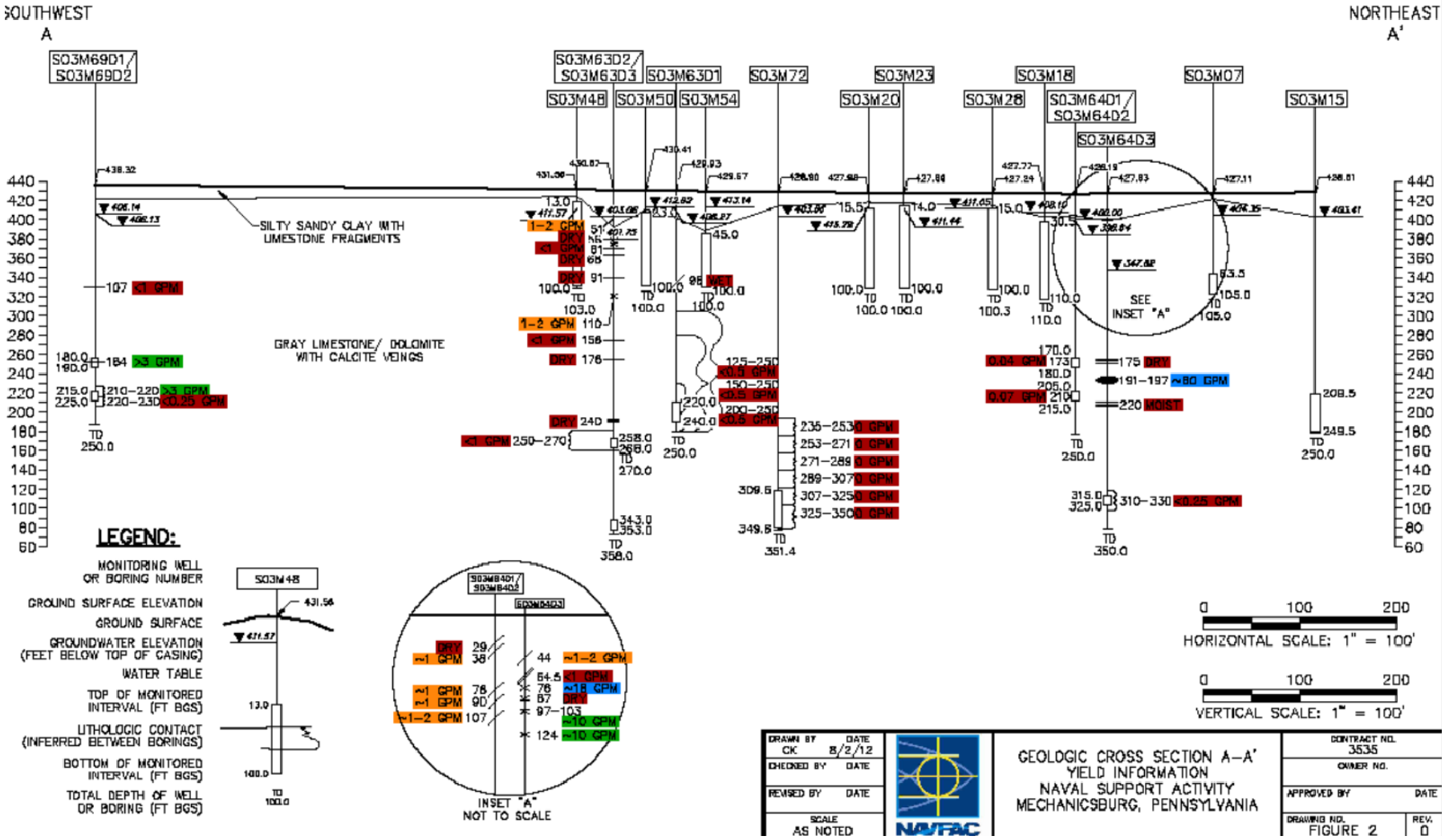
2011 TIW Technical Meeting Summary

- Issues identified by the partnering team, remaining data gaps
  - Additional deep wells needed around former burn pit 1{spatial three-dimensional area} (TI zone)
  - Additional water level data needed to better understand groundwater flow patterns
- Potential Path Forward
  - Propose MNA (outside TI zone) remedy through a ROD Amendment
  - Pursue a Post Implementation (TIW) for deep groundwater portion of the aquifer

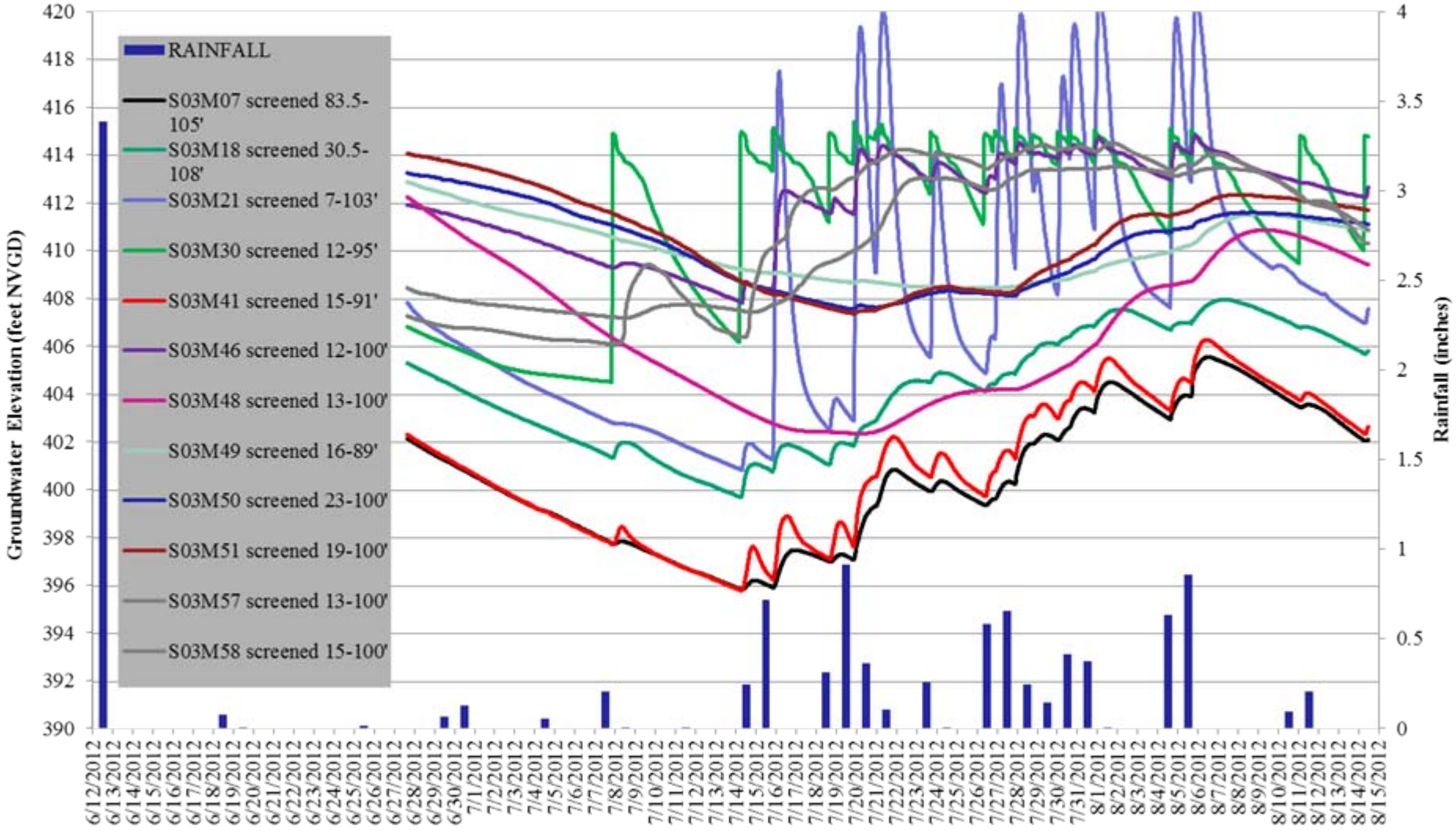
2011/2012 Vertical Plume Delineation



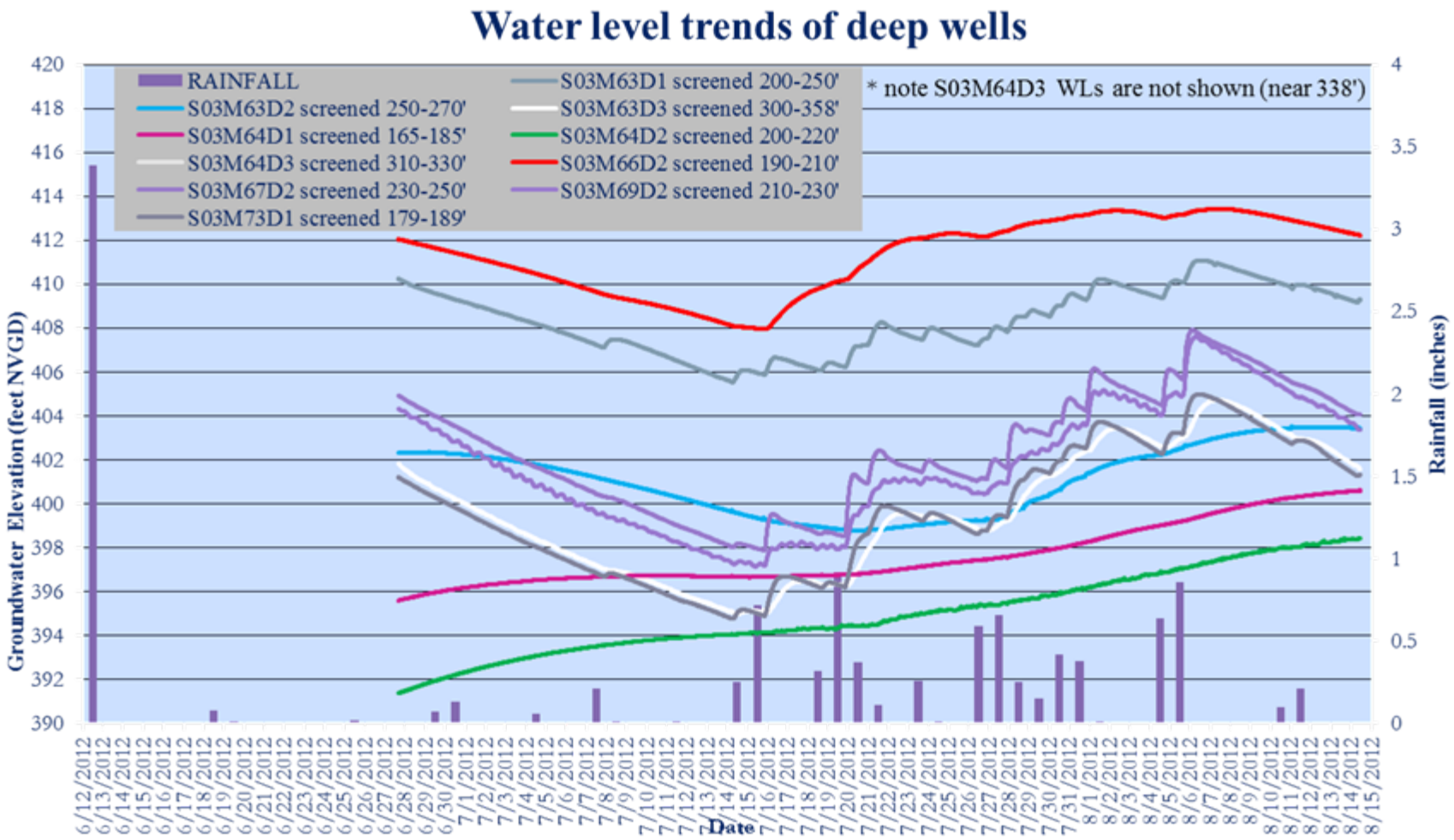
Deep Well Yield Data



Water Level Trends Shallow Aquifer

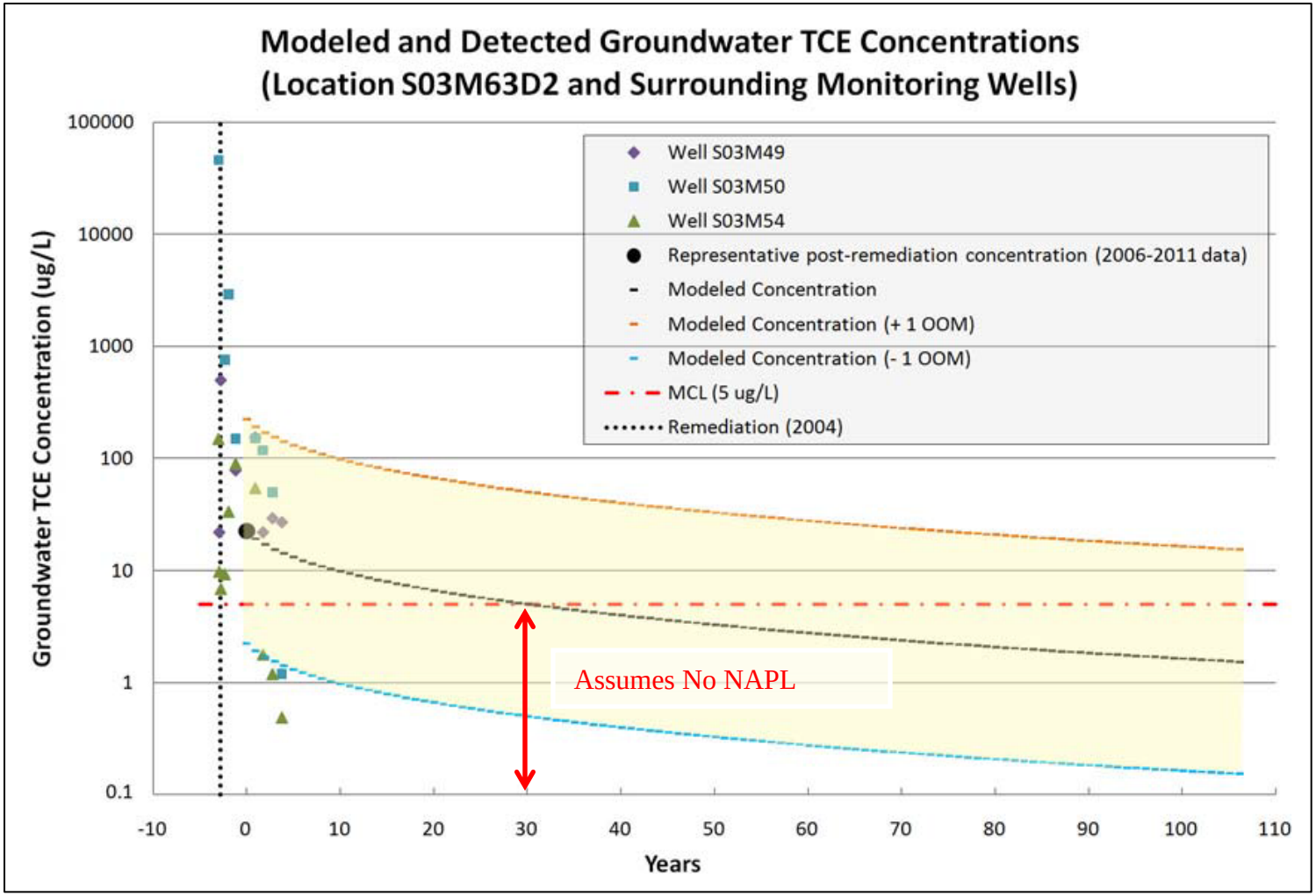


Water Level Trends Deep Aquifer



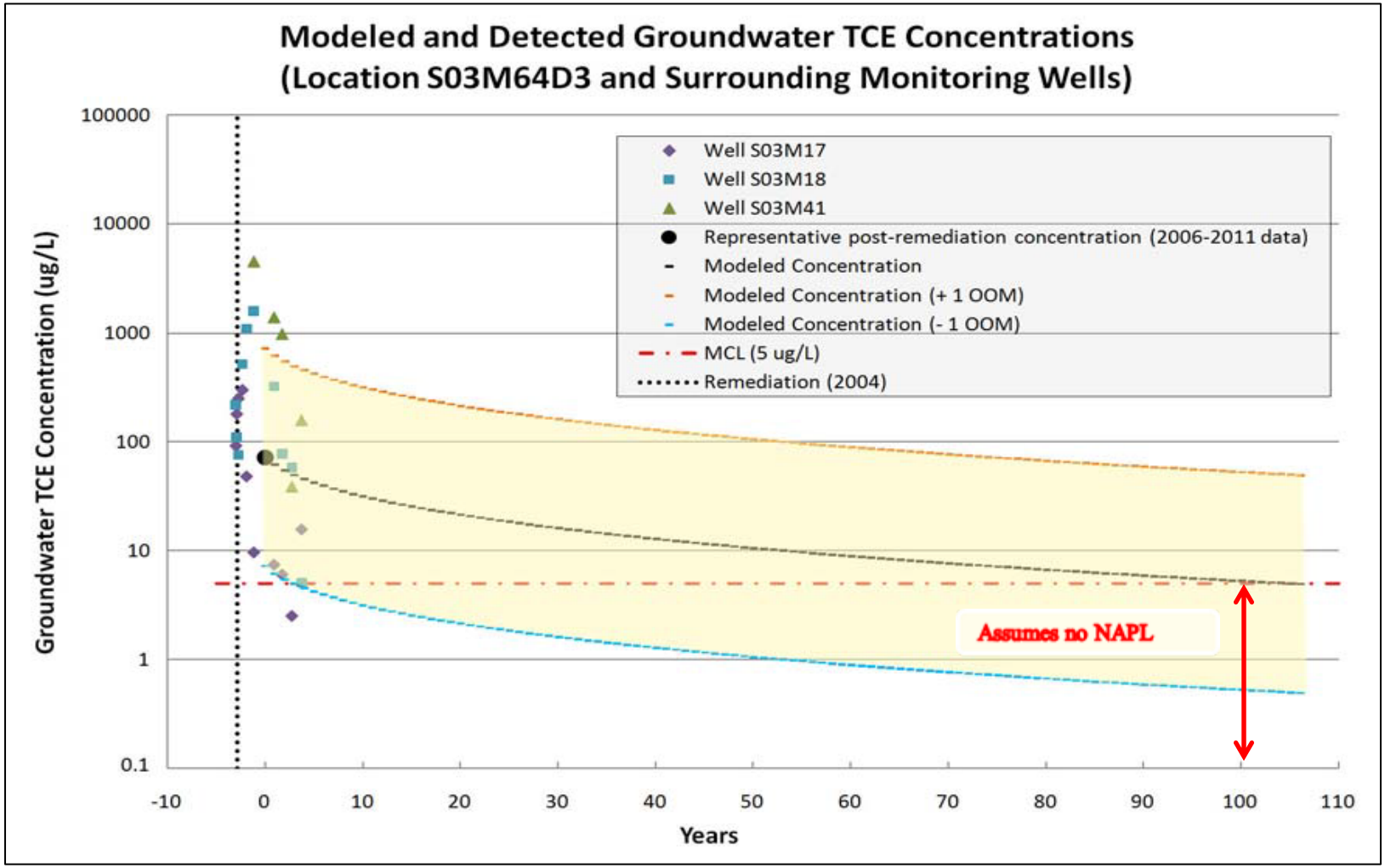
TCE Model 30 years (Burn Pit 1)

Source: Newell, (2012)

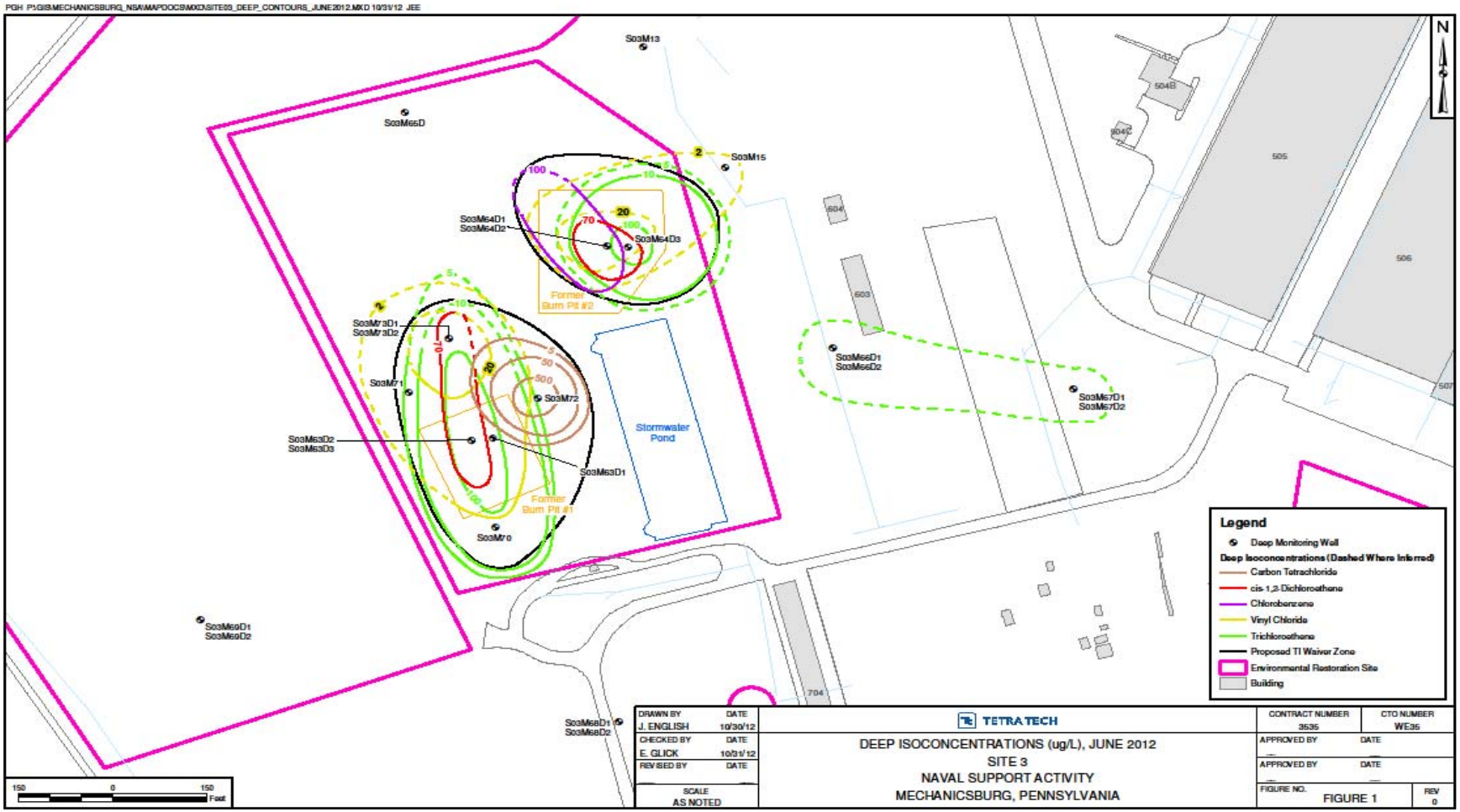


TCE Model 100 years (Burn Pit 2)

Source: Newell, (2012)



TIW DEEP Zone (Proposed)



Upcoming Activities

- Submittal of 2012 annual monitoring report for Site 3 (fall 2012)
- Site 3 water level study report (fall 2012)
- Site 3 TIW Evaluation Report submission (late 2012/early 2013)
- Ongoing groundwater monitoring, five-year reviews/LUCs
- ROD Amendment 2013

Summary/Conclusions

- This alternative endpoint is not a “do-nothing” solution, but does recognizes what is practical based on scientific investigation
- Considerations:
  - Cost Analysis
  - Optimizing prior to assessing alternative endpoints
  - Source treatment/mass removal to the extent practicable
  - Containment, MNA (outside TI zone), monitoring, and institutional controls
  - Long-term management of residual contamination
- Approach is protective of human health and environment

- Applicable under CERCLA cleanup program

References

Charsky, M. (2007). Technical Impracticability (TI) Waivers Usage at Superfund Sites, *EPA Office of Superfund Remediation and Technology Innovation (OSRTI).*

Environmental Security Technology Certification Program, (2011). Alternative Endpoints and Approaches Selected for the Remediation of Contaminated Groundwater, *ESTCP Project ER-200832.*

Interstate Technology & Regulatory Council, (2012). Using Remediation Risk Management to Address Groundwater Cleanup Challenges at Complex Sites. *RRM-2.Washington, D.C.: Interstate Technology & Regulatory Council, Remediation Risk Management Team.*

Malcolm Pirnie, (2004). Technical Impracticability Assessments: Guidelines for Site Applicability and Implementation, Phase II Report. *Prepared for the U.S. Army Environmental Center.*

References

Naval Facilities Engineering Command, (2008). Groundwater risk management handbook.

Naval Facilities Engineering Command, (2010). Guidance for optimizing remedy evaluation, selections, and design.

Newell, C.(2011). Potential Impact of Matrix Diffusion Process for Site 3 Limestone Aquifer. Mechanicsburg, Pennsylvania. *Tetra Tech NUS, Ins. & NAVFAC.*

United States Environmental Protection Agency, (1993). Guidance for Evaluating the Technical Impracticability of Ground Water Restoration. *EPA/540/R-93/080, OSWER Directive 9234.2-25.*

United States Environmental Protection Agency, (1995). Memorandum: Consistent Implementation of the FY1993 Guidance on Technical Impracticability of Ground Water Restoration at Superfund Sites. *OSWER Directive 9200.4-14.*

United States Environmental Protection Agency, (1996). Presumptive Response Strategy and Ex Situ Treatment Technologies for Contaminated Ground Water at CERCLA Sites. *EPA/542/R-96/023.*

Questions ?

Contact Information

James M. Tarr, CPG, CG
Remedial Project Manager
NAVFAC Mid-Atlantic
9742 Maryland Avenue
Bldg. Z-144, Code OPTE 3-5
Norfolk, VA 23511

Email: james.tarr@navy.mil
Tel: 757-341-2009