Oak Ridge Field Research Center

FRC Workshop
Site Characterization Update
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David Watson (865-241-4749) - FRC Manager
Environmental Sciences Division
Oak Ridge National Laboratory
E-Mail: watsondb@ornl.gov

http://www.esd.ornl.gov/nabirfrc/

Contributors

- **Sample collection, processing, shipping, and analysis – Kirk Hyder, Kenneth Lowe, Mary Anna Bogle, Tonia Mehlhorn, Wiwat Kamolpornwijit, and George Houser**
- **Geophysics - Les Beard, Jacob Sheehan, and Bill Doll**
- **Core Characterization - Debra Phillips**

Presentation Outline

- New Wells and Sample Distribution
- Area 2 extent of contamination
- Area 4 and 5 Site Characterization
  - Objectives
  - Activities, methods, and tools
  - General approach
  - Results
- Lessons learned well clogging

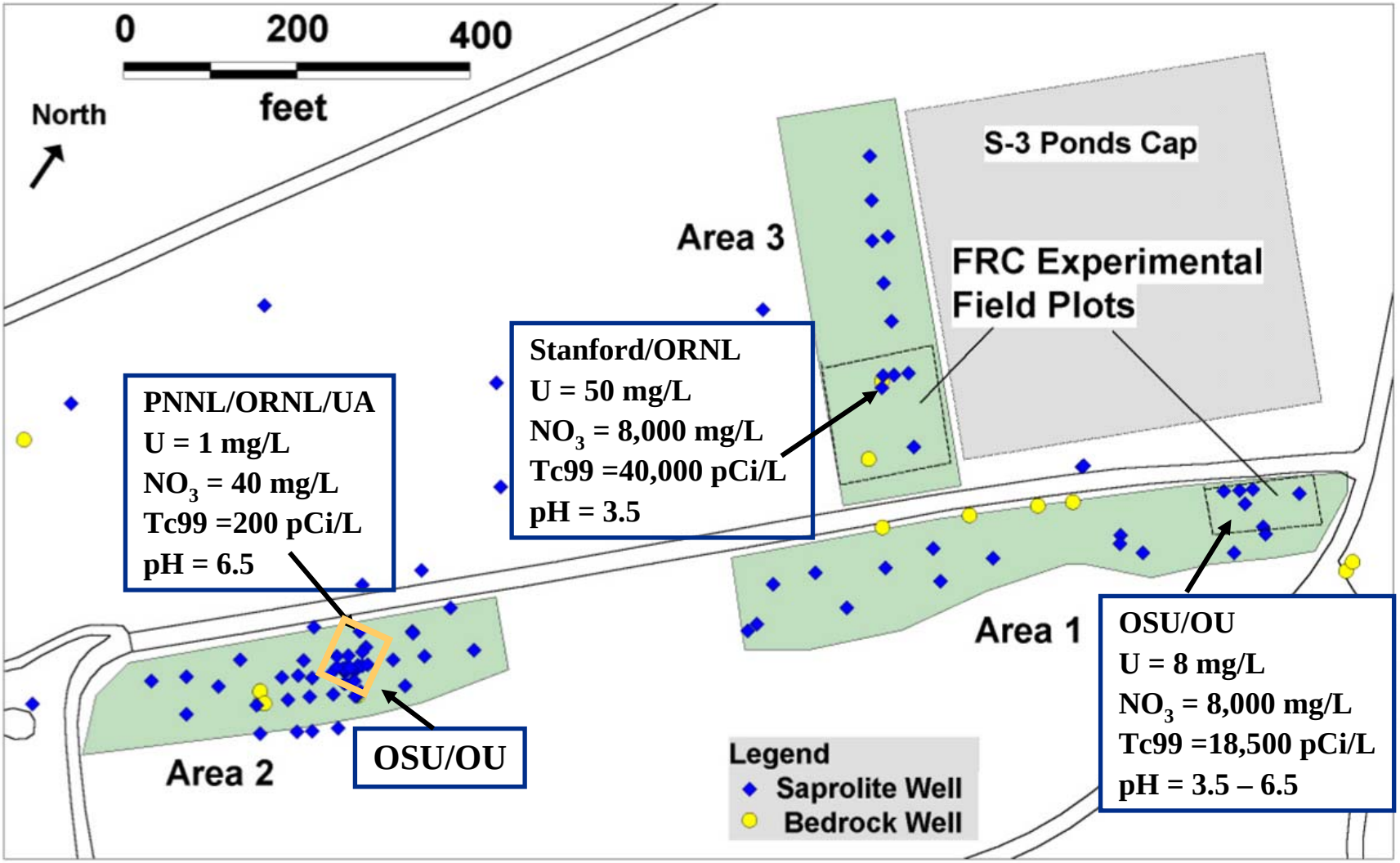
New Wells

- **Area 1**
  - **3 wells for MLS sampling**
  - **2 wells for LBNL geophysics testing**
- **Area 2**
  - **3 wells for MLS sampling**
  - **10 wells for push-pull tests**
  - **3 wells for LBNL geophysics testing**
  - **PNNL field plot wells (18 wells and numerous cores)**
- **Area 3 – 1 piezometer upgradient of field plot**
- **Area 4 and 5 characterization (21 new wells)**

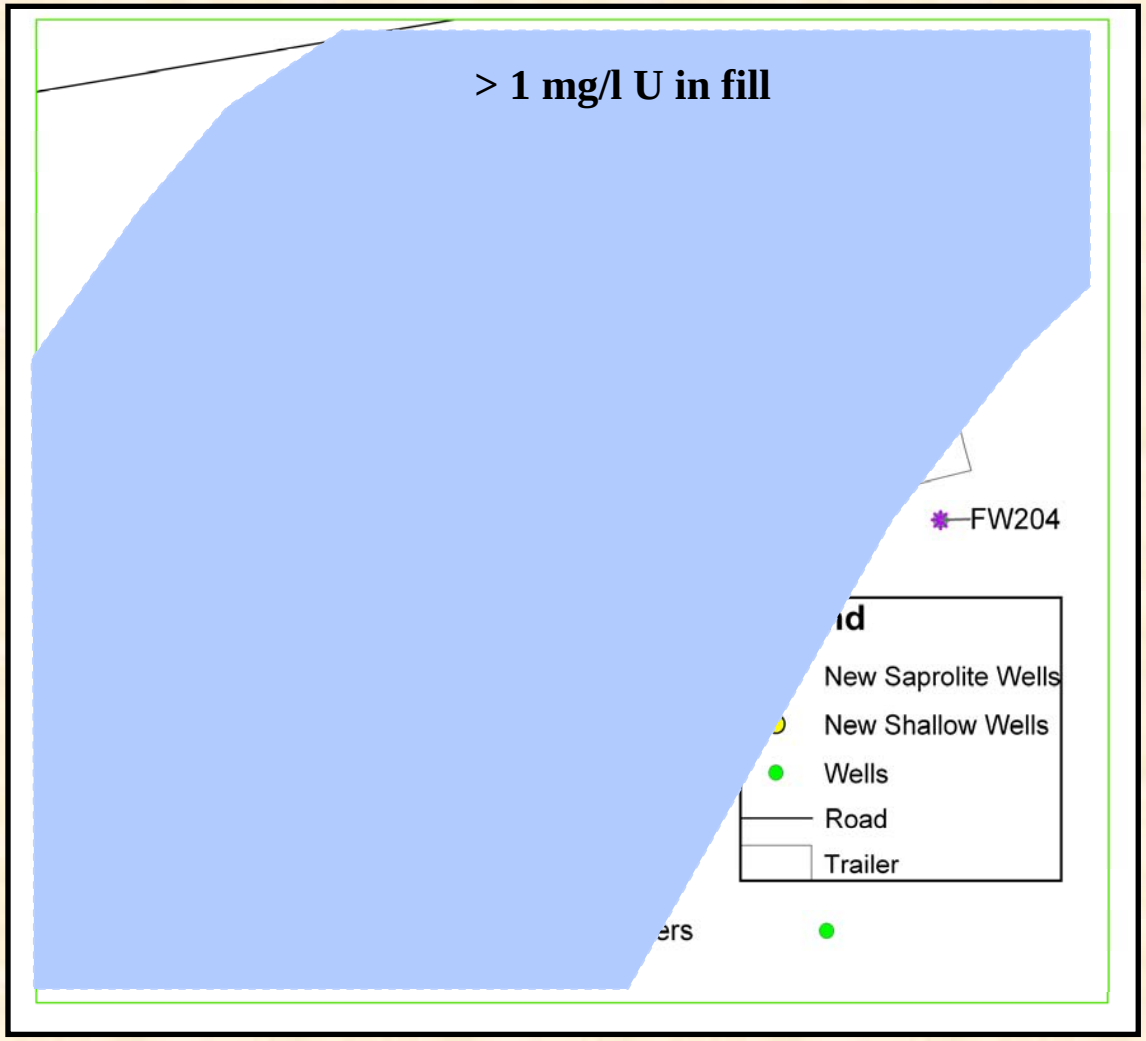
FRC Sample Distribution

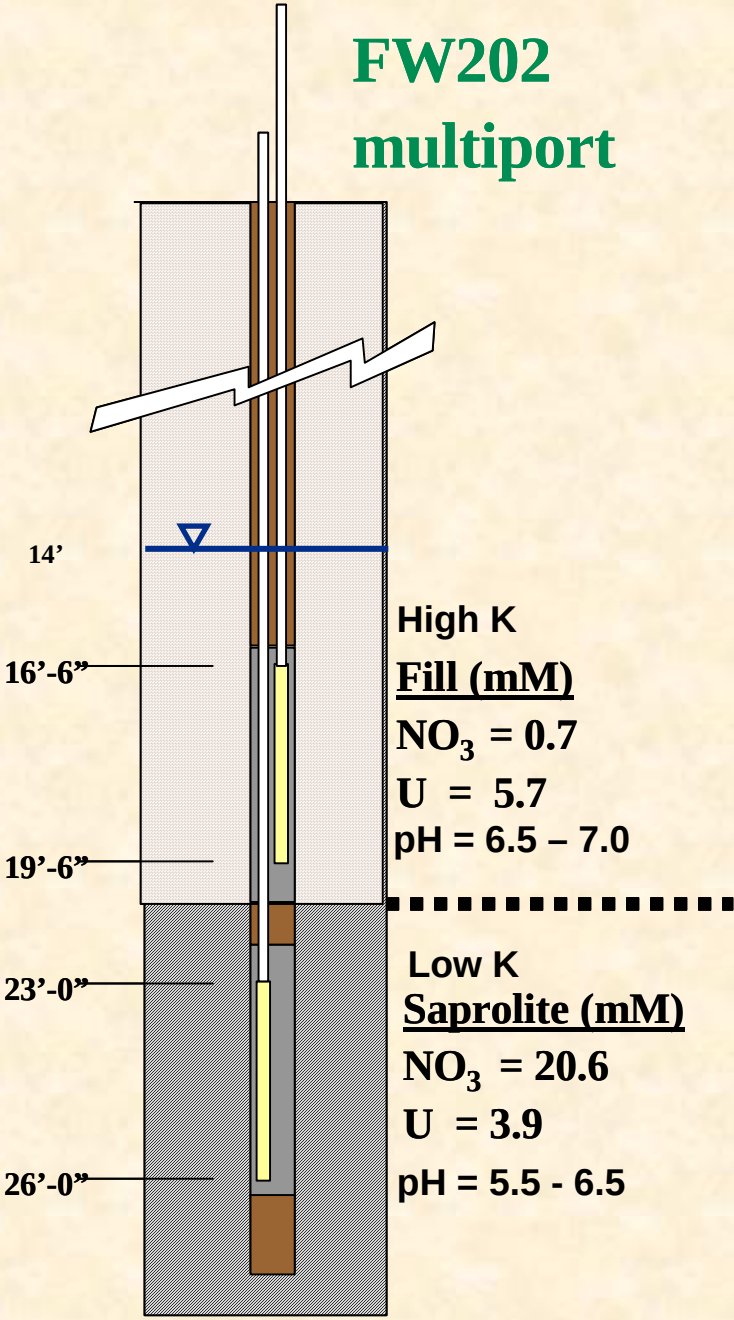
- 2,340 samples distributed to researchers for laboratory studies
- >10,000 collected for field studies
- 105 wells installed – 2,700 feet
- 100 coreholes (no wells) drilled - 1,850 feet
- Analyses (Does not include analyses for PIs)
  - 18,000 FRC new analyses results
  - 39,000 historical analyses results entered into the database
- Samples distributed to NABIR, GTL, EMSP, and JGI researchers
- Samples shipped overseas to Switzerland, Denmark, and UK
- Hg samples collected and shipped

Field Plots in Contaminated Area

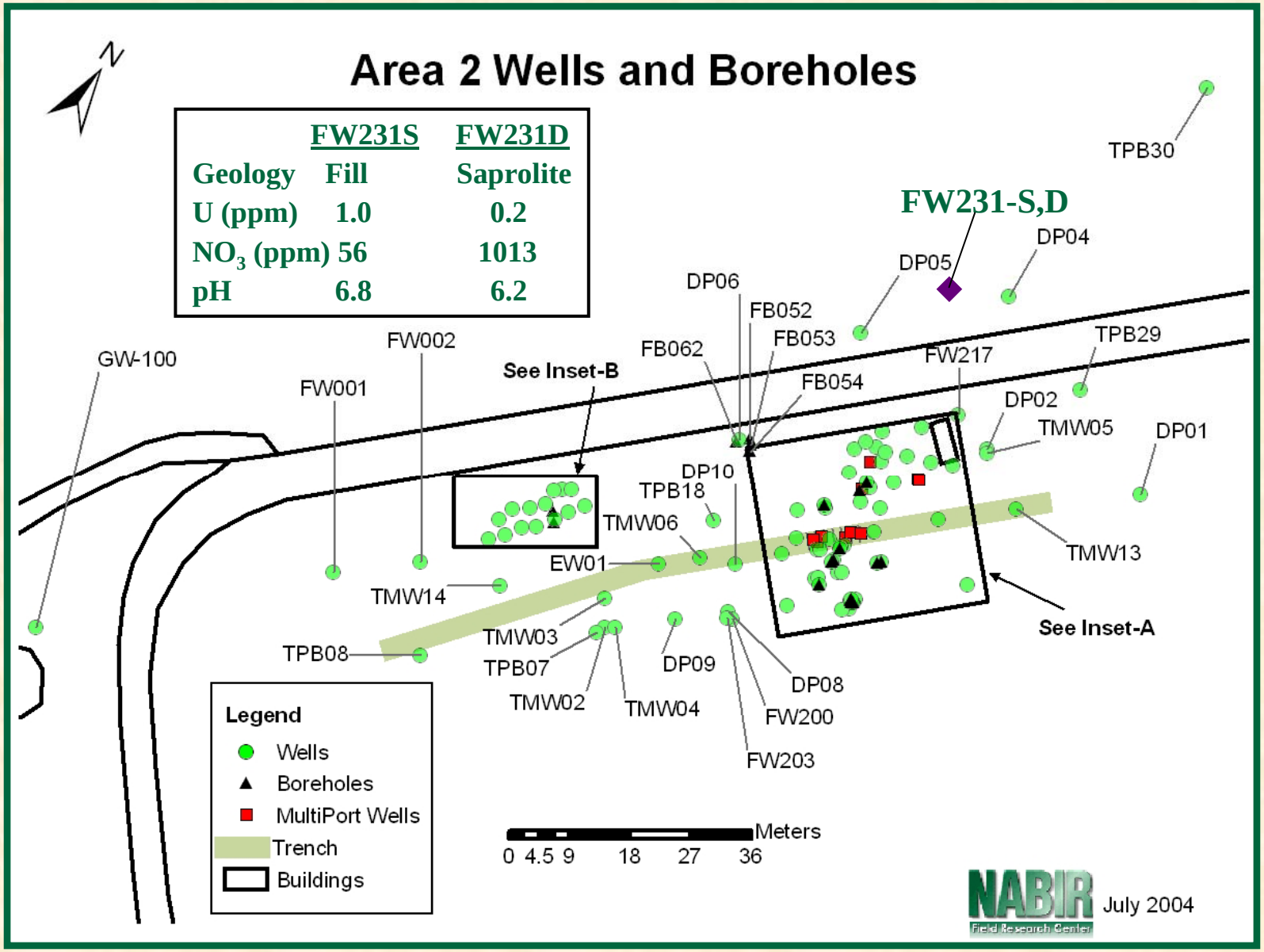


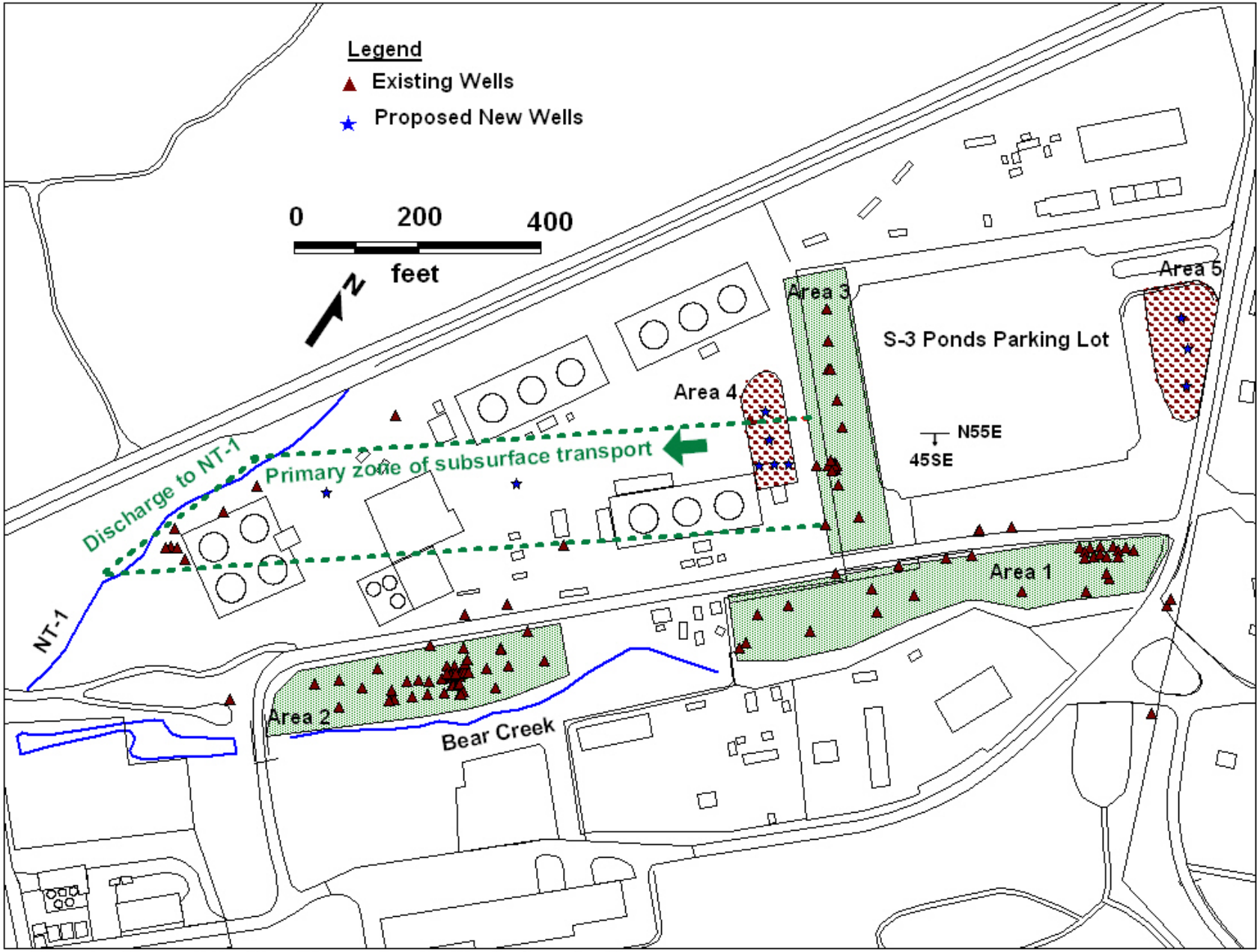
PNNL Area 2 Field Plot





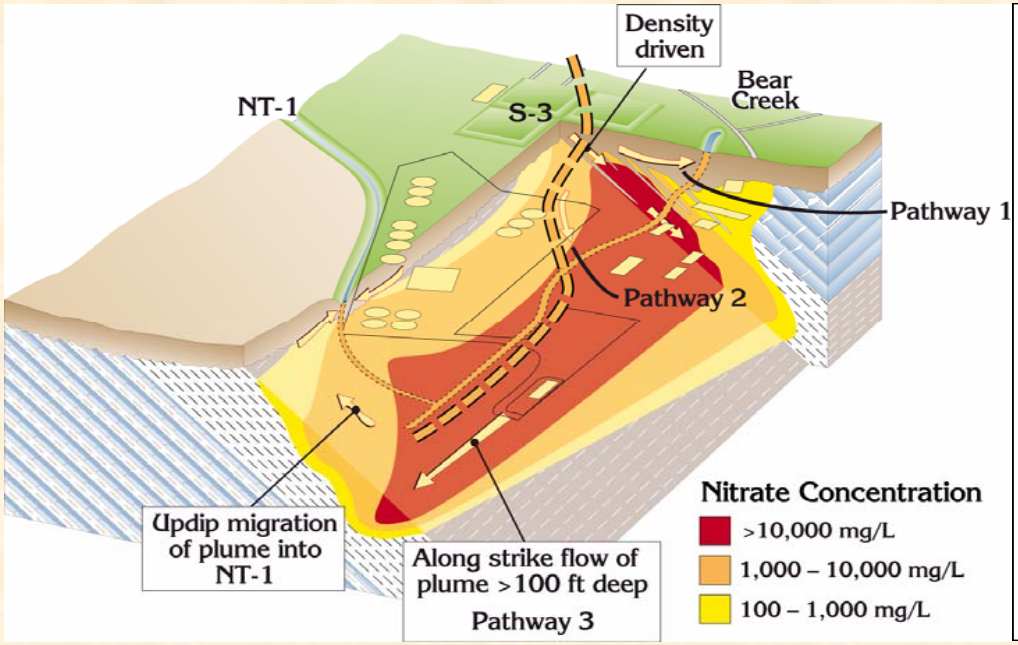
Saturated fill and U extends across the road from Area 2 (FW231)

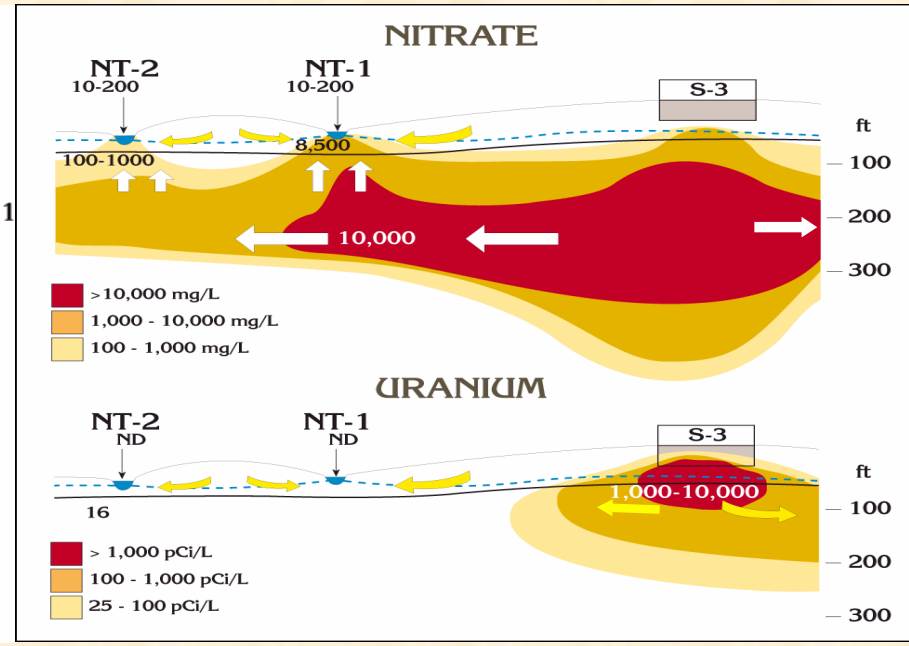




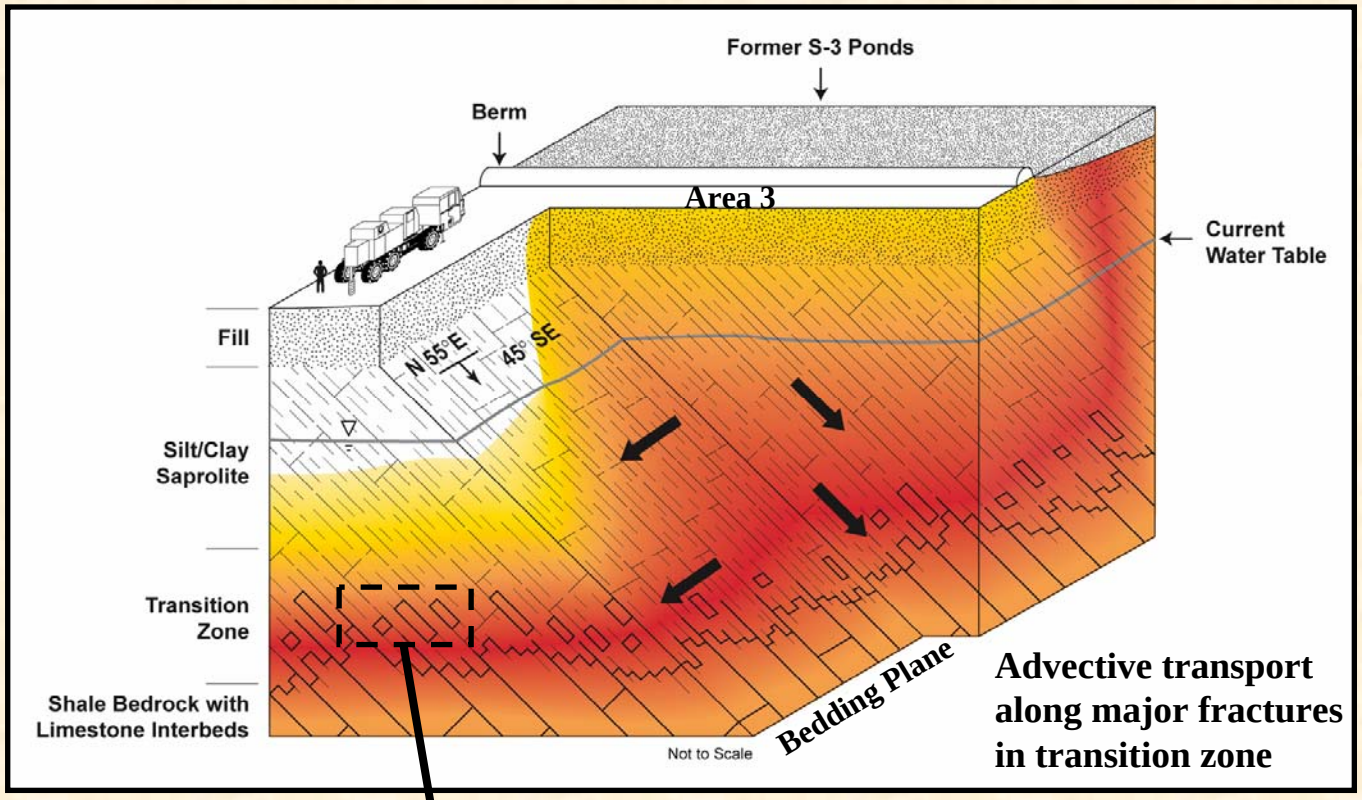
Area 4 and 5 Site Expansion and Characterization

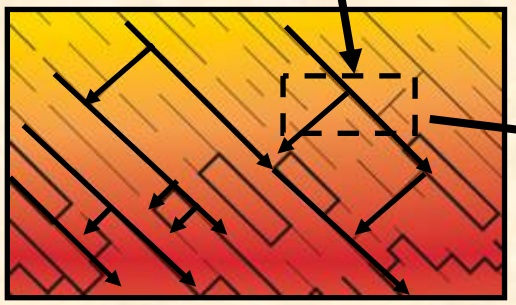
Conceptual Model of Contaminant Transport at the S-3 Ponds Site



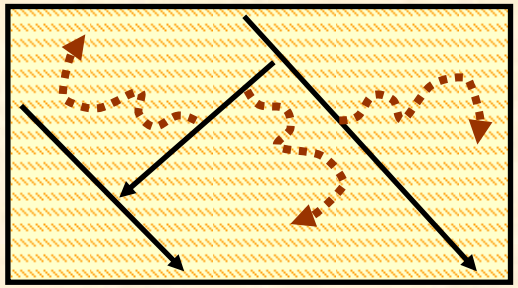


Conceptual Model – Flow Paths





Diffusion along small fractures



Diffusion into silt/clay/shale pores

FRC Site Expansion and Characterization

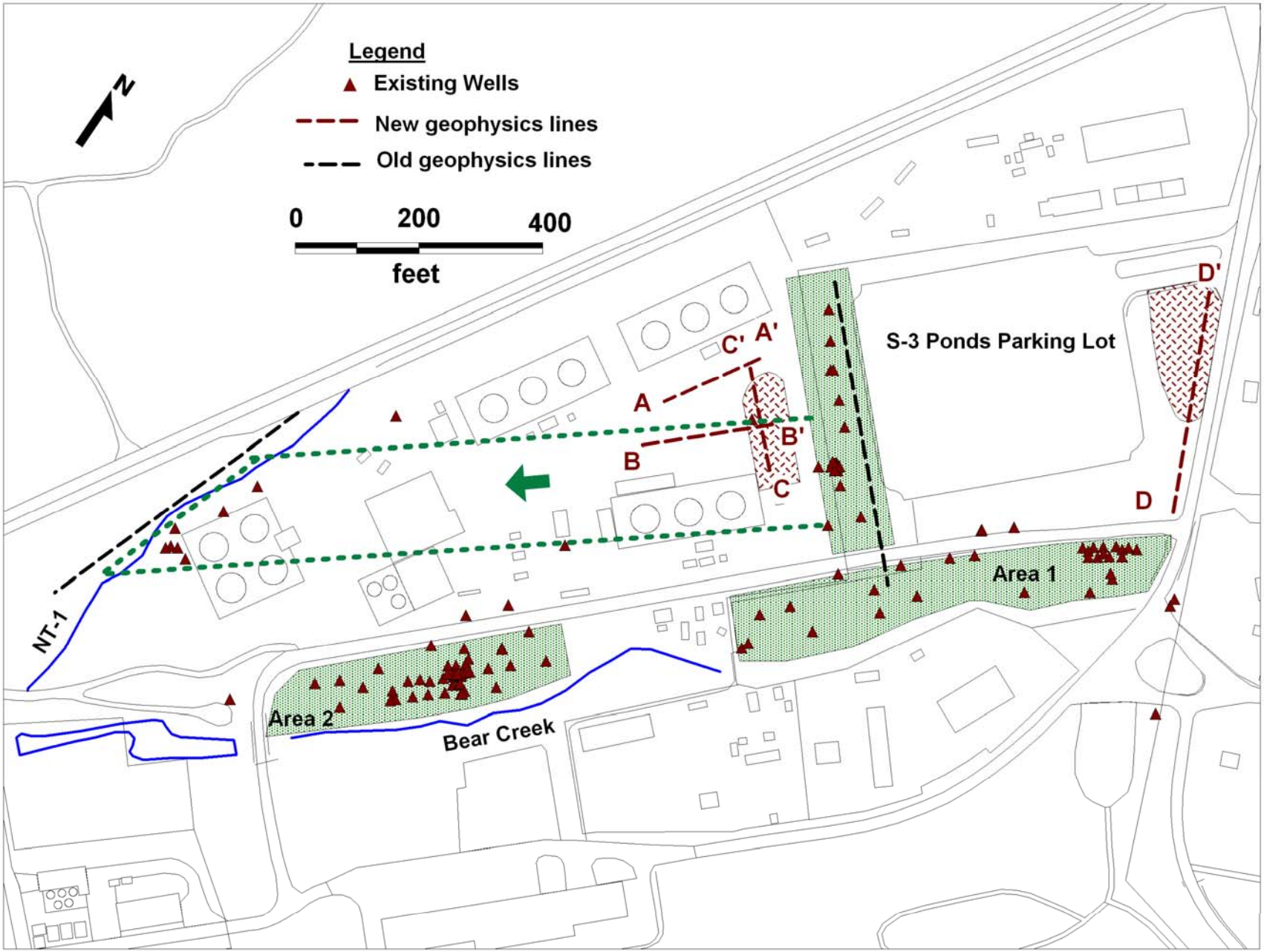
- **Objectives**
  - **Obtain data necessary to determine if Areas 4 and 5 have geochemical characteristics suitable for NABIR research**
  - **Assess the geochemical and mineralogic changes in groundwater and saprolite along the primary flowpath west of the S-3 Ponds**
  - **Establish the basic hydraulic characteristics of existing and proposed new sites**
  - **Provide investigators with the data needed to design experiments and determine whether existing or new sites are suitable for their proposed project**

General Approach to Characterization

- **Conduct surface electrical and seismic tomography to select targets for subsurface investigation**
- **Conduct conductivity probing with Geoprobe**
  - **Install well in probe hole**
  - **Sample and analyze temporary wells**
- **Select locations to collect core samples and install wells based on previous studies**
- **Conduct borehole gamma logging to select screened intervals of wells**
- **Install additional wells at discreet depths**
- **Sample wells**

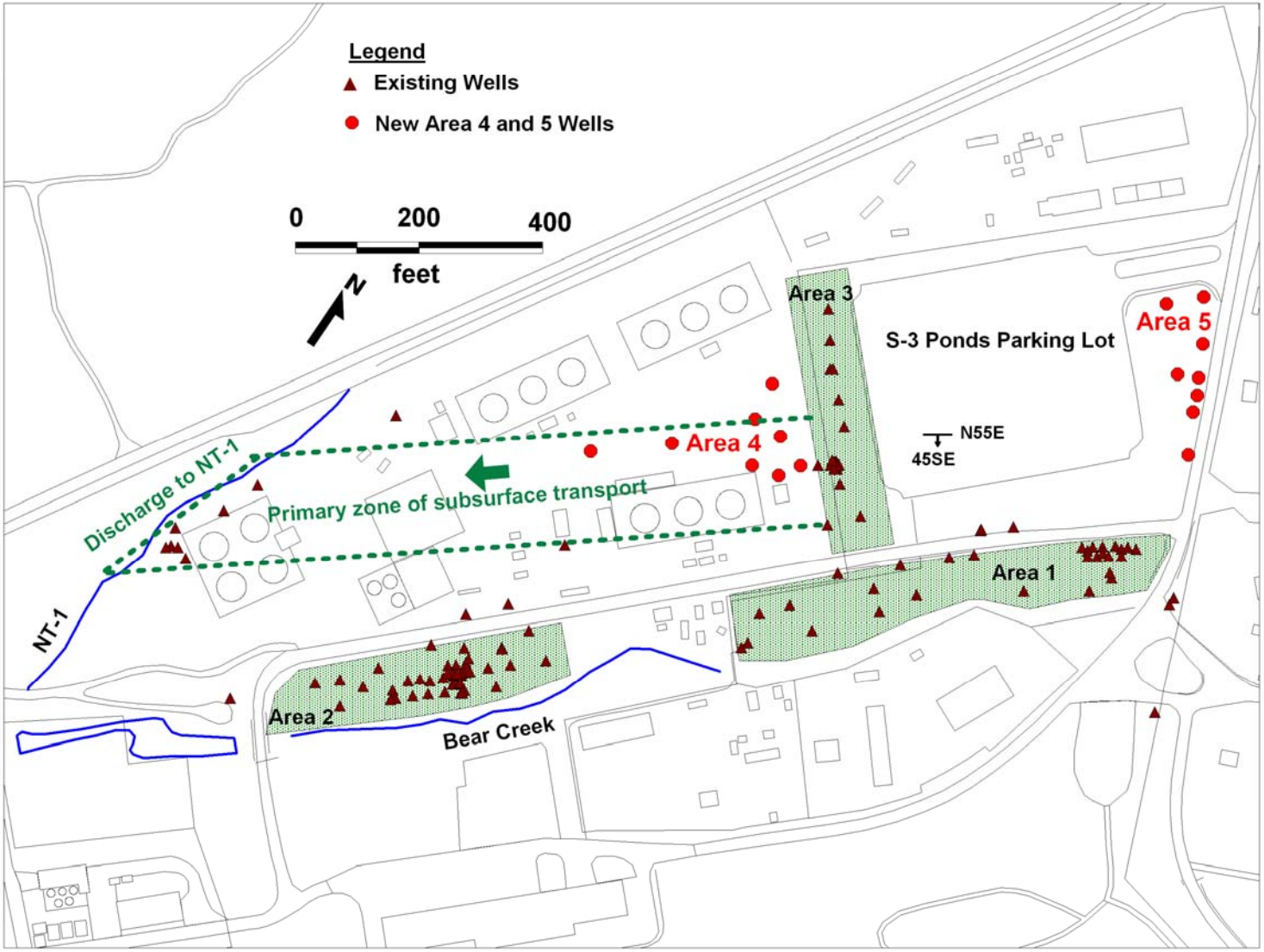
General Approach to Characterization (continued)

- **Core analysis - U, metals (ICP/MS) pH, sequential extractions, mineralogical analysis (SEM, EDX, BSE mapping, XRD, thin sections), CEC, and EXAFS?**
- **Groundwater analysis - U, cations (ICP/MS), anions (IC), field parameters, and TOC/TIC**
- **Hydraulic testing (pumping tests, flow meter tests, tracer tests, and water levels)**



Surface Tomography Lines

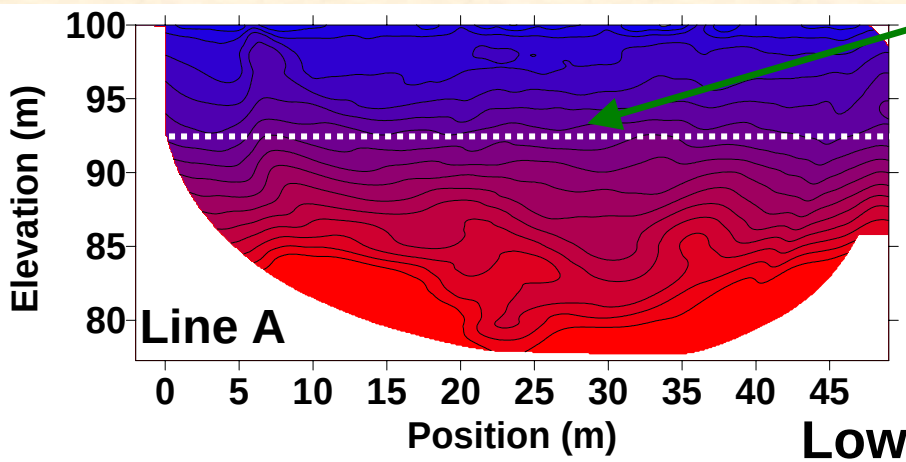
Piezometers in Areas 4 and 5

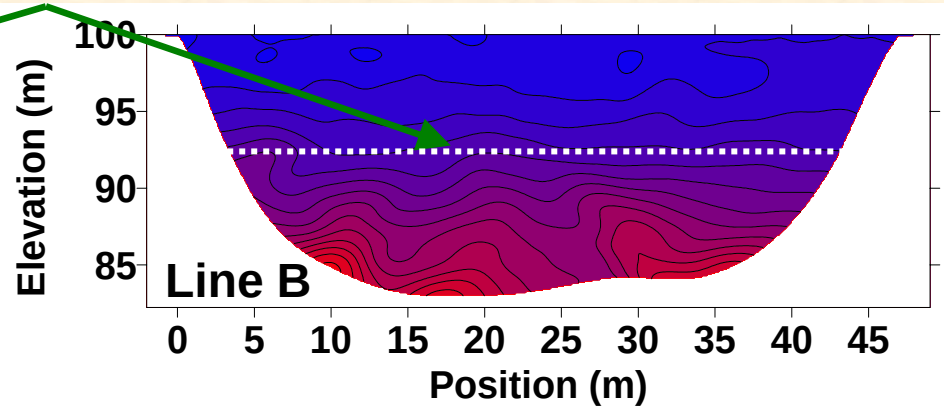


Location of new Area 4 and 5 boreholes and wells

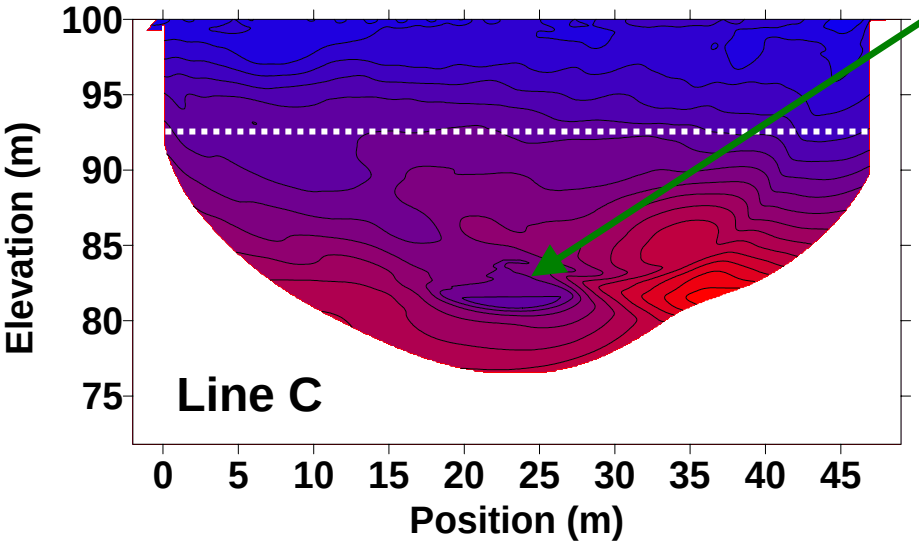
Area 4 and 5 Seismic Results

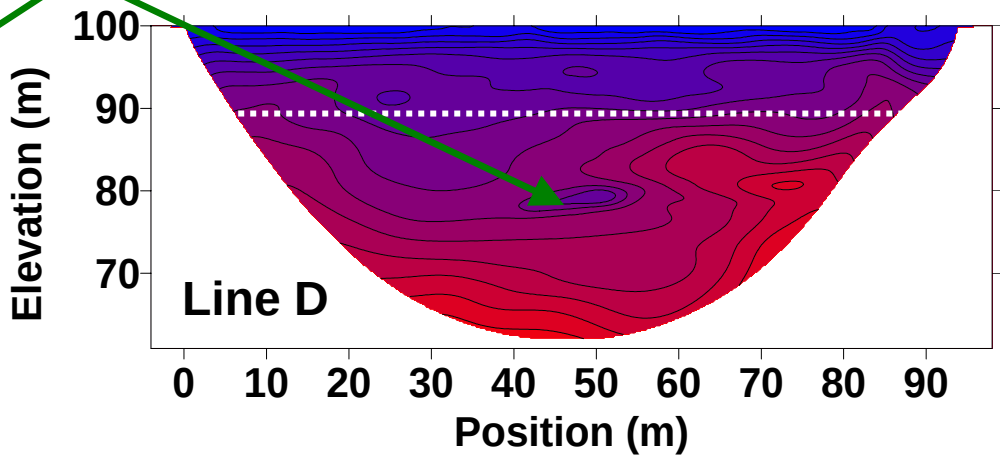
General depth of push-probe refusal



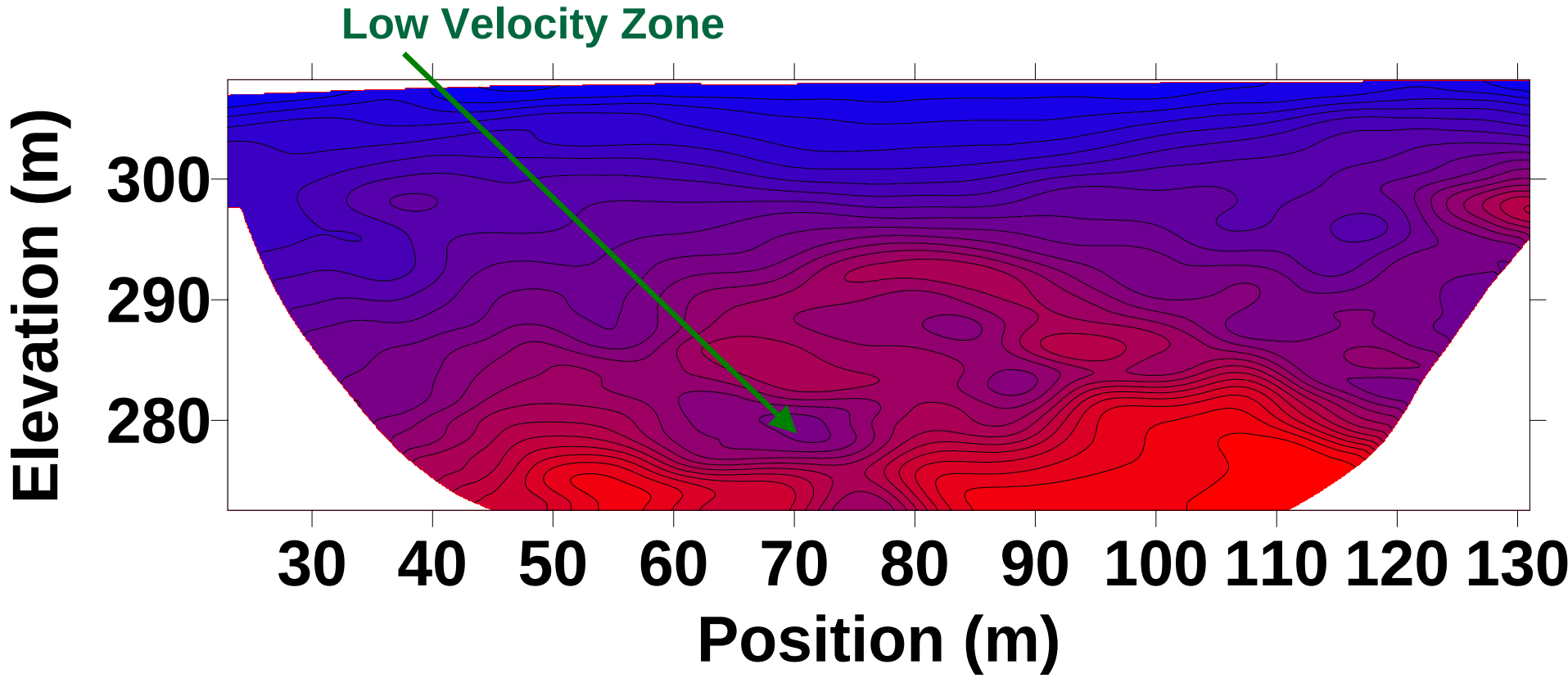


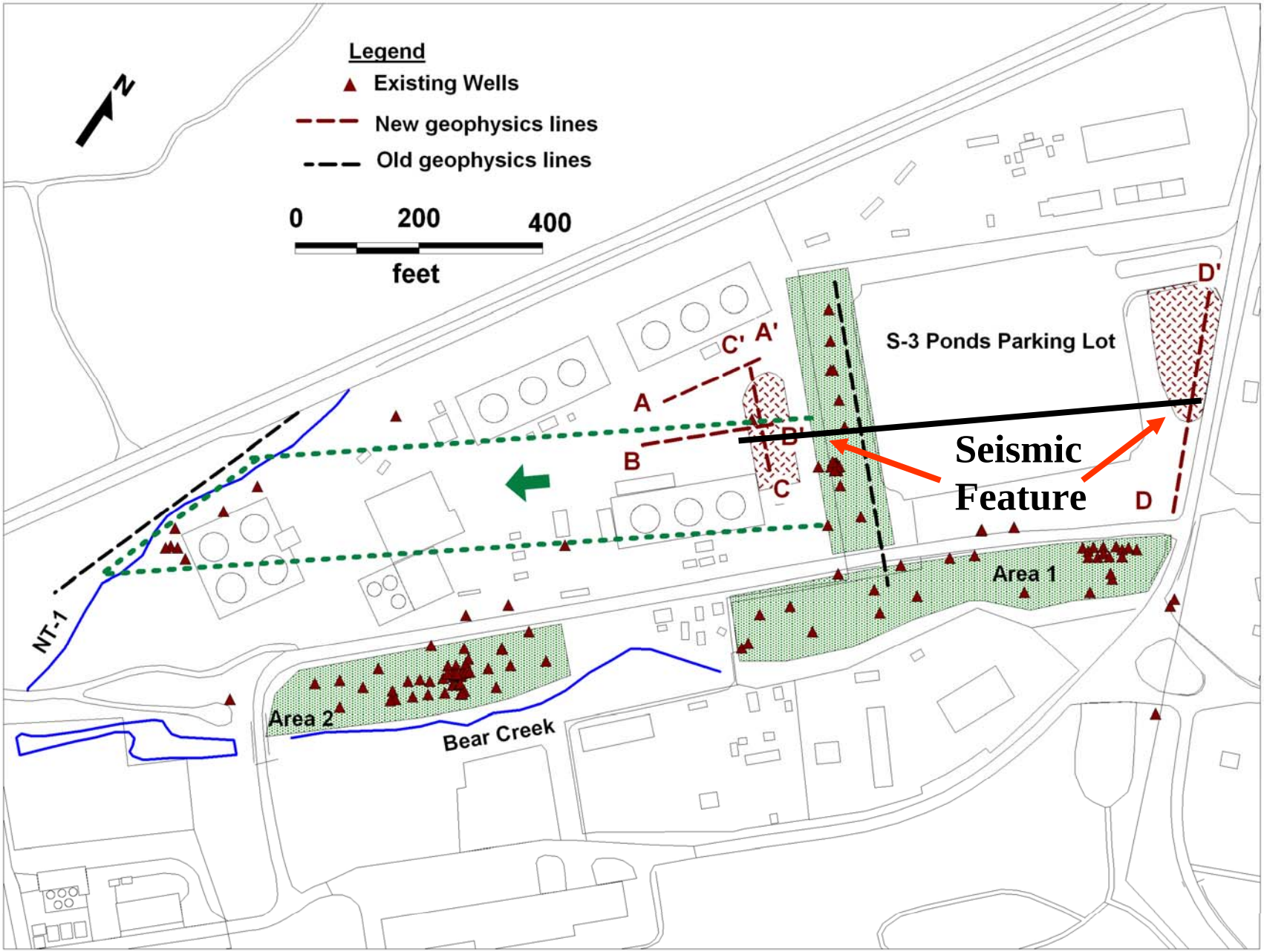
Low Velocity Zones





Previous Seismic Results, FRC Area 3





Seismic Feature Identified

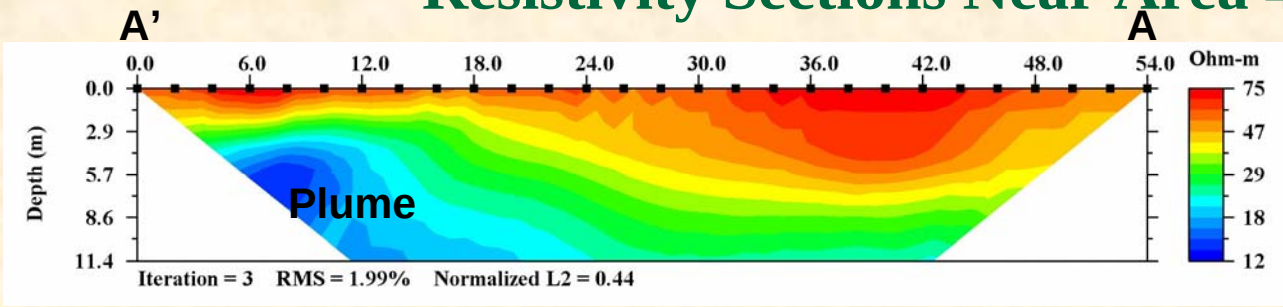
Resistivity Sections Near Area 4

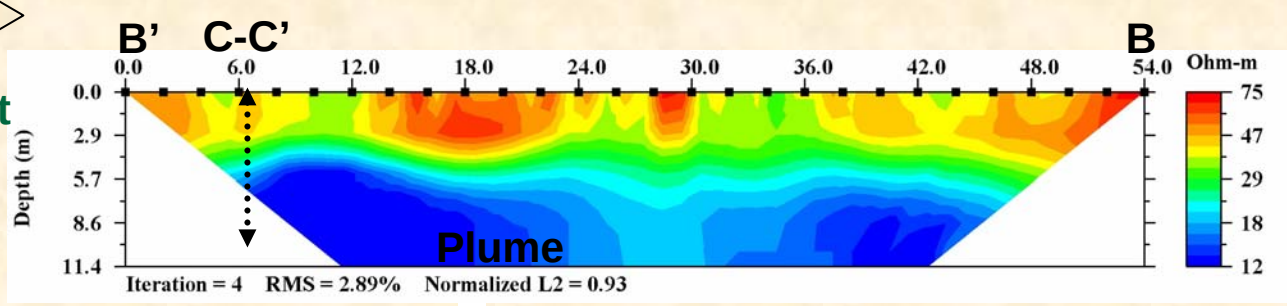
S-3 Ponds source

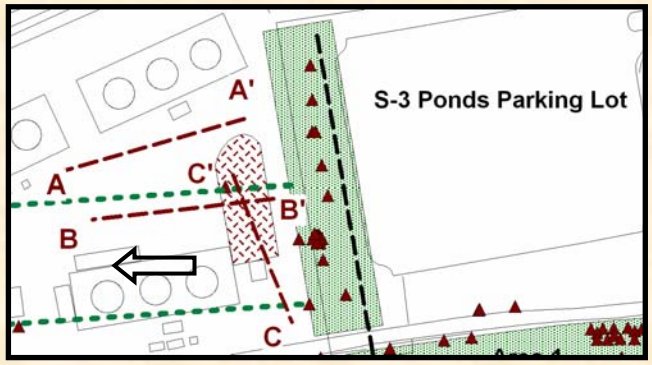
Northern transect outside pathway

Flow direction

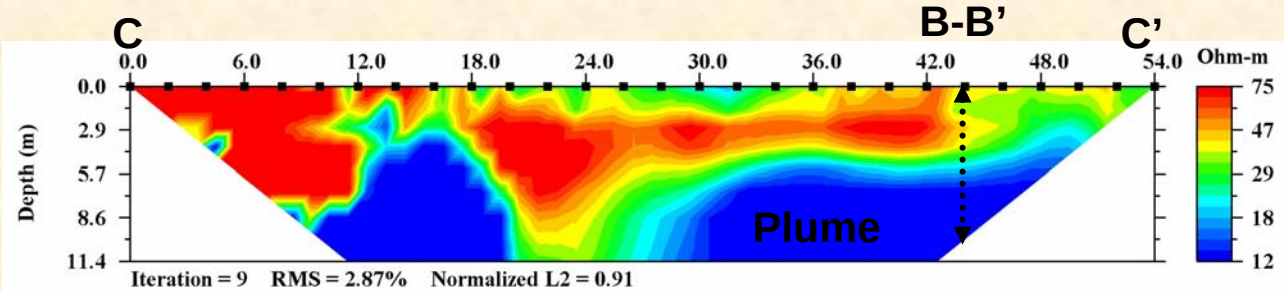
Southern transect inside pathway

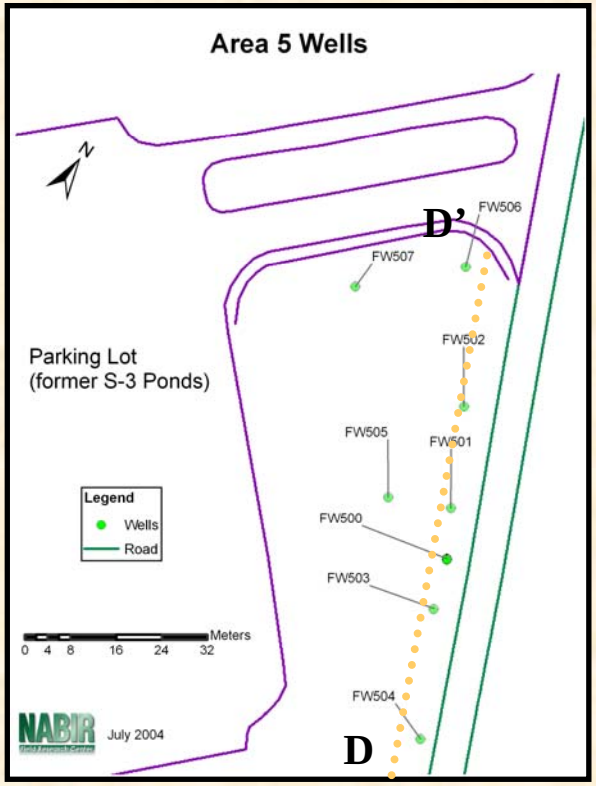






North-South section: Direction of flow into page

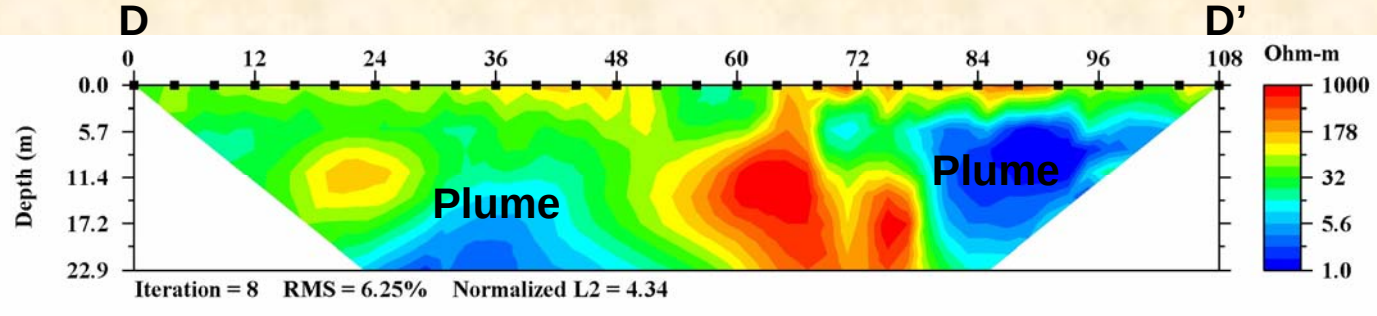




Preliminary Data From Area 5

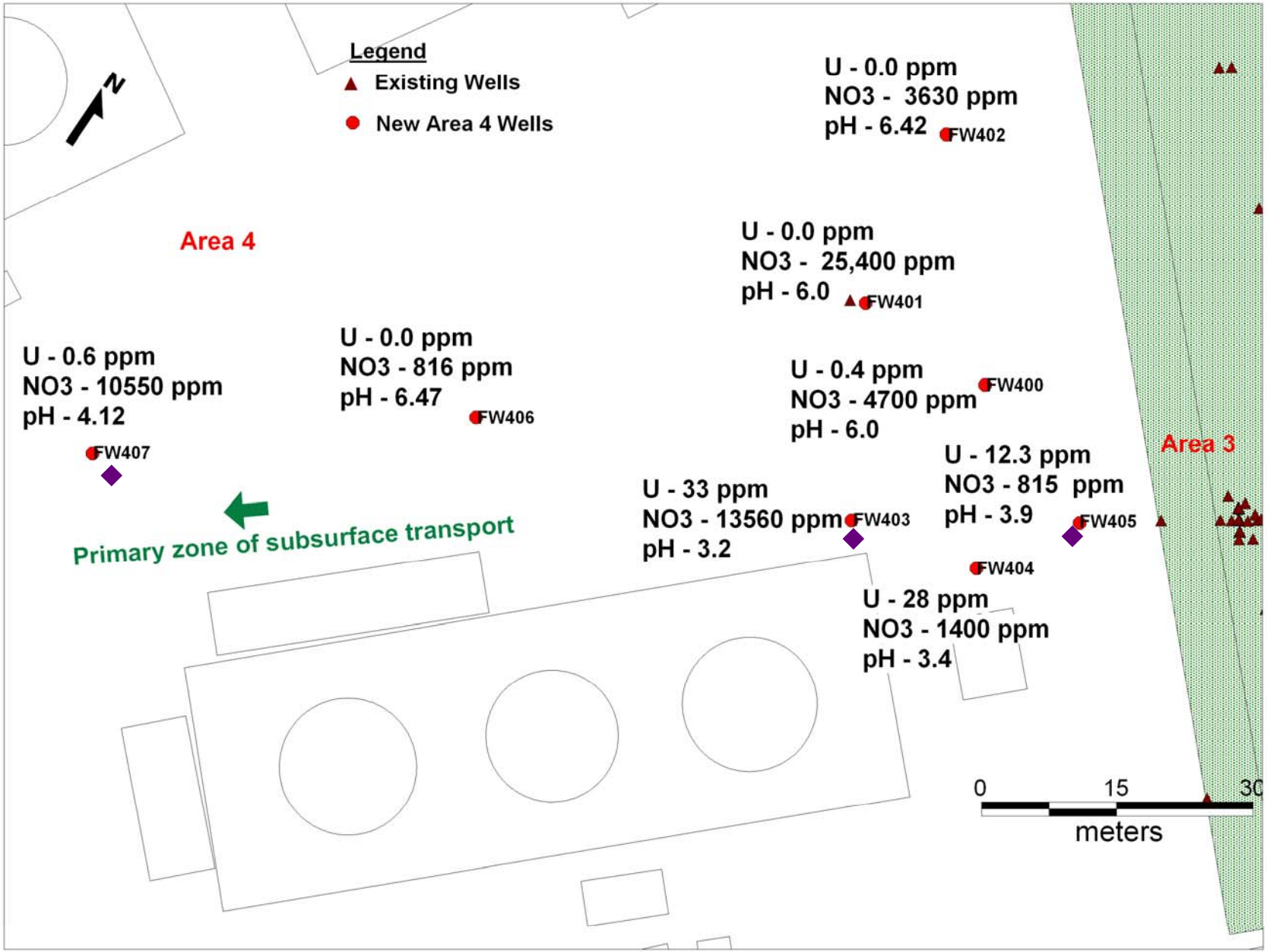
- 8 EC probes and piezometers installed
- Nitrate: 1140 – 6130 ppm
- U: 0.0 – 17.3 ppm
- pH 3.2 – 6.4
- Highest U is south
- 2 cores collected
- 2 discreetly screened wells

North-South Resistivity Section: Direction of flow out of page



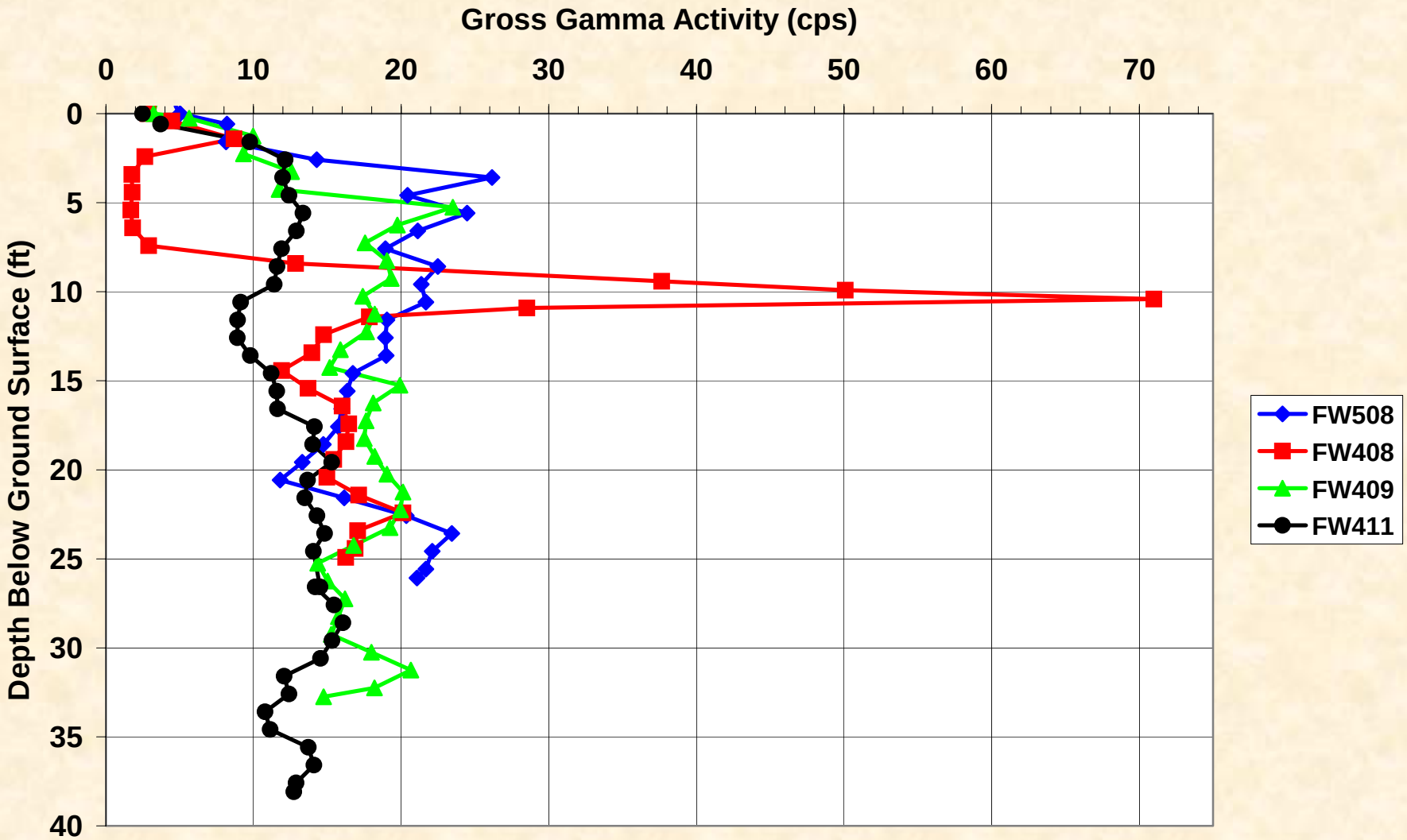
Area 4 Results

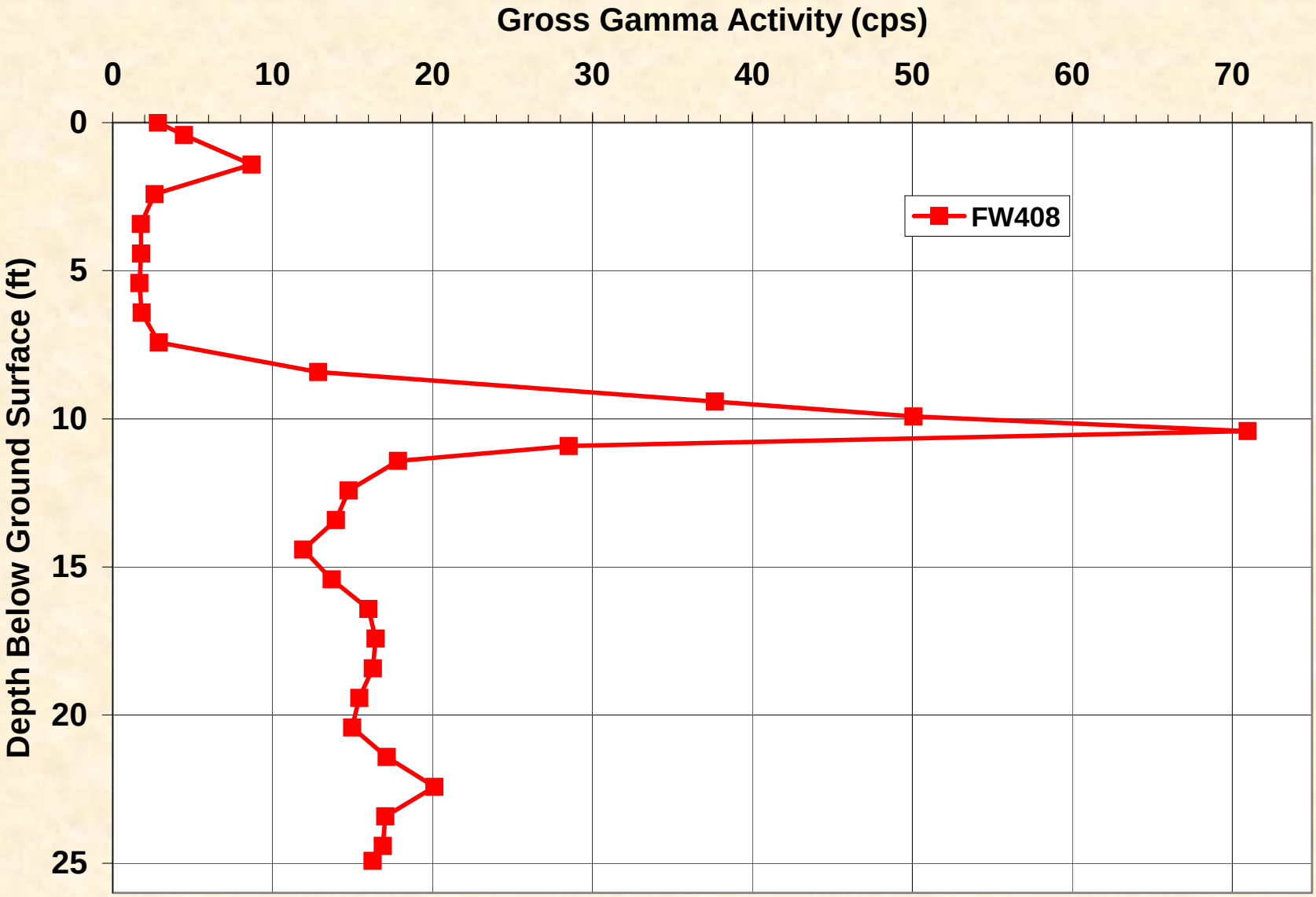
- 8 EC probes and piezometers installed
- Nitrate: 815 – 25,400 ppm
- U: 0.0 – 33 ppm
- pH 3.2 – 6.5
- Highest U is south
- 3 cores collected
- 3 discreetly screened wells
- 1 more core and well to be installed

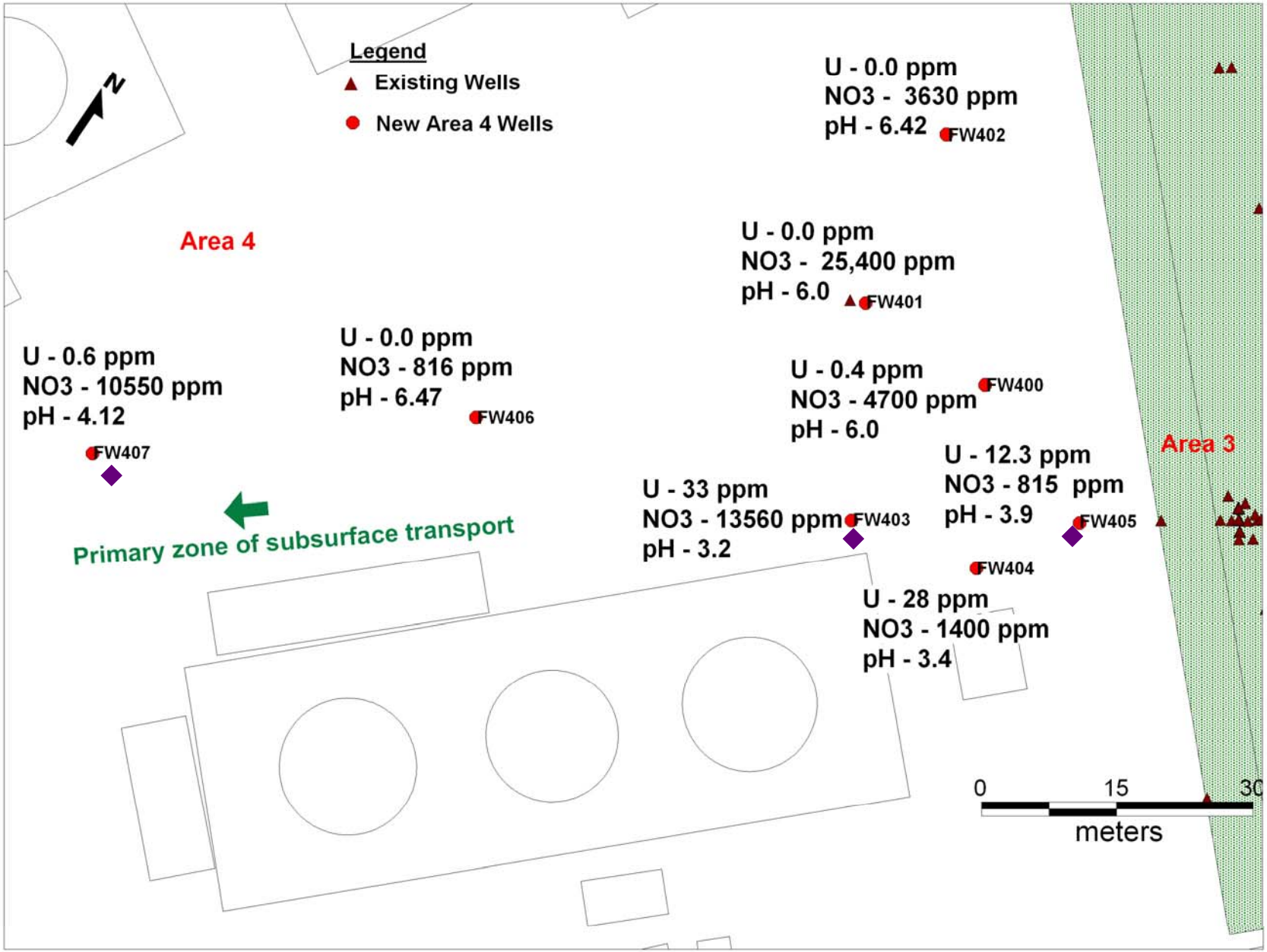


Area 4 Sampling Results

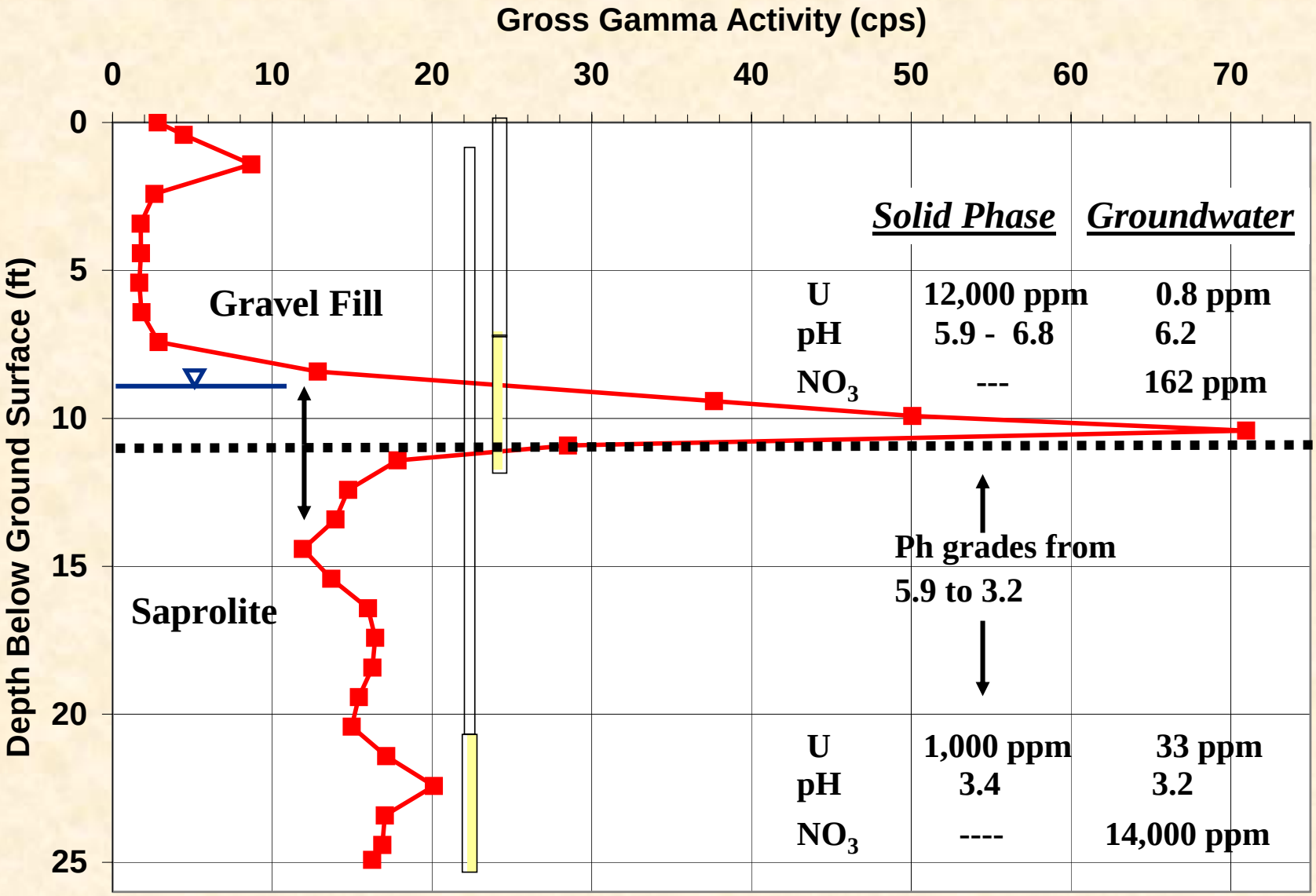
FRC Wells Logged In Situ August and October, 2004




Gross Gamma Activity (cps)
0
10
20
30
40
50
60
70
Depth Below Ground Surface (ft)
0
5
10
15
20
25
FW408

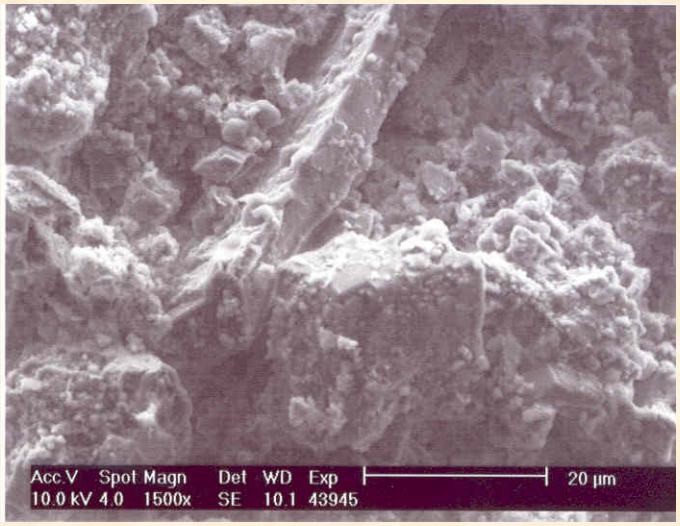


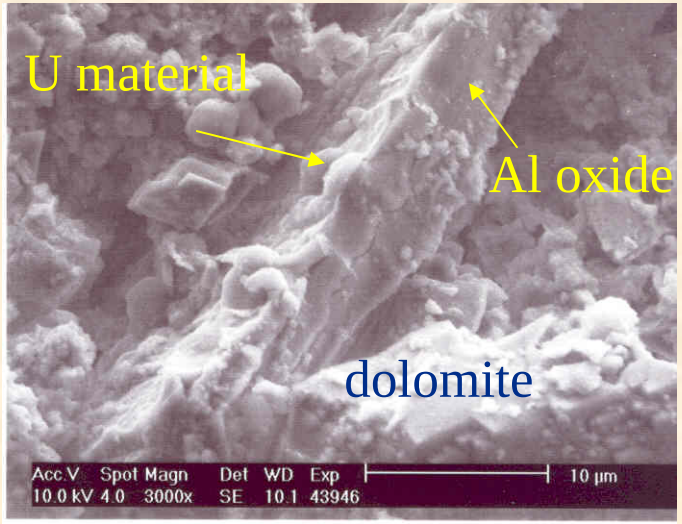
Area 4 Sampling Results

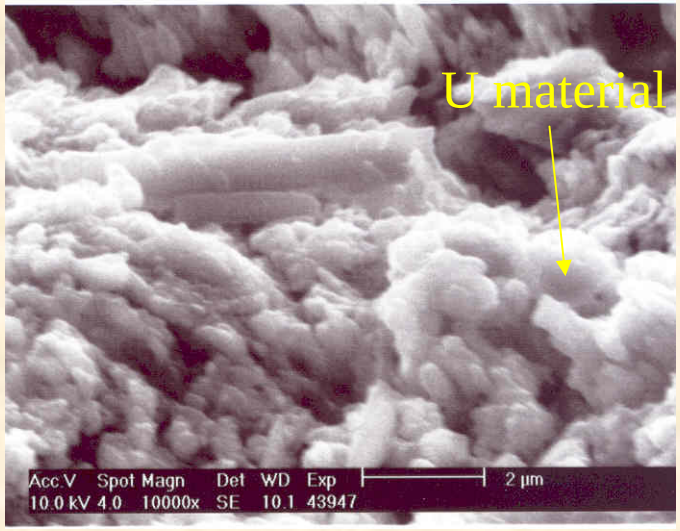

Gross Gamma Activity (cps)
0
10
20
30
40
50
60
70
Depth Below Ground Surface (ft)
0
5
10
15
20
25
Gravel Fill
Saprolite
Solid Phase
Groundwater
U
pH
NO3
12,000 ppm
5.9 - 6.8

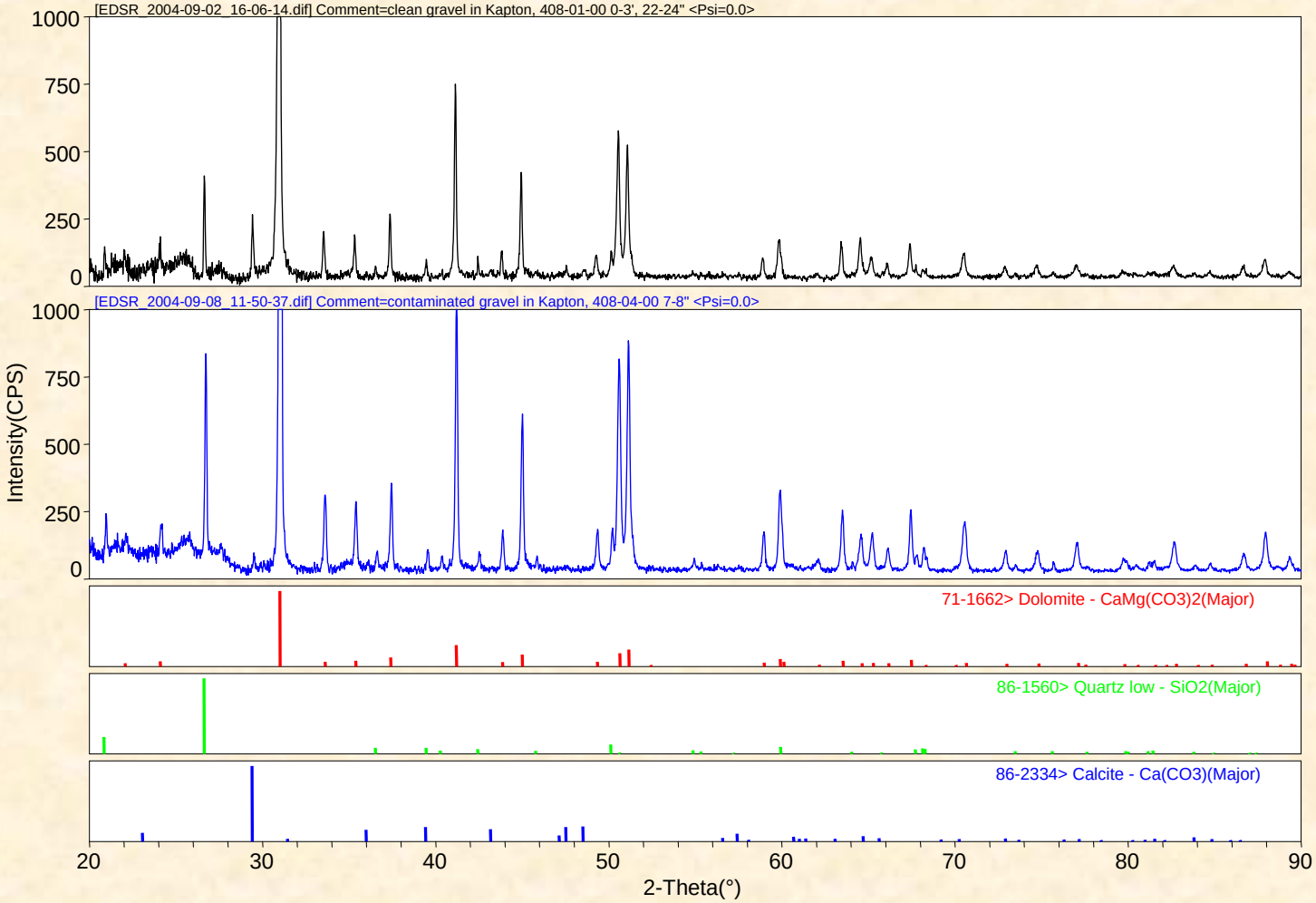
0.8 ppm
6.2
162 ppm
Ph grades from
5.9 to 3.2
U
pH
NO3
1,000 ppm
3.4
----
33 ppm
3.2
14,000 ppm

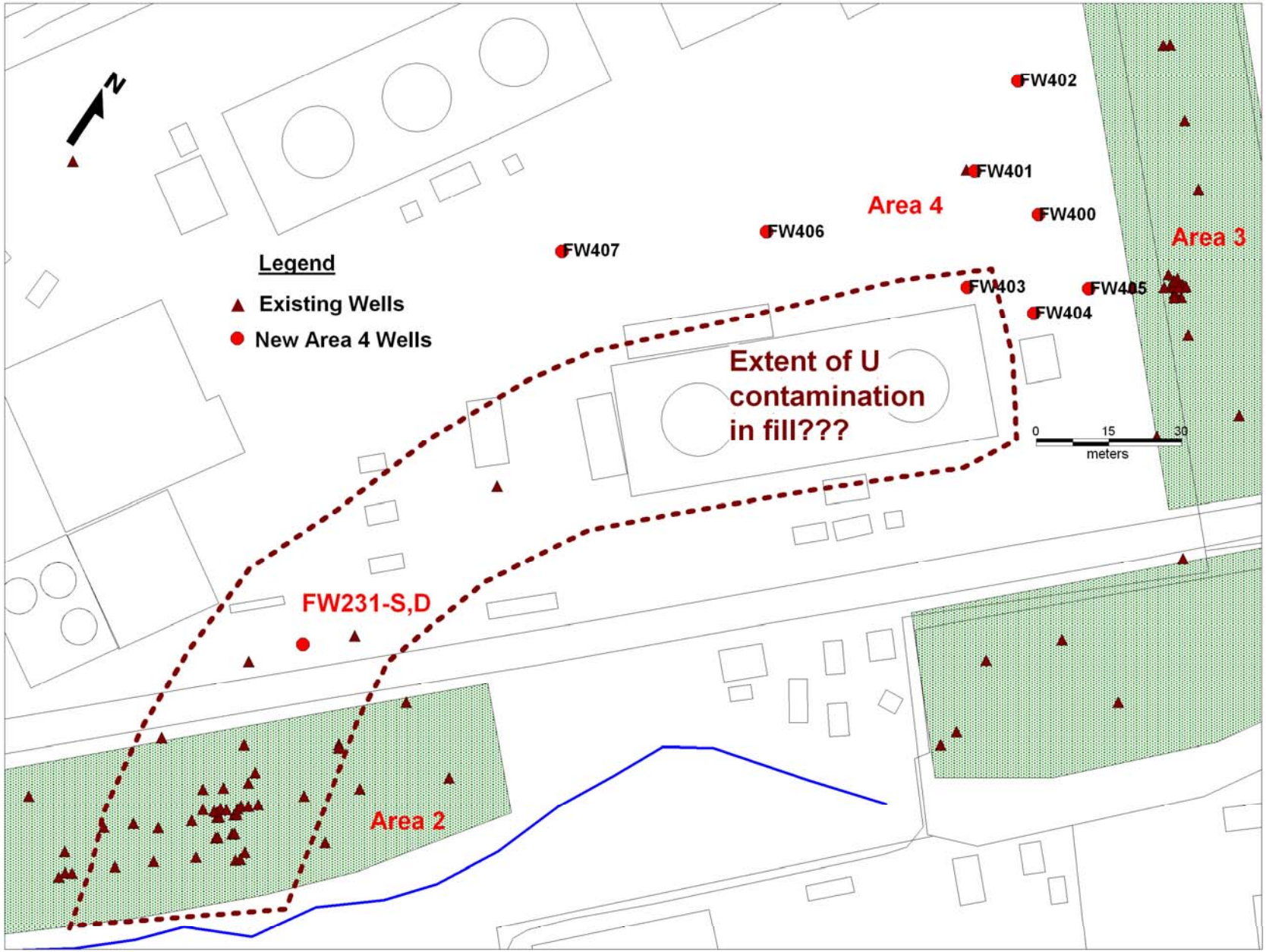
SEM of Gravel





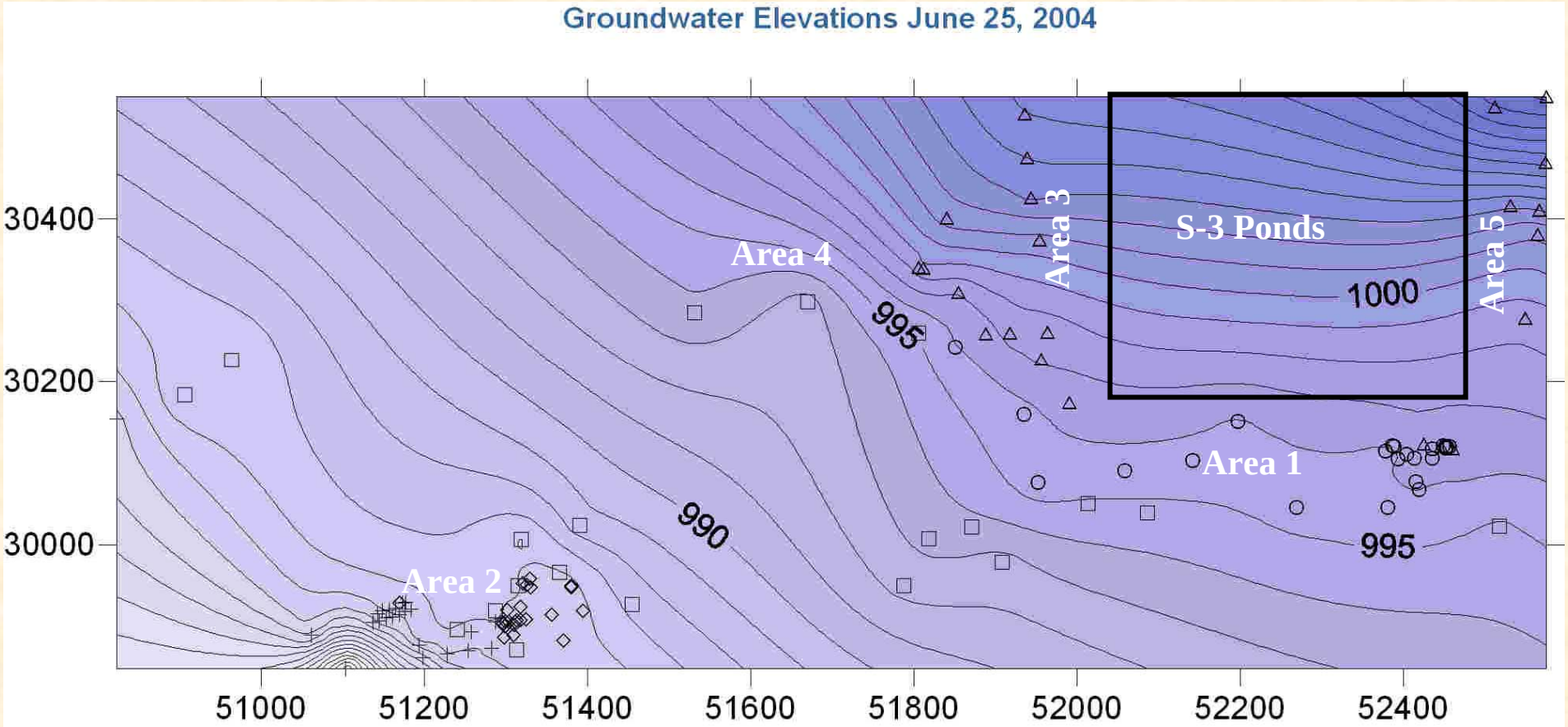



[EDSR_2004-09-02_16-06-14.dif] Comment=clean gravel in Kapton, 408-01-00 0-3', 22-24" <Psi=0.0>
[EDSR_2004-09-08_11-50-37.dif] Comment=contaminated gravel in Kapton, 408-04-00 7-8" <Psi=0.0>
Intensity(CPS)
1000
750
500
250
0
71-1662> Dolomite - CaMg(CO3)2(Major)
86-1560> Quartz low - SiO2(Major)
86-2334> Calcite - Ca(CO3)(Major)
20
30
40
50
60
70
80
90
2-Theta(°)



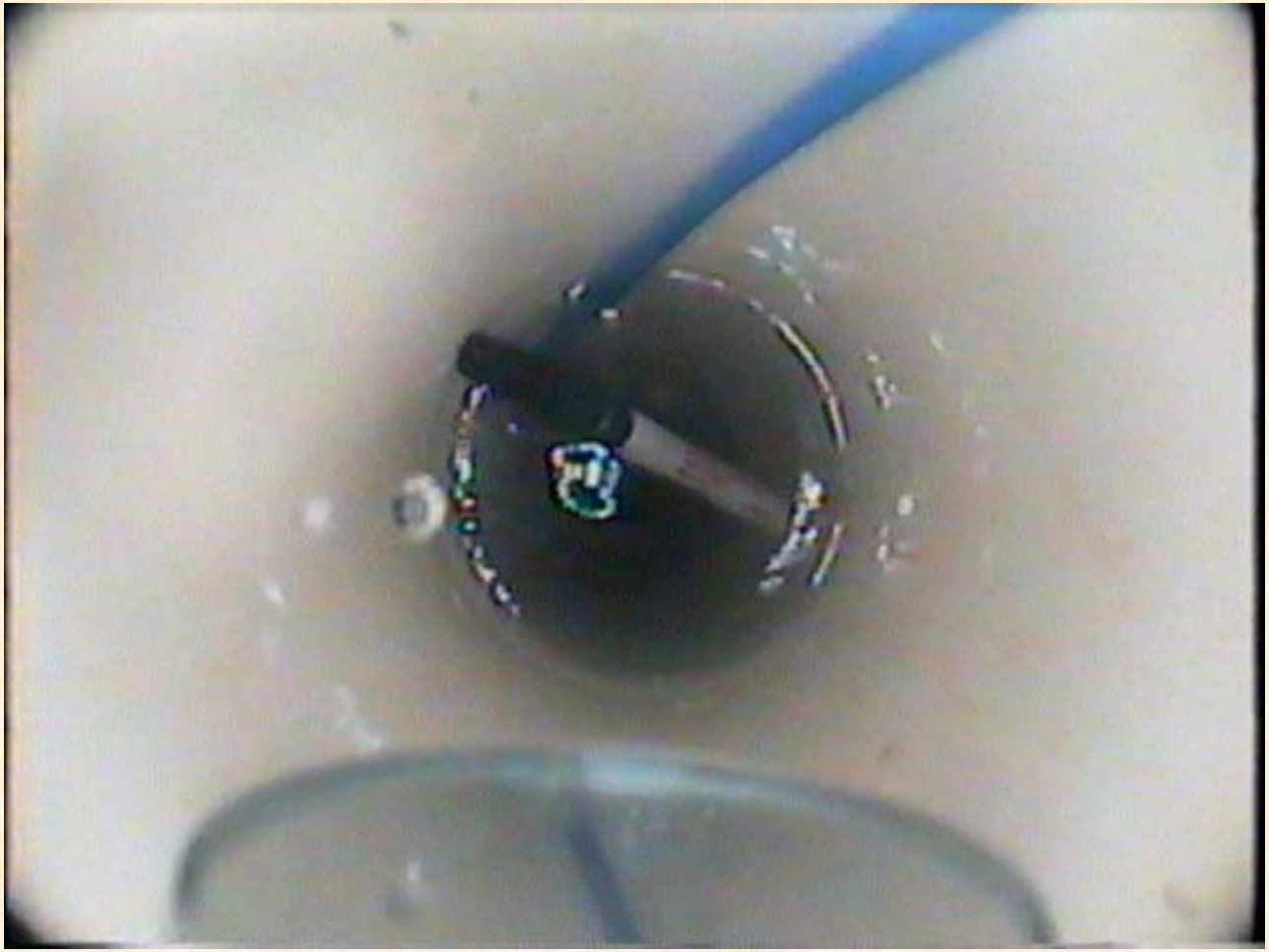
Extent of U Contamination in Shallow Fill

Groundwater Elevations



Well clogging in Area 3 Field Plot

	Reference well (FW106)	Inner injection well	Inner extraction well
Pre-Cleaning			
Post-Cleaning			

Lessons Learned – Well Screens

- **Slotted 2” diameter well screen**
  - **0.01” slot size = 2.75 sq. in/ft**
  - **0.02” slot size = 5.23 sq. in/ft**
  - **0.05” slot size = 11.45 sq. in/ft**
- **Wire wrap even more open area**