U.S. Department of Energy

Office of Science

NABIR Field Research Center
Oak Ridge, Tennessee

Paul E. Bayer

NABIR Field Activities Manager

Environmental Remediation Sciences Division
Office of Biological and Environmental Research

September 23, 2003

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

Presentation Outline

Oak Ridge FRC Operations and Activities
- Operating a field site for "users"
- FRC services
- Coordination of activities

Oak Ridge FRC Site Information
- Field site overview
- Site characterization

In Situ Projects
- Istok – OSU
- Criddle/Jardine – Stanford/ORNL
- Scheibe - PNNL

Future FRC Activities

Mission and Scope of the NABIR FRCs

Mission: To serve as premier field research sites at which NABIR and other BER investigators can obtain samples and conduct in situ studies that will lead to new insights into the bioremediation of metals and radionuclides and related contaminant fate and transport processes

Scope: Four general types of activities

- Sample acquisition
- Intrinsic bioremediation analyses
- Accelerated bioremediation research
- In situ Assessment of new characterization, monitoring and prediction approaches

Oak Ridge FRC - Operations

- Operational Documents
  - Finding of No Significant Impact (FONSI) under NEPA
  - Plans – Management, H&S, QA, Communication & Site Characterization
  - MOU's with Other Site Contractors
- Staffing
  - FRC Manager, Science Advisor, Technical & Field staff
- Services
  - Users Guide, Website, Newsletter, In situ Project Fact Sheets, Brochure
  - Data management & posting on website
  - Annual workshops
- Infrastructure
  - Trailer with hoods, core barn, lysimeters

Oak Ridge FRC - Field Activities

- Background & Contaminated Site Characterization
  - Phase I and Phase II – first few years
  - Borehole/well drilling & coring
  - Field plot identification for PI's
  - FRCs Strategic Plan
- Site Characterization Activities
  - Well logging, hydraulic testing and tracer tests
  - Geochemical and physical analyses of core and ground water
  - Geophysics - electrical conductivity
- In Situ Project Support – well installation & waste disposal
- Samples for PI's
  - Core & ground water
  - Humic materials

Oak Ridge FRC - Coordination

- Regular Coordination Conference Calls
  - DOE Field Activities Manager, FRC Manager, FRC Science Advisor, FRRP Chair, In situ project Team Leaders
- Independent Field Research Review Panel (FRRP) Review of In Situ Project Work Plans and Site Characterization Plans
  - Recommendations to FRC Manager
- "Hub & Spoke" Model for In Situ Projects
  - Hub – Team Leaders for in situ project team
  - Other NABIR PI's working with the team
- Working Groups – 4
  - Microbial Community Analysis, Rates and Mechanisms of Metal Reduction, Geochemistry/Geophysics and Modeling
- Meetings
  - Annual workshop & Breakout session at annual NABIR PI meeting

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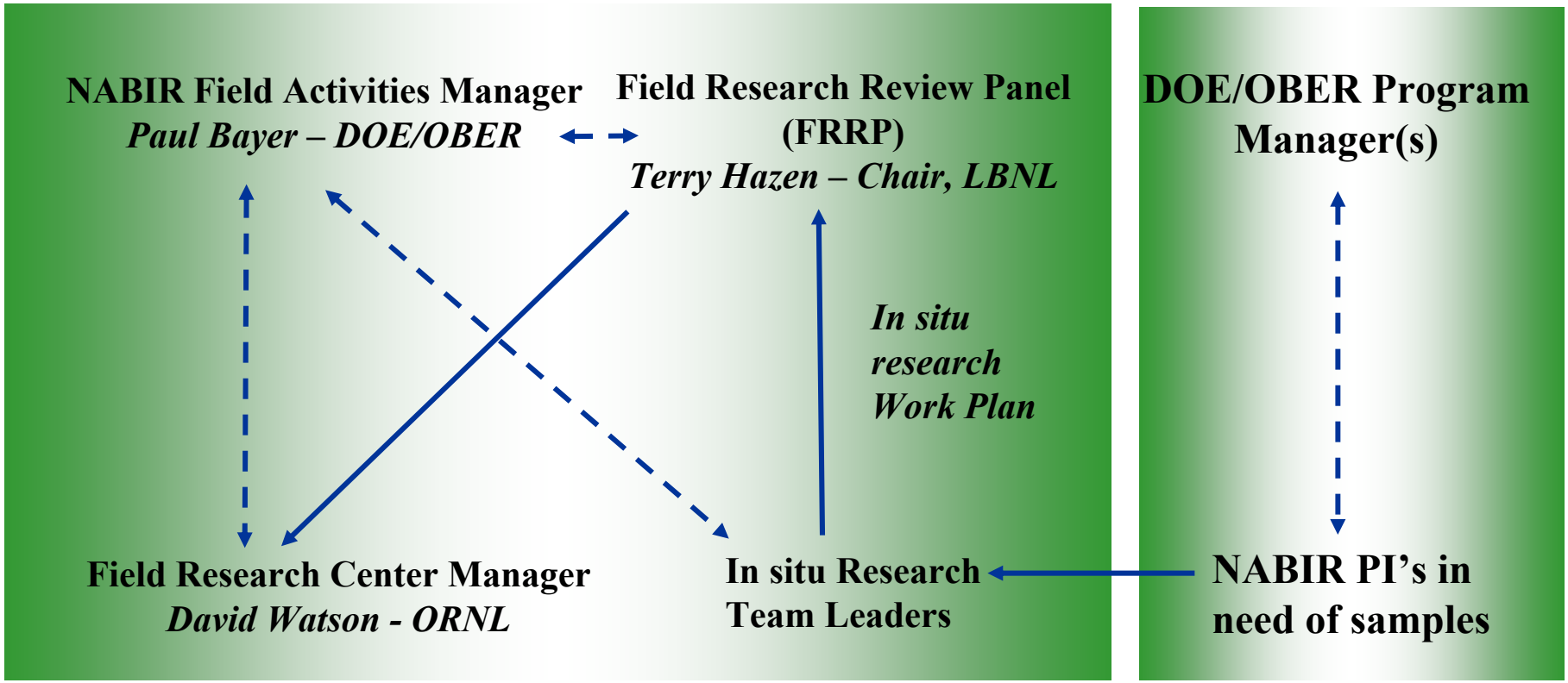
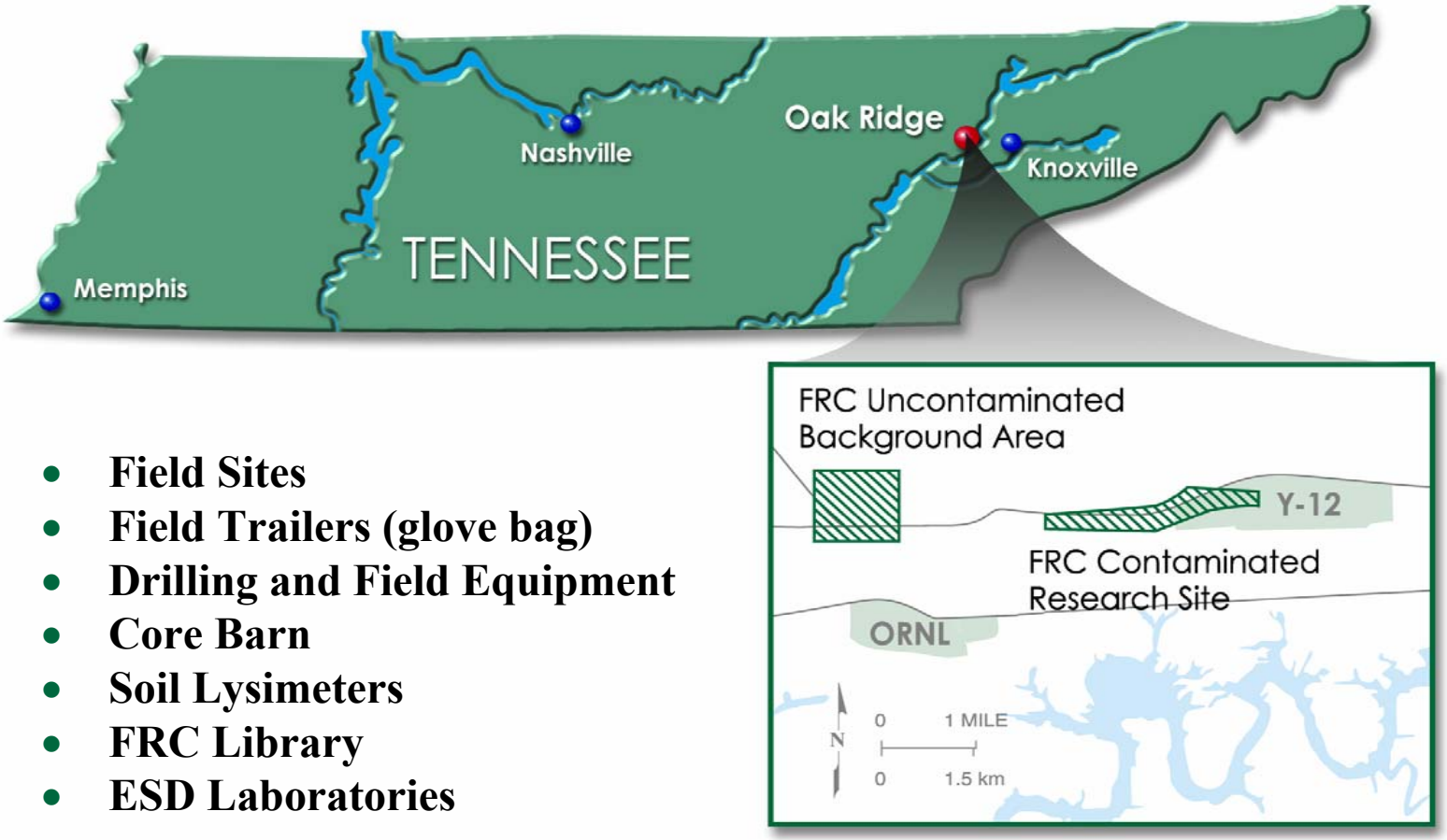
Coordination of Research at the NABIR Field Research Center



Location of the Oak Ridge FRC



- Field Sites
- Field Trailers (glove bag)
- Drilling and Field Equipment
- Core Barn
- Soil Lysimeters
- FRC Library
- ESD Laboratories

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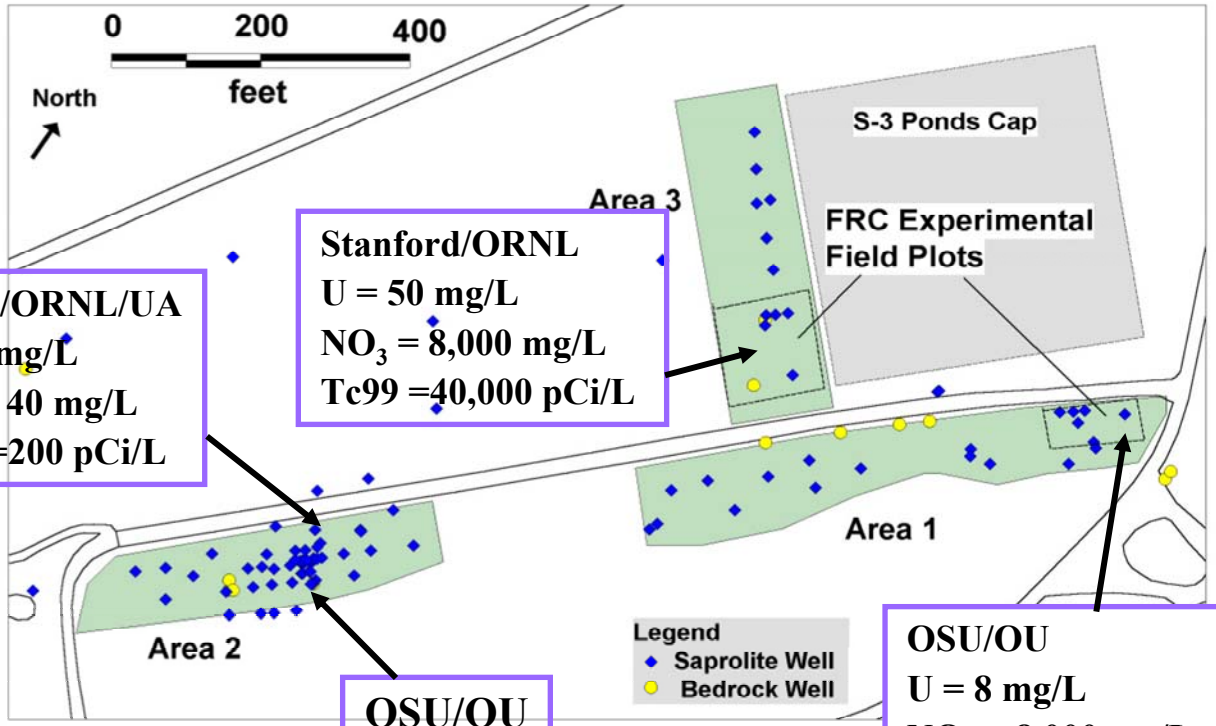
FRC Located at West End of Y-12 Site

Experimental Plots at the Contaminated Site



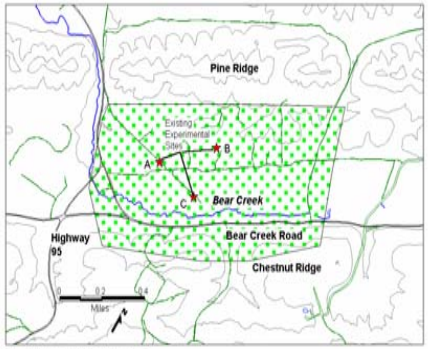
PNNL/ORNL/UA
U = 1 mg/L
NO_3 = 40 mg/L
Tc99 =200 pCi/L

Stanford/ORNL
U = 50 mg/L
NO_3 = 8,000 mg/L
Tc99 =40,000 pCi/L

OSU/OU

OSU/OU
U = 8 mg/L
NO_3 = 8,000 mg/L
Tc99 =18,500 pCi/L

Contaminated Area



Background Area

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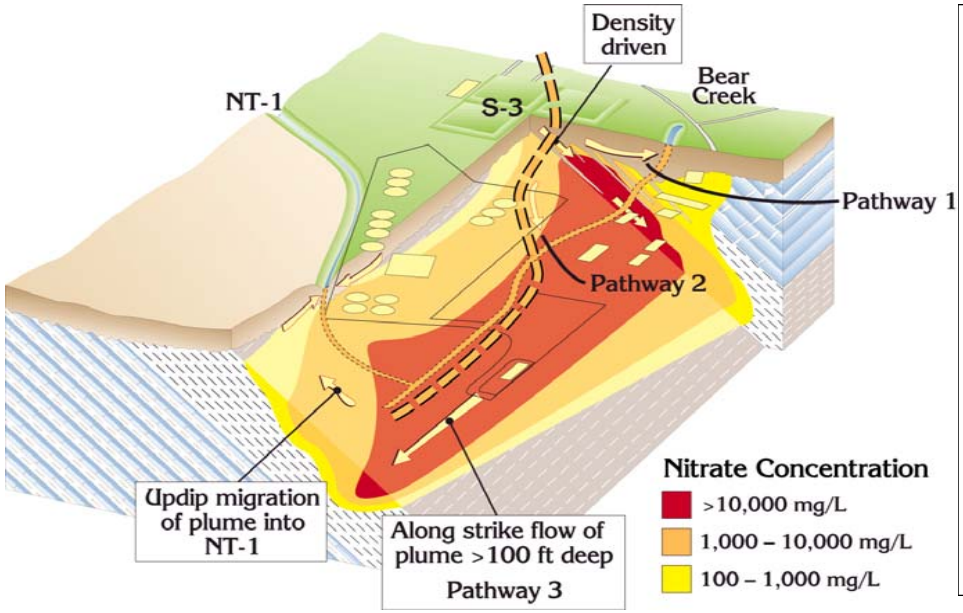
S-3 Ponds and the Contaminated FRC Site

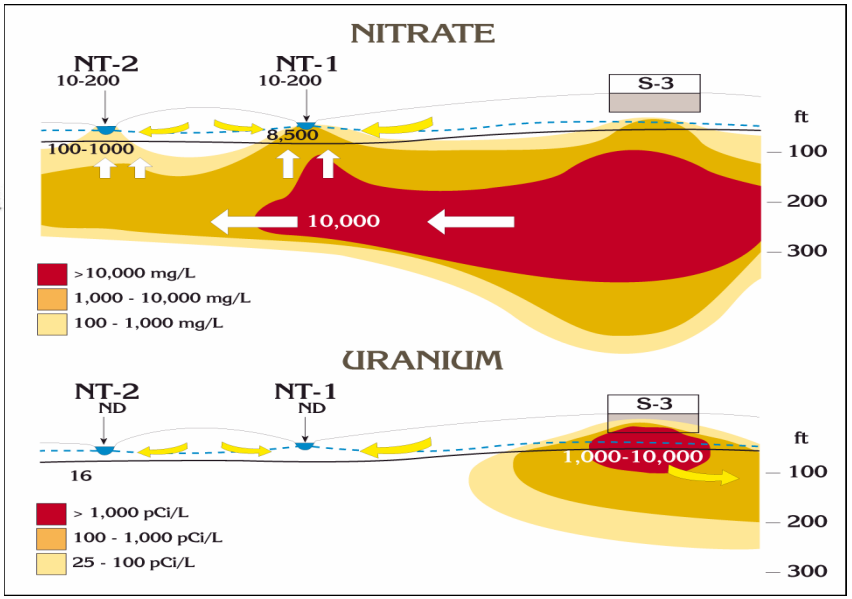
- Operated from 1951 to 1983
- 400 ft x 400 ft x 17 ft deep
- Over 2.5 million gallons waste/year
- Wastes contained nitrate, uranium, Tc-99, metals, VOCs, high TDS, and low pH (<2.0)
- Neutralized in 1984 capped in 1988

Currently a parking lot

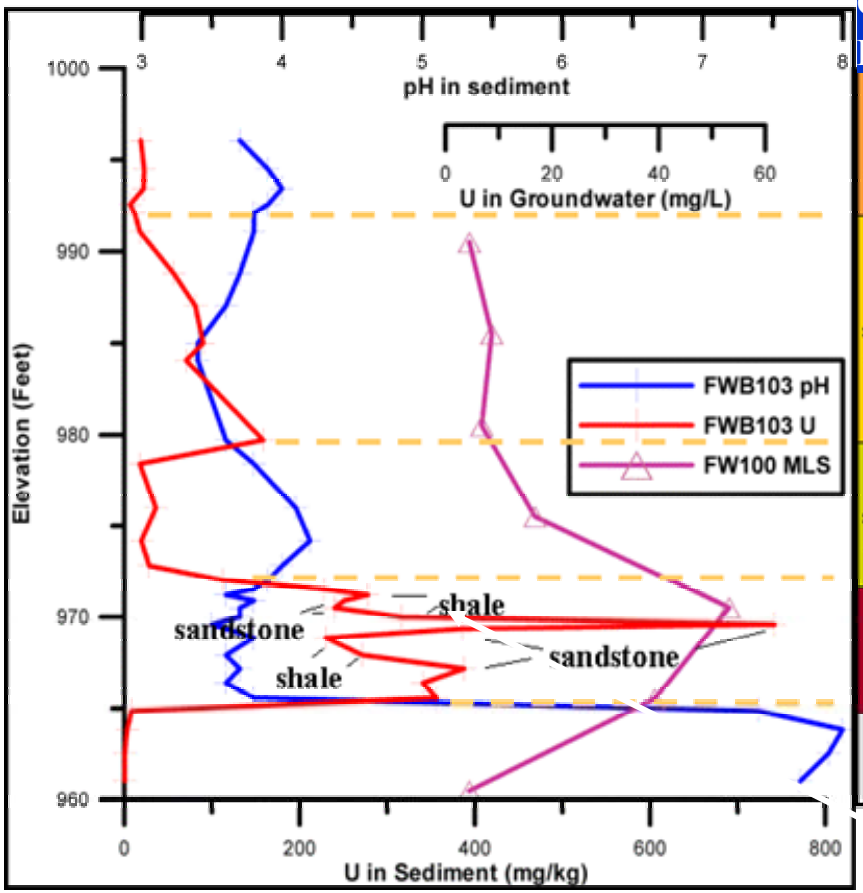
S-3 Disposal Ponds During Denitrification

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





Drilling and Geological Characterization



Generalized Lithology

- Highly weathered shale and sandstone saprolite
- Moderately weathered shale, siltstone and sandstone saprolite
- Less weathered shale, siltstone and sandstone saprolite
- Weathered shale and sandstone
- Limestone and shale bedrock

Limestone zone

Mineral precipitation zone

Uranium and pH on Sediment compared to U in Groundwater
Area 3 Field Plot (FWB103)

Geophysical Characterization

Electrical Conductivity Probing with FRC Geoprobe

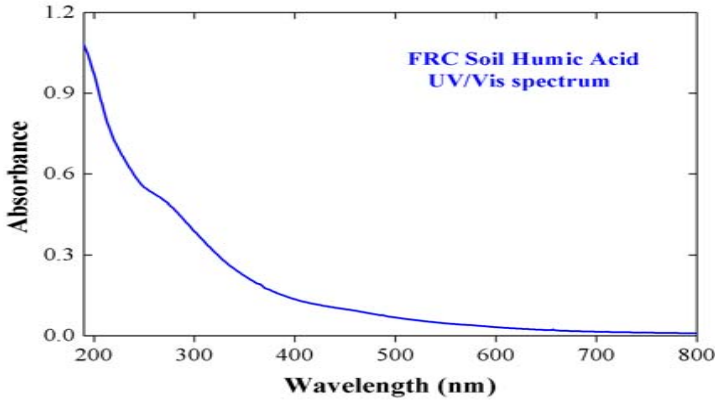
- Useful for mapping stratigraphy and high U zones

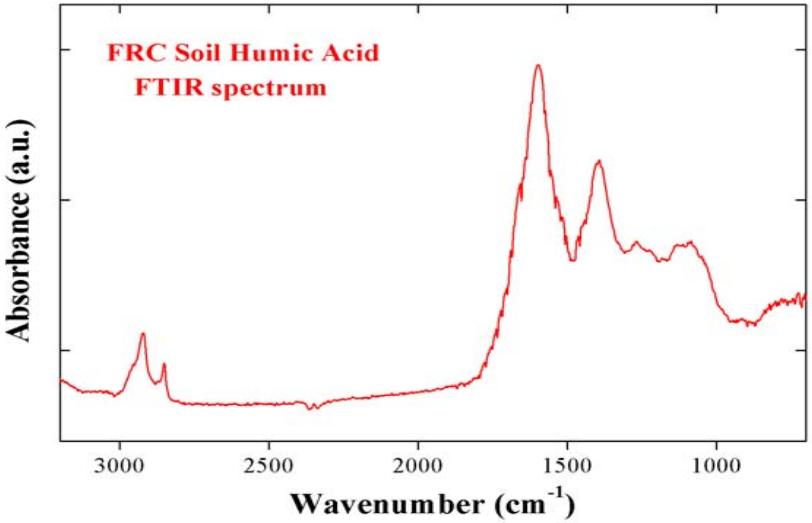
Soil Humics from the FRC

Background Area Forested Soil Humics

- Extracted, concentrated, and freeze dried
- Spectroscopic characterization

- Contact: Baohua Gu/ORNL



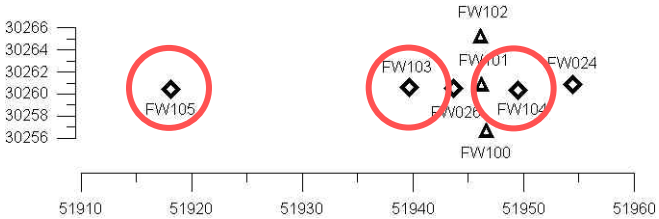


Elemental Composition of Humic Acid

Element	%
C	54.50
O	30.46
H	4.62
N	4.10
S	0.50
Ash	1.86

Characterization of FRC Cores

- Three rotasonic coreholes to 15 meters (Area 3 Field Plot)
- Analyses
  - pH
  - Uranium (kpa)
  - Oxalate and CBD extractions (Fe, Mn, Al, Si by ICP)
  - P (fusion/ICP) and S (combustion infrared Leco)
- Mineralogical Analyses
  - Thin sections, SEM, EDX, BES element mapping
  - XAFS (ANL – Ken Kemner and Shelly Kelly)
- Column, sorption and bioreduction studies



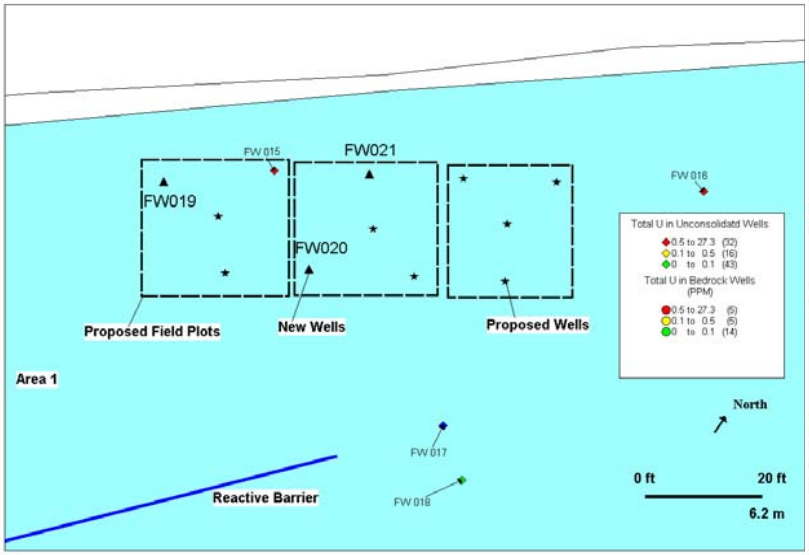
Oregon State/Oklahoma In Situ Project

In Situ Determination of Uranium Reduction Kinetics

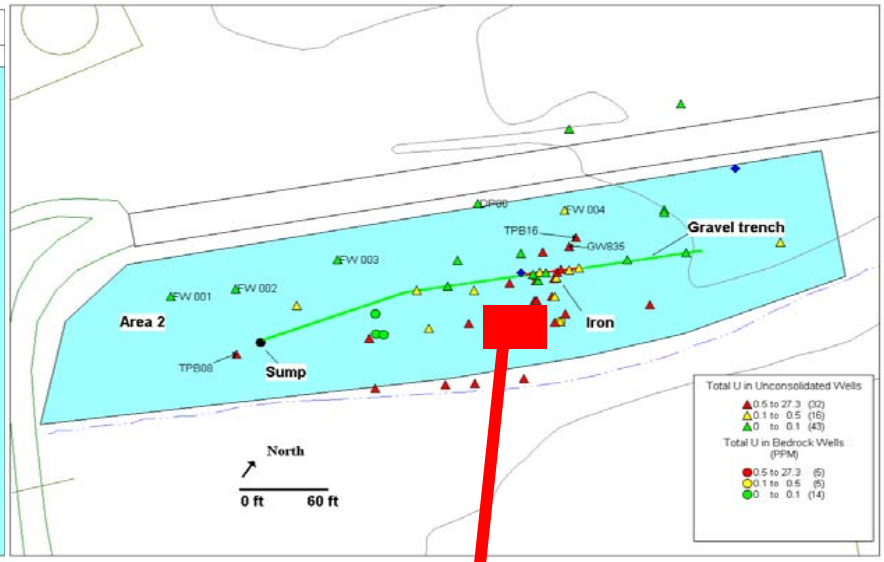
Scope of Work - Push-Pull Tests

- Test plots in Area 1 and Area 2
- Laboratory studies to identify and optimize test solutions
- Site groundwater amended with electron donors and multiple push-pull tests to stimulate the formation of anaerobic and reducing conditions

Location of Oregon State/Oklahoma Well Plots



Location of New Istok Wells and Potential Field Plots



Test Plots in Area 1

Location of Field Plot in Area 2

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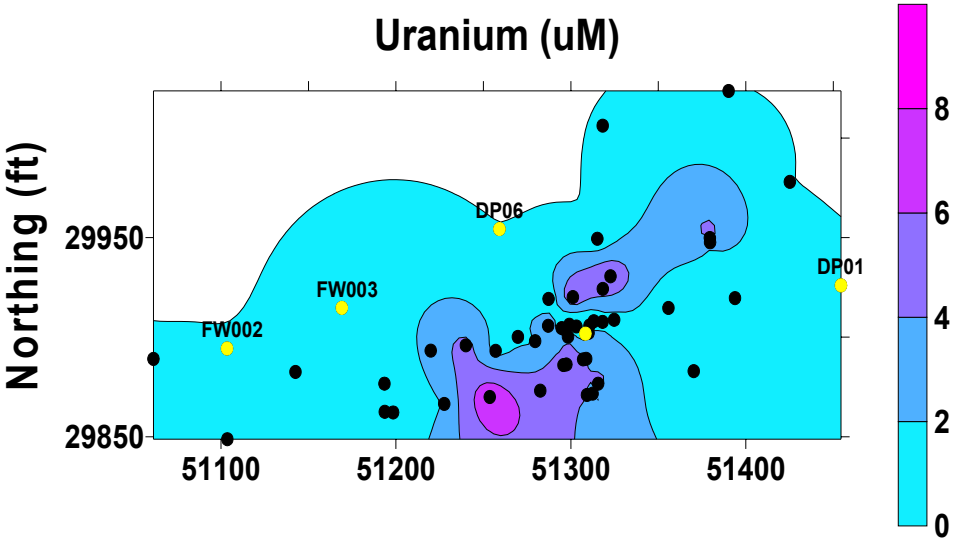
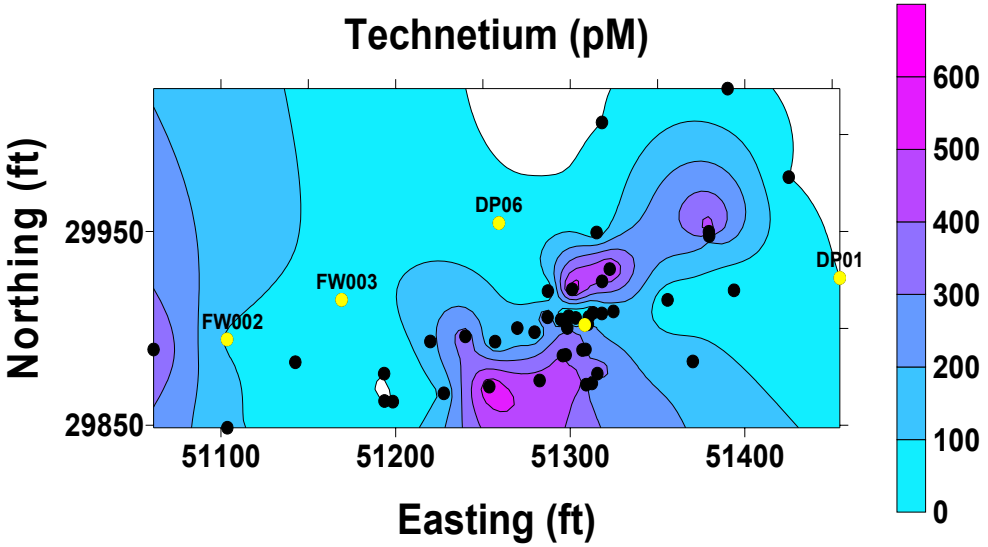
Setup for Istok In Situ Project

Well field in Area 2

Test solutions prepared in plastic drums





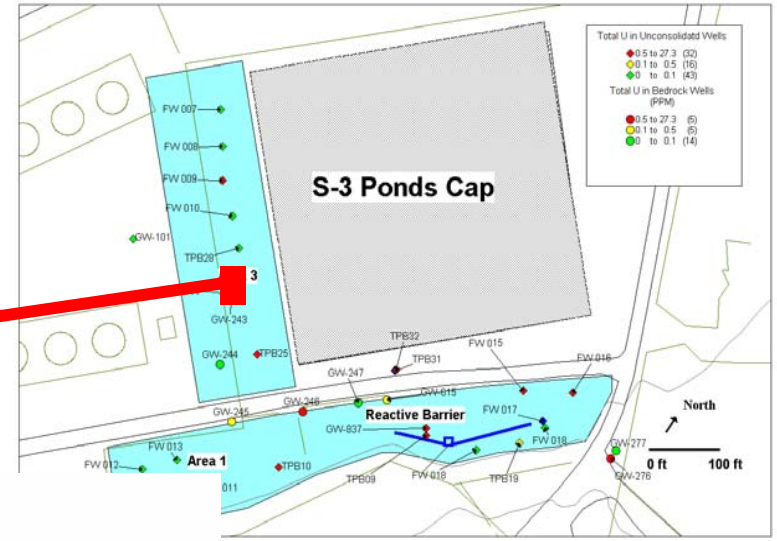
Stanford/ORNL In Situ Project

Field-Scale Evaluation of Biostimulation for Remediation of Uranium-Contaminated Groundwater

Scope of Work – Laboratory & Field Studies

- Laboratory Studies (microbial, FBR, nitrate removal).
- Installation of wells in conductive zone and characterization.
- Tracer studies and geophysics analyses.
- Ground water recirculation modeling.
- Ground water "pretreatment" train.
- Ex site and In situ operations.

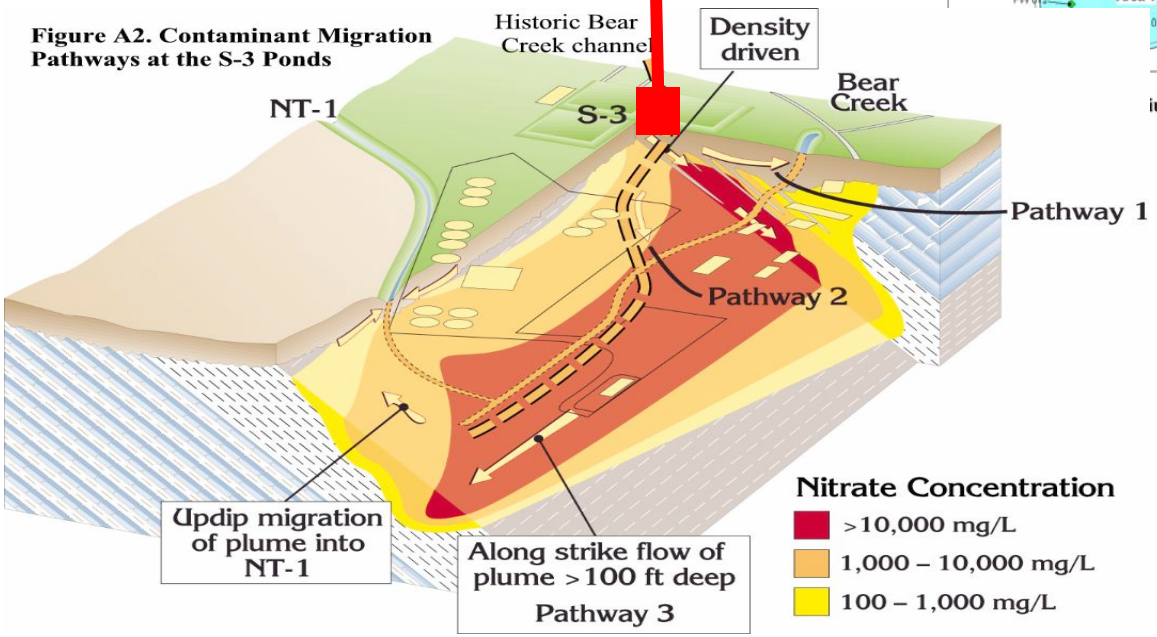
Location of Stanford/ORNL Field Plot



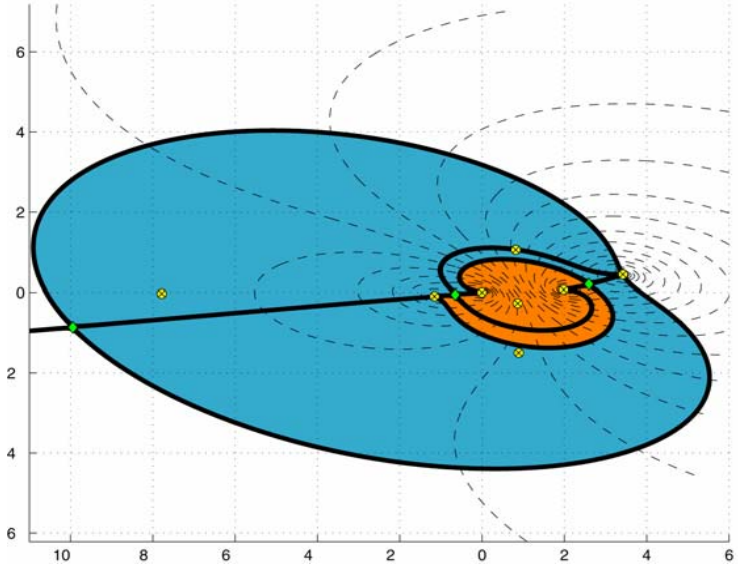
ium Concentrations at Areas 1 and 3

Where we are

Figure A2. Contaminant Migration Pathways at the S-3 Ponds



Stanford/ORNL Ex Situ Setup



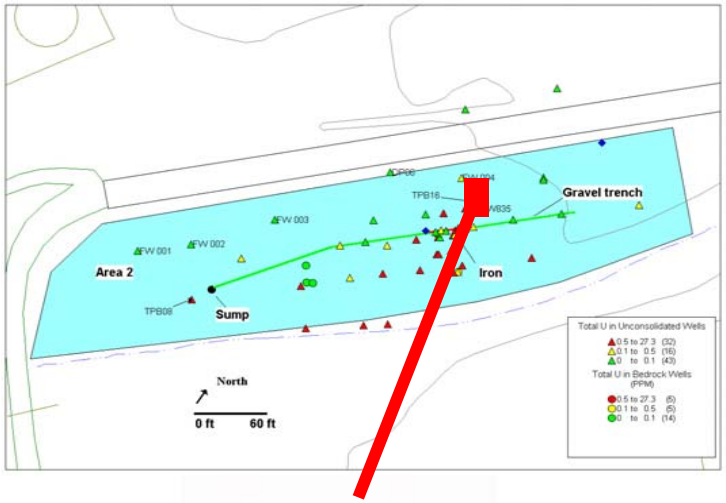
PNNL/Alabama/ORNL In Situ Project

In Situ Immobilization of Uranium in Structured Porous Media via Biomineralization at the Fracture/Matrix Interface

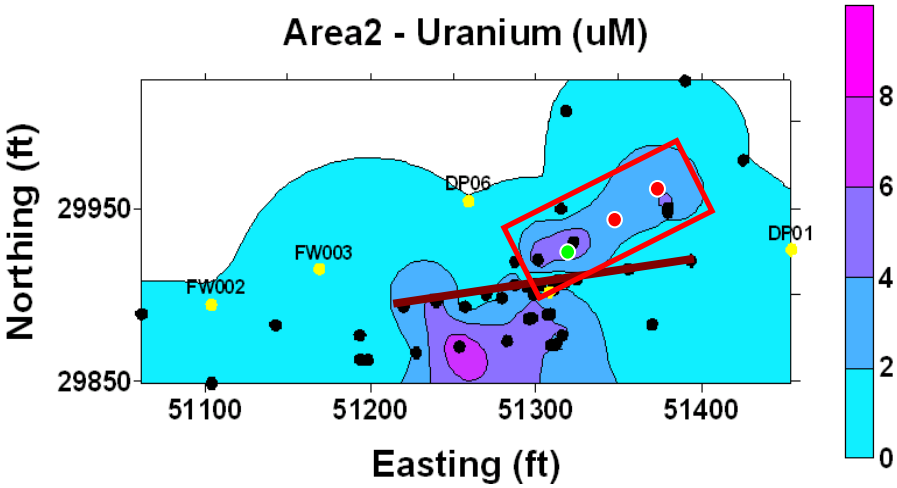
Scope of Work – Laboratory & Field Studies

- Laboratory studies (Fe/U reduction potential, microscopic biogeochemical analyses)
- Field site characterization – ground water and sediment sampling and tracer tests
- Numerical modeling to guide field experiment.
- Field-scale biostimulation experiment.

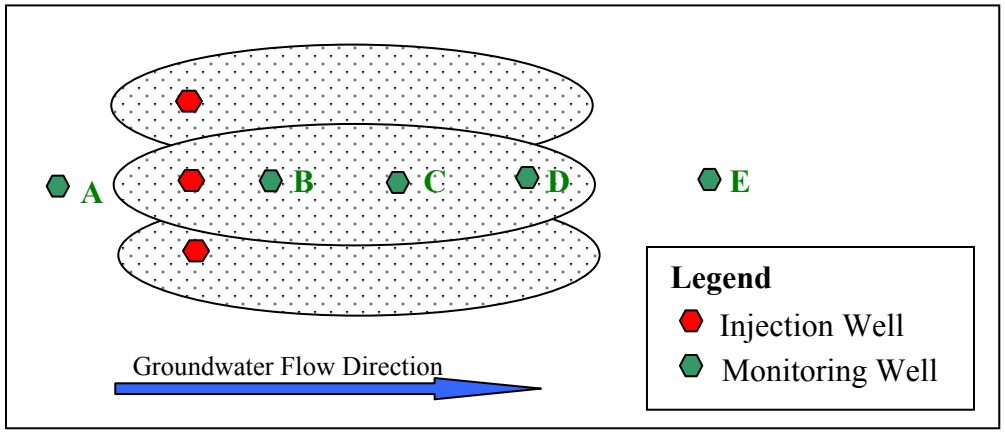
Location of PNNL Well Plots



Location of Field Plot in Area 2

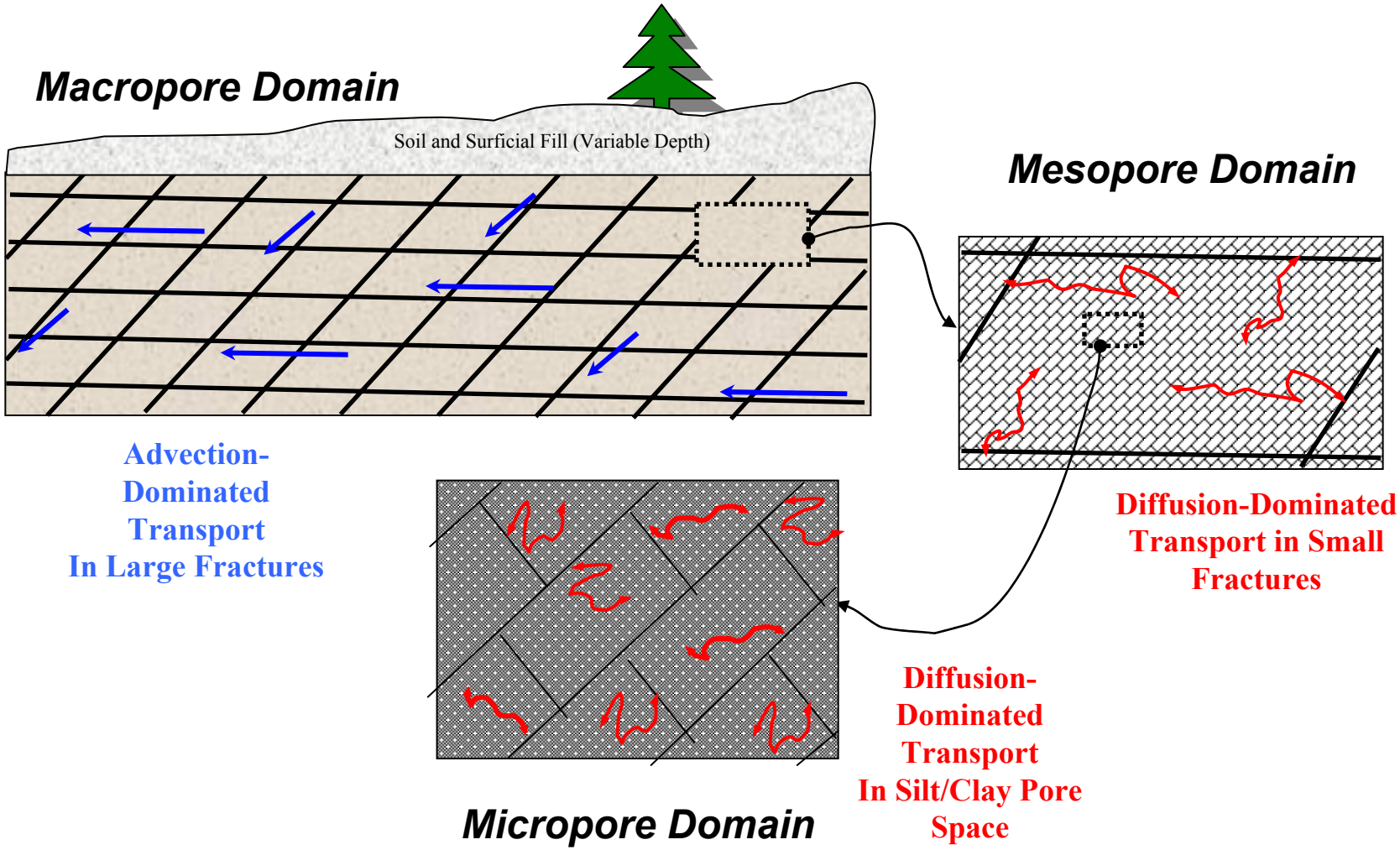


Two exploratory wells installed in Spring 2003



Planned Field Injection Setup

Structured Porous Media



FRC Strategic Planning

- October 2001 Review by the NABIR/BERAC Subcommittee
  - "Brief scientific strategy consistent with the NABIR Strategic Plan"
- Strategic Planning Process
  - Initiated planning in Summer 2002
  - Strategic planning meetings for ERSD
  - Field sites for NABIR and EMSP research
- FRC Strategic Plan
  - Mission, four goals and tasks

Second FRC

- NABIR Interest in Establishing a Second FRC
  - Included in ERSD subcommittee scope to review the need for additional field sites for all ERSD programs
- Solicitation and Review
  - NEPA Documentation
  - Scientific, management and cost proposal
- Subsurface Hydrogeology very Different from Oak Ridge
- Solicitation, Review and Award in FY04