



Implementing SEAR in the Field

Duke Engineering and Services



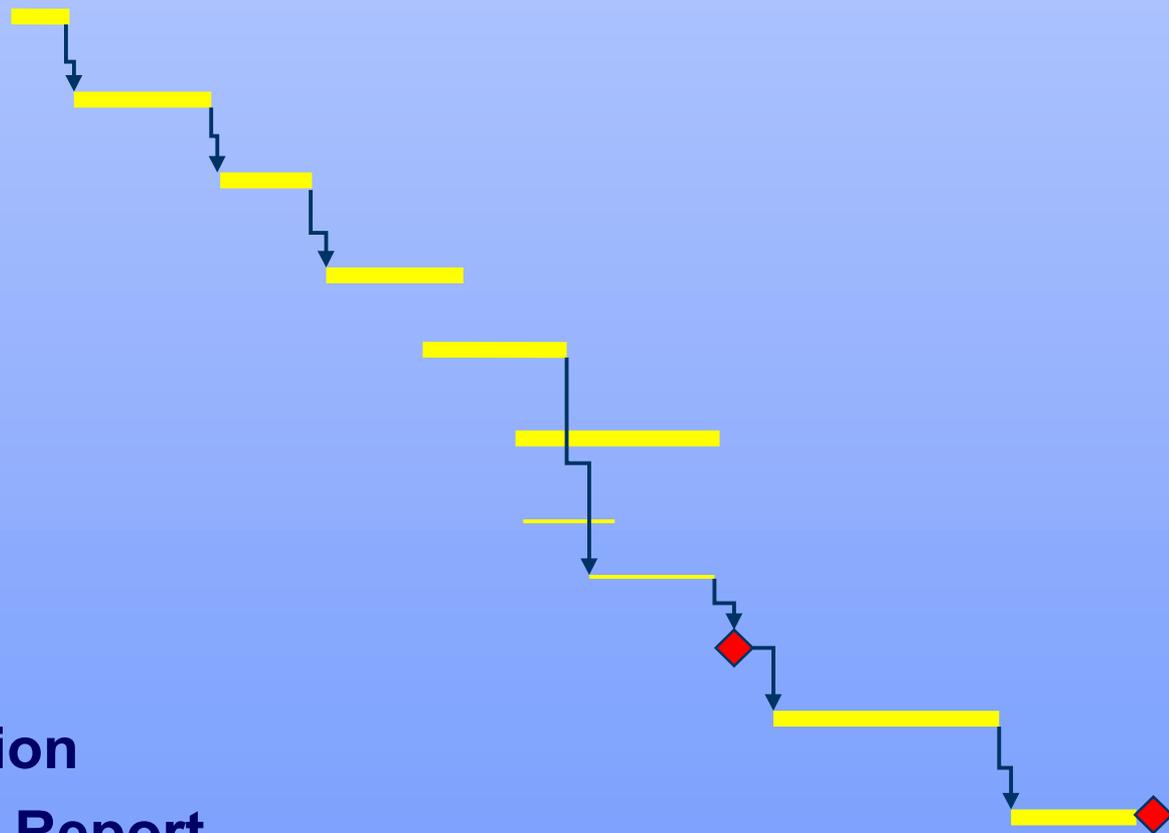
SEAR Workshop

Topics

- SEAR Process System
 - Mixing and Injection
 - Extraction
 - Monitoring and Sampling
 - Control
- Logistics
- Process Control

Generic SEAR Project Components

- 1.0 General Work Plan
- 2.0 Characterization
- 3.0 Wellfield Design
- 4.0 Well Installation
- 5.0 Hydraulic Testing
- 6.0 SEAR Design
 - 6.1 Design Lab Work
 - 6.2 UTCHEM
- 📄 SEAR Work Plan
- 7.0 SEAR Implementation
- 8.0 Analyses and Final Report



SEAR Components

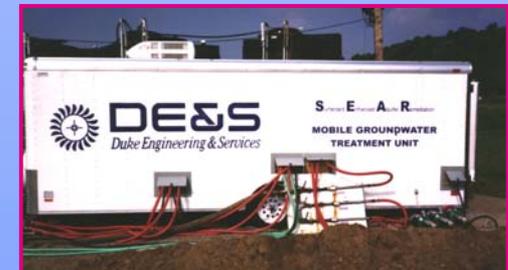
- Planning and coordination
- System construction, mobilization, setup, and shakedown
- Pre-flood PITT
- SEAR operations
- Post-flood PITT/confirmation borings
- Tear-down and demobilization

Technology Status

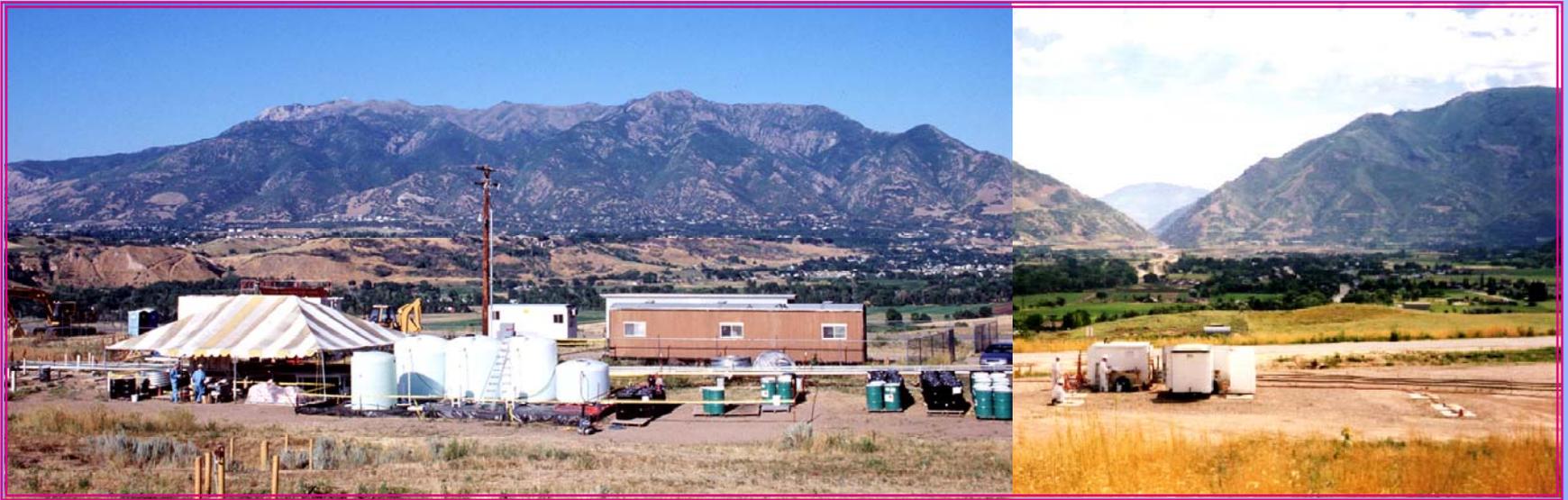


1996
**Manual Control &
Monitoring System**

1998
**Fully-Automated
System**



Changes in System Footprint



1996



1998

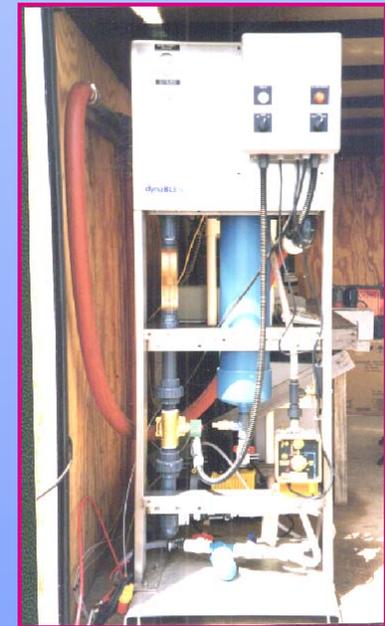
Technology Refinements



**20,000-gal
Mixing Tanks**



**14-18 ft
Control Trailer**



**In-Line Mixer
Inside Trailer**

Technology Refinements

Flow Control and SCADA

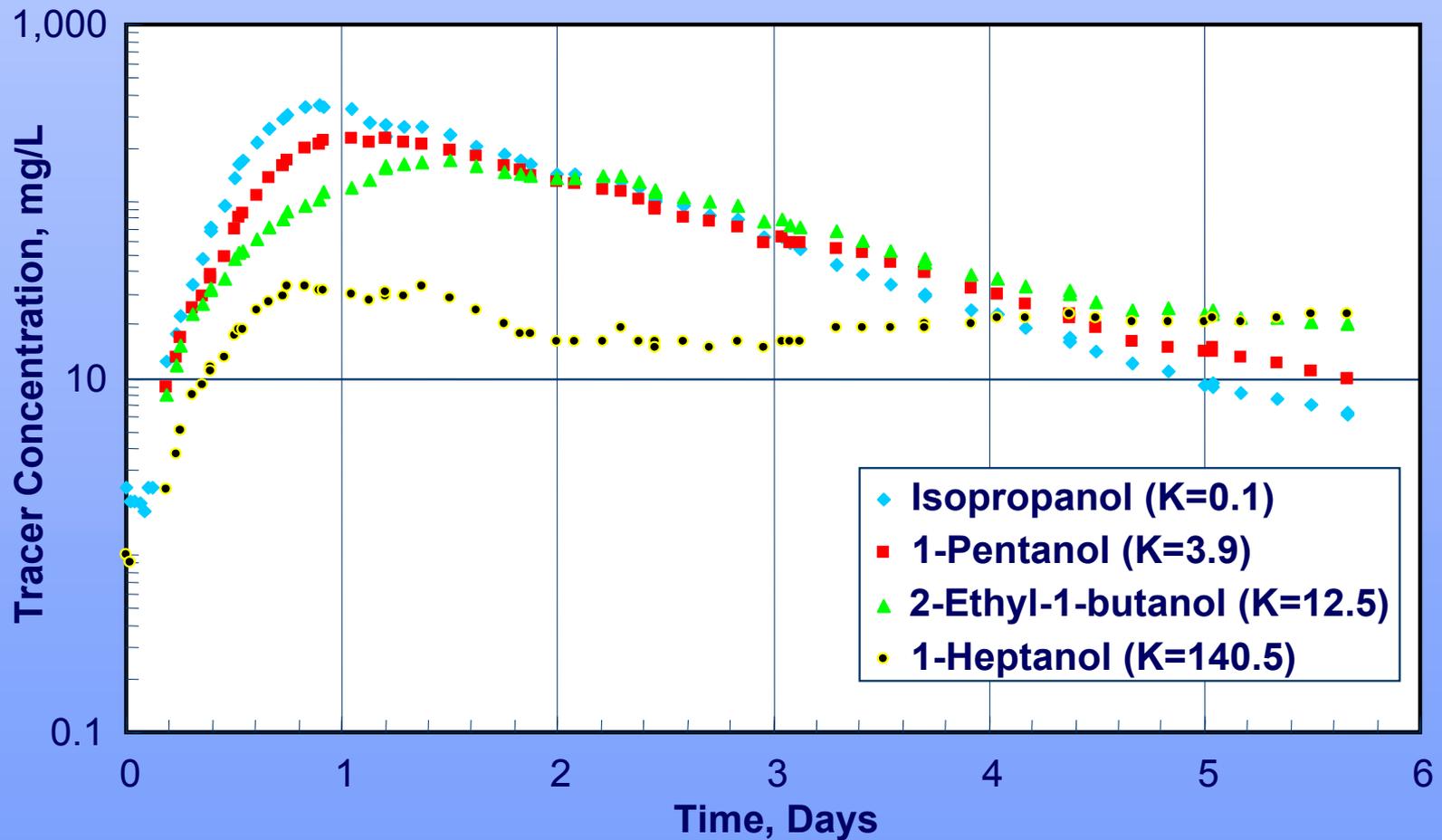
Remote monitoring,
alarms, and control
have drastically
reduced labor
requirements



Manual Sampling



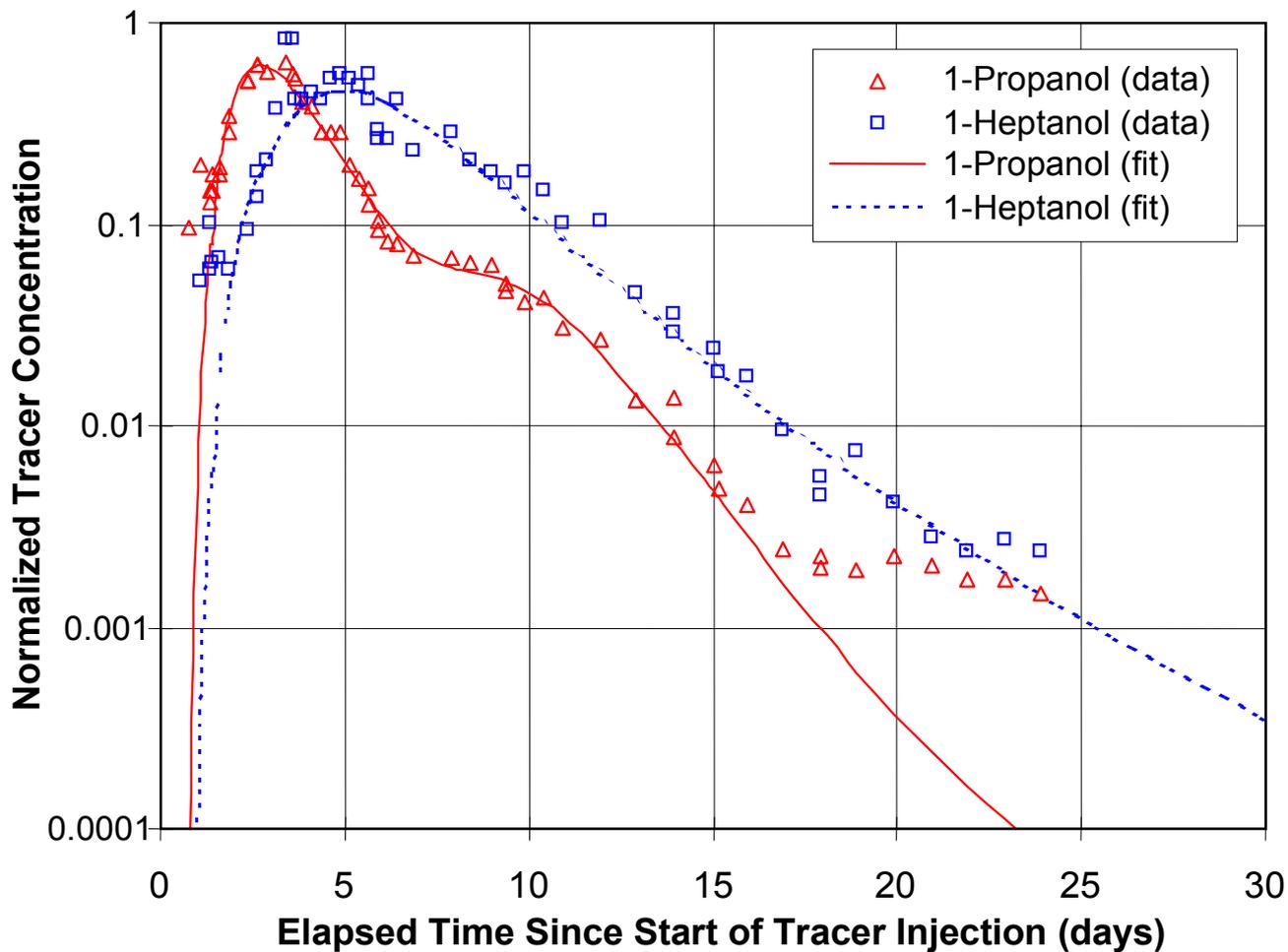
Manual Sampling



Automatic Sampling

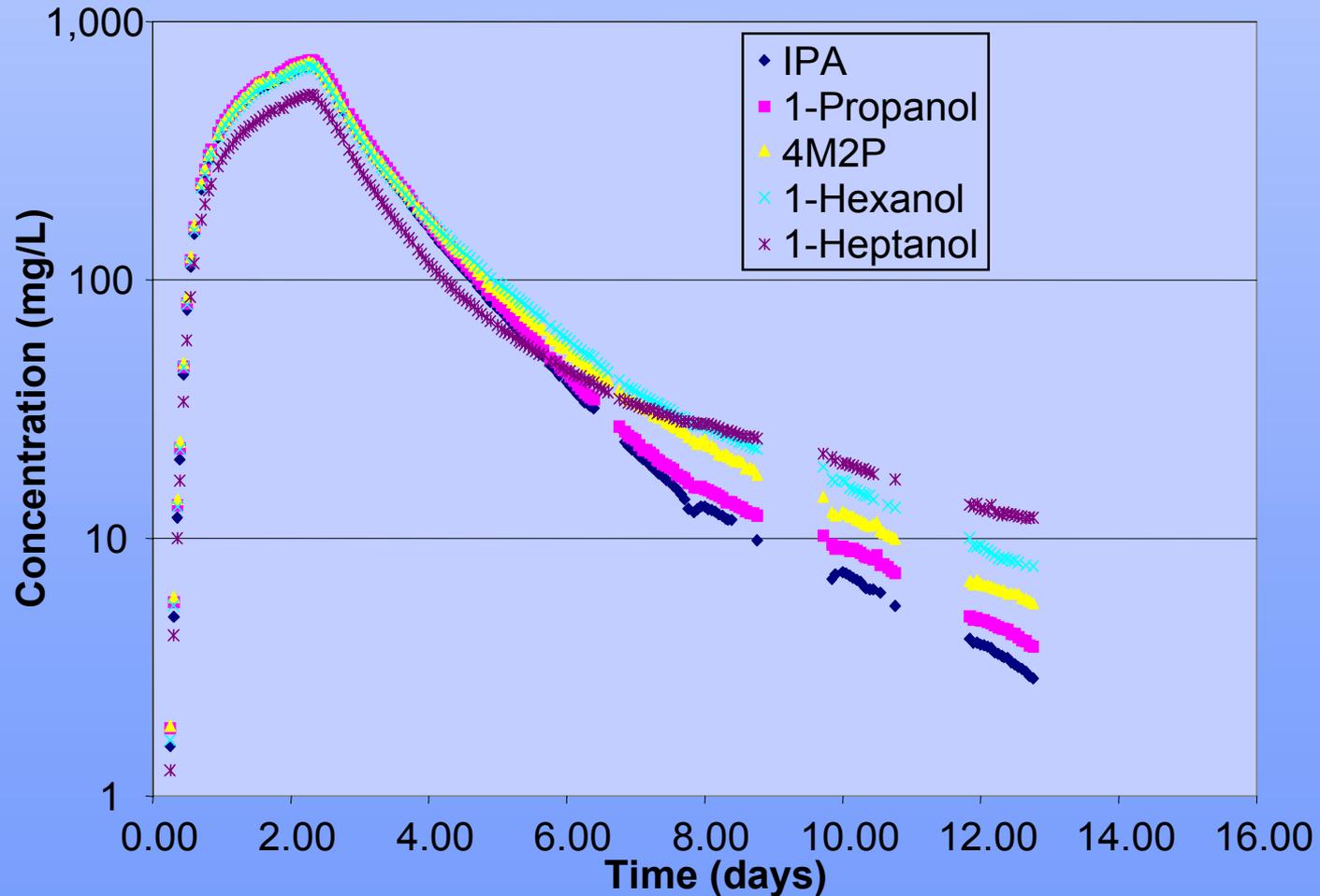


Automatic Sampling

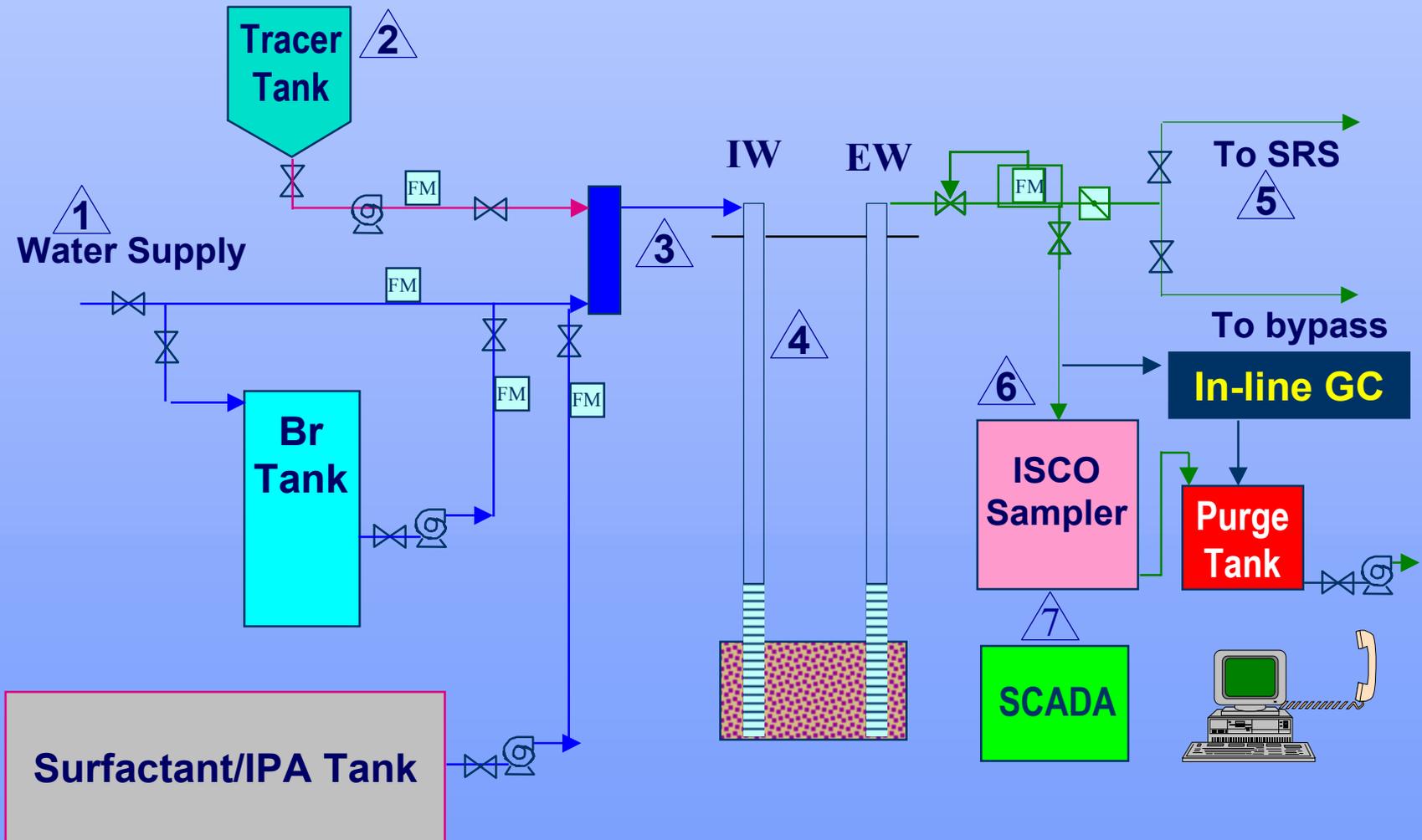


Automatic Sampling

U2-206 Tracer Breakthrough



PITT/SEAR Process System



Mixing/Injection System Issues

- Reagent transportation
- Reagent receiving and storage
- Make-up water supply
- Staging and mixing process
- Injection rate and concentration control
- Logging injection parameters
- Sampling for QA/QC and process control
- Contingency planning and spill control

Monitoring and Sampling Issues

- Data objectives
- Sampling/monitoring parameters
- Data quality objectives
- Sampling/monitoring locations
- Purge water/wastewater handling and treatment
- Sampling/monitoring schedule
- Sample logging, control, and handling
- Sample analyses

Extraction System Issues

- Pump types (shear) and plumbing
- Rate control
- Water-level monitoring (hydraulic control)
- Rate and volume logging
- Sampling for PA and process control
- Effluent treatment operations
- Contingency planning and spill control

Process Control Issues

- Control parameters and specifications
- Ranges and tolerances
- Alarms and alerts
- Trending and logging/reporting needs
- System reliability
- System flexibility

SEAR Implementation Pitfalls

- Utilities: electrical, water, air, phones
- Equipment/material compatibility
- Specifications: tanks, pipes, pumps
- Weather (temperature)
- Shipping and vendor management
- Waste disposal



SEAR Logistics

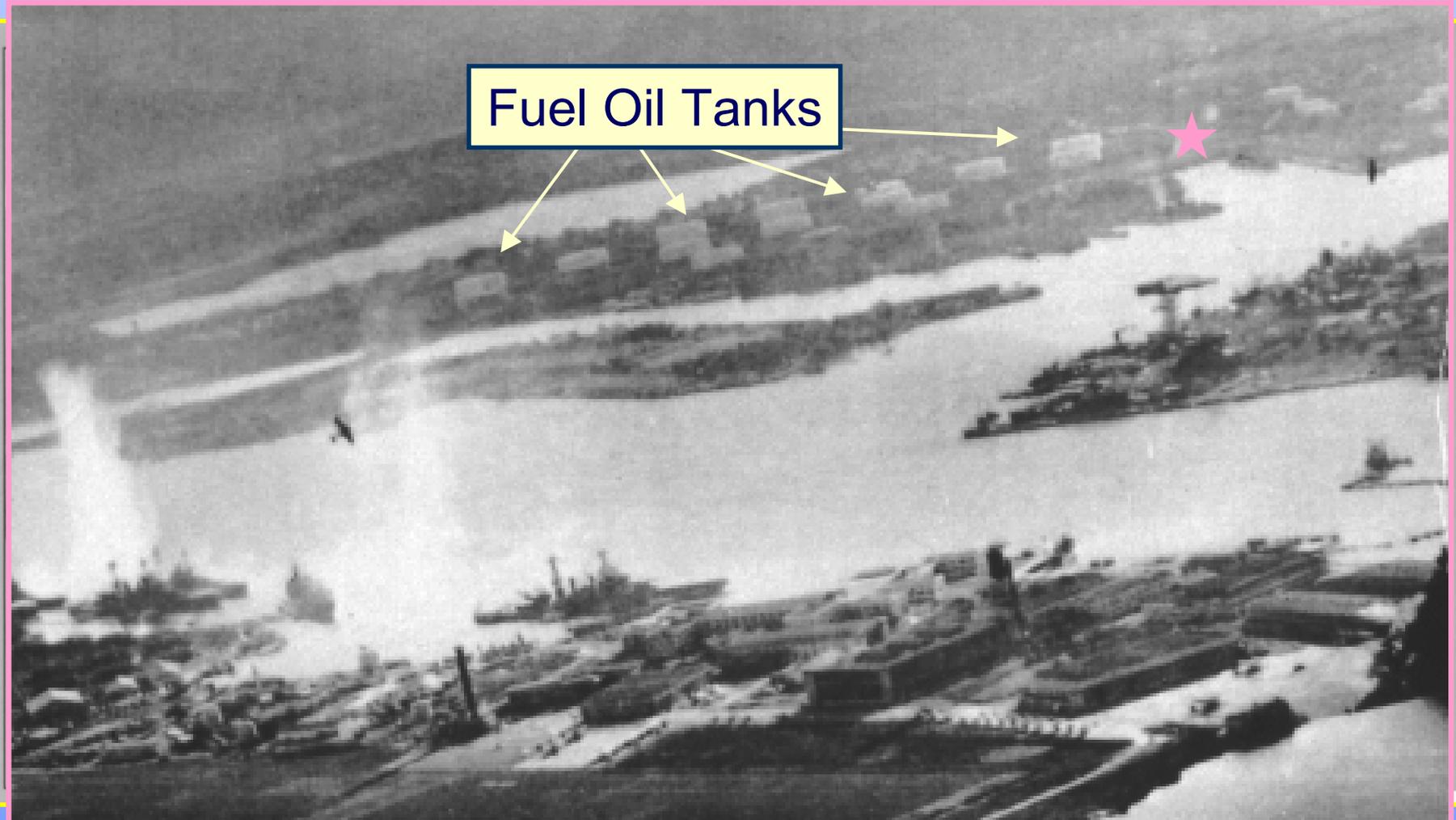
DE&S SEAR Field Implementation Case Histories



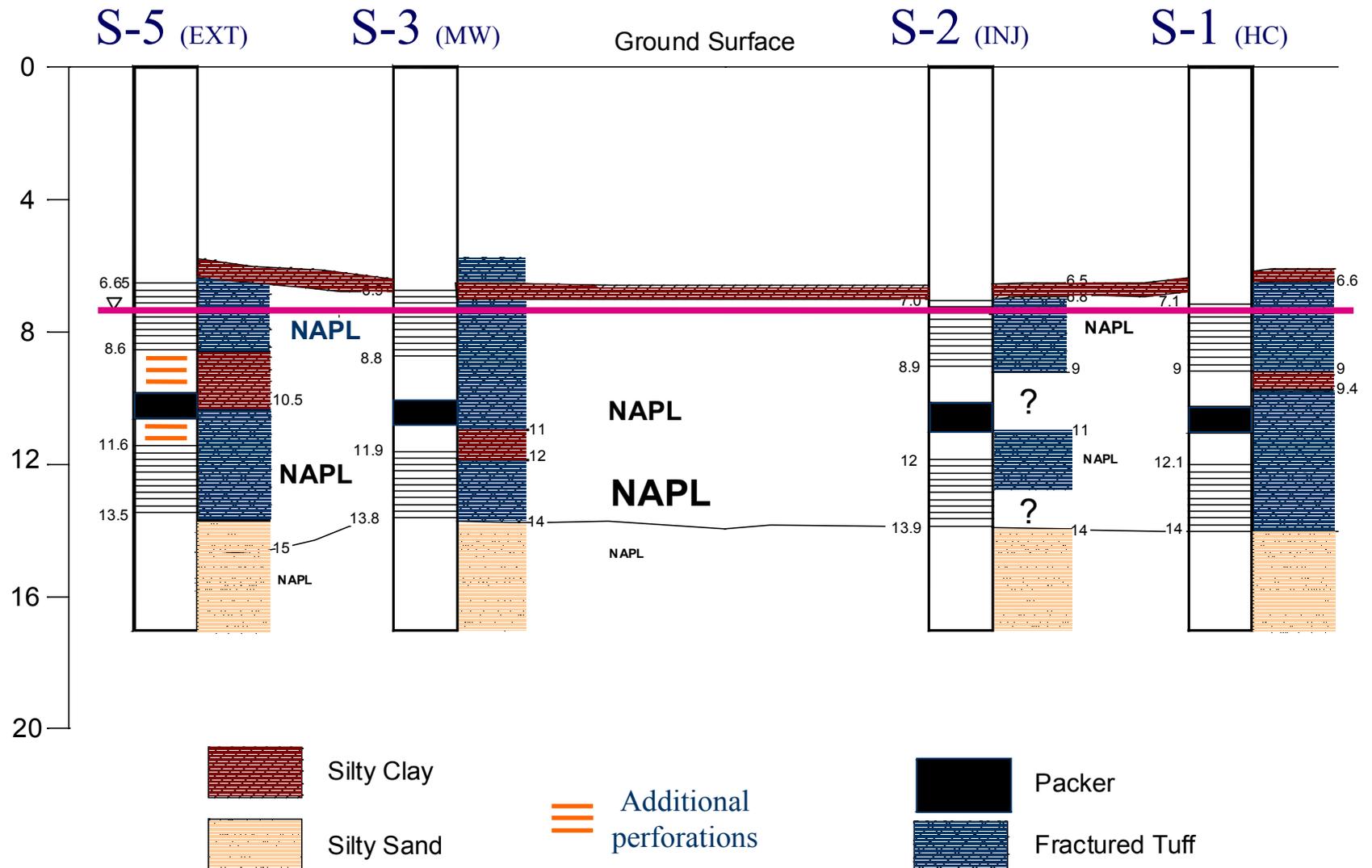
SEAR Workshop



December 7, 1941
~7:55 am



Stratigraphic Cross Section



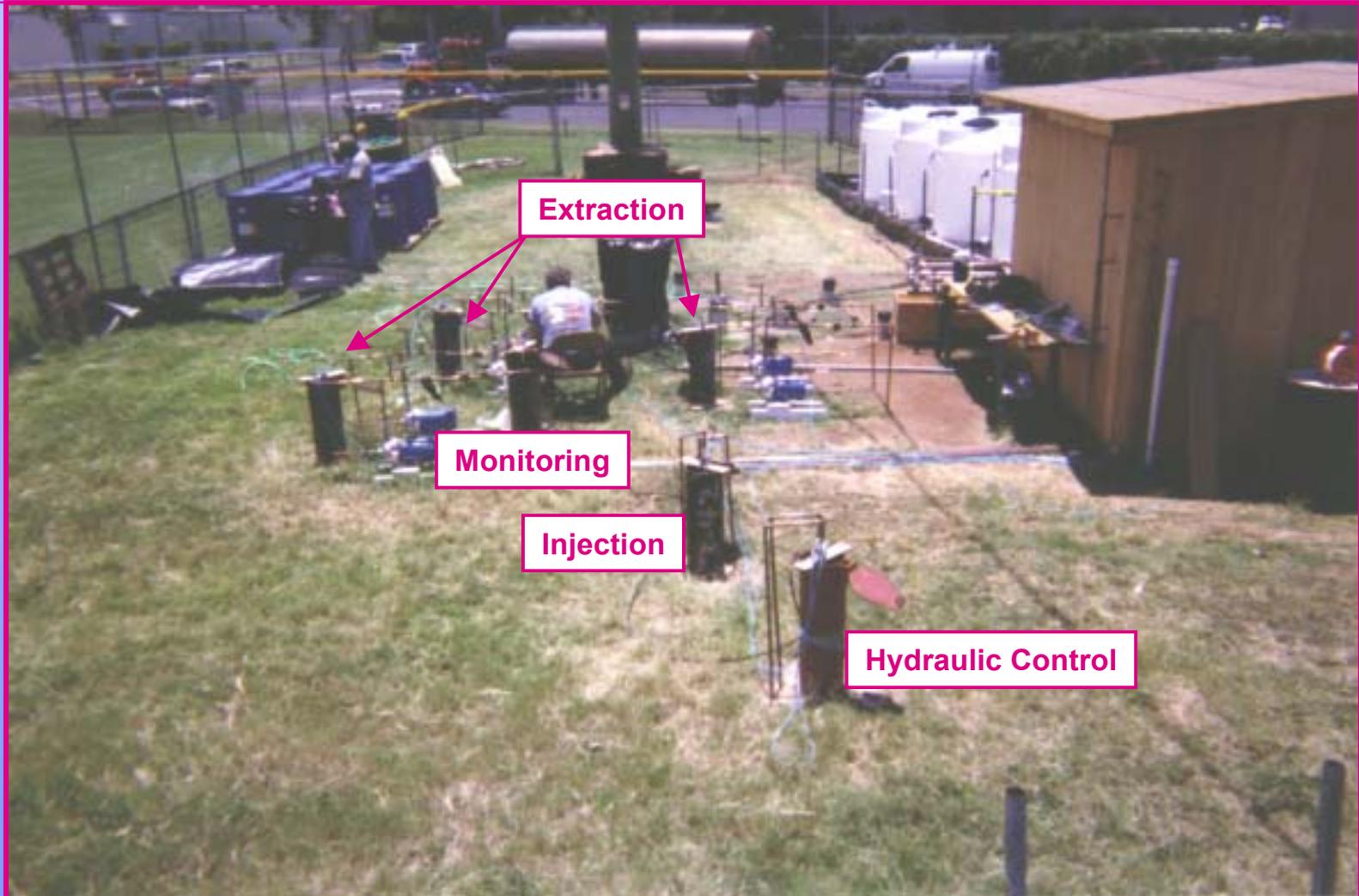
Navy Special Fuel Oil



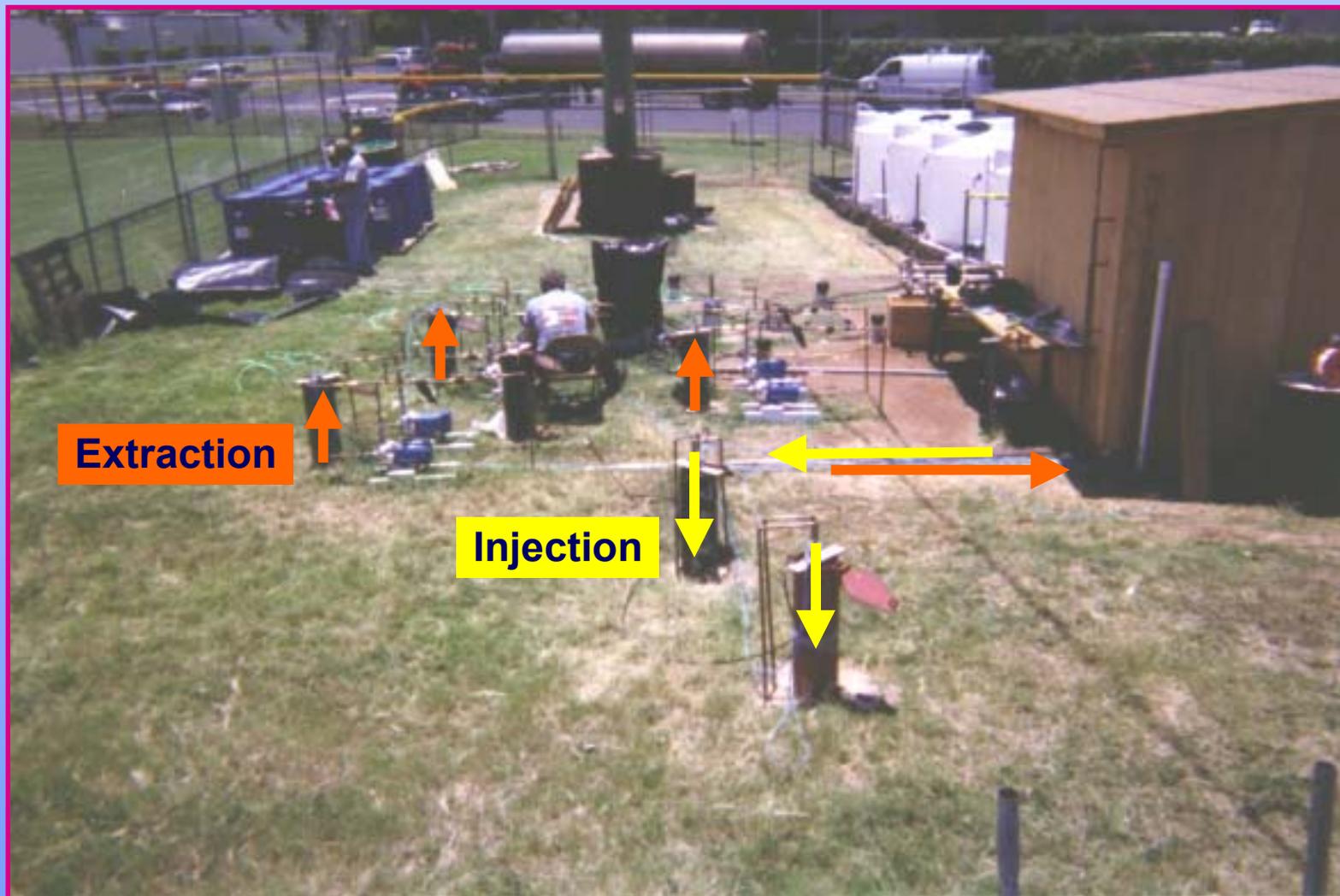
Site Layout



Wellfield Layout



Injection/Extraction



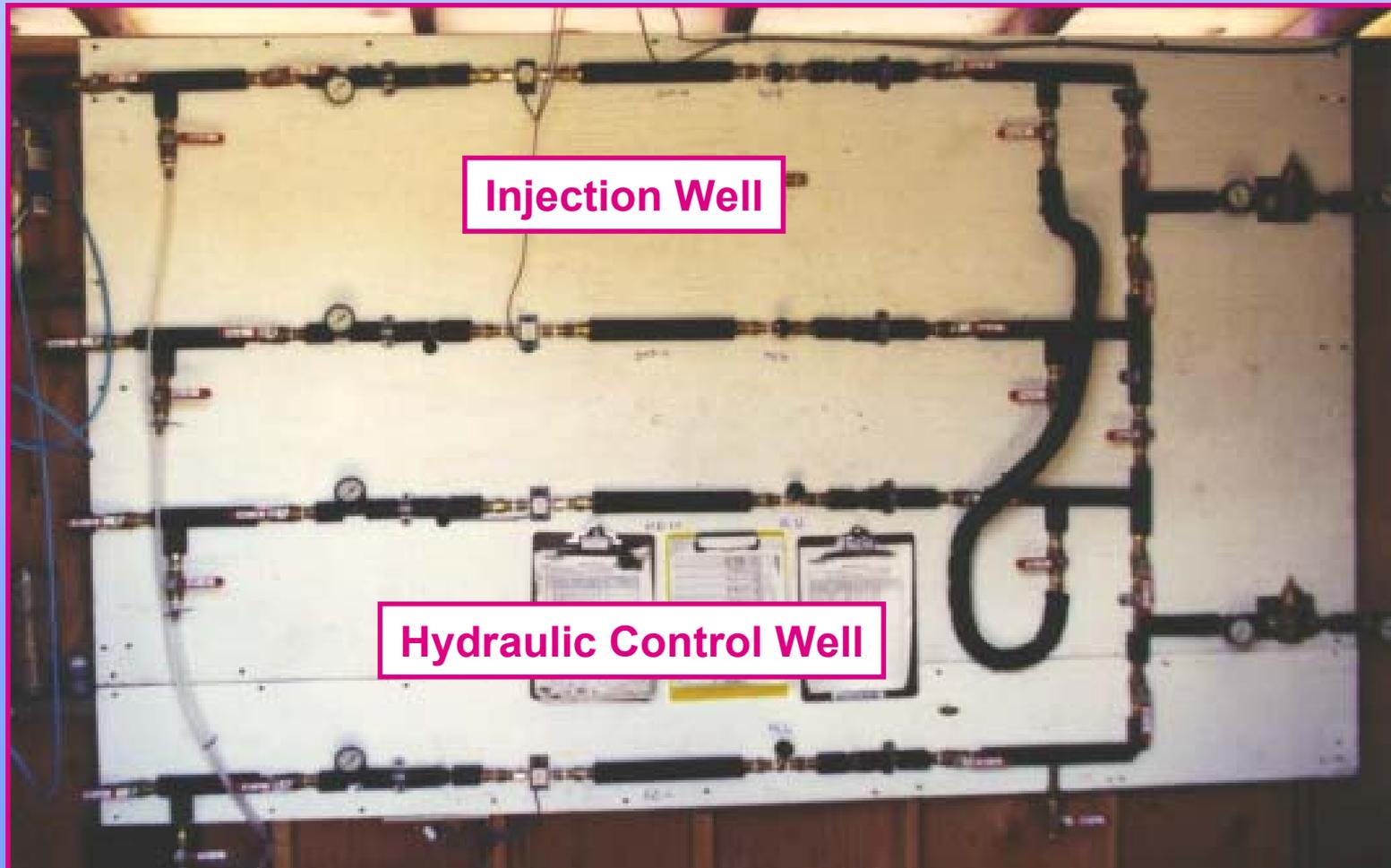
Chemical Transfer Area



Mixing Tanks



Injection Panel



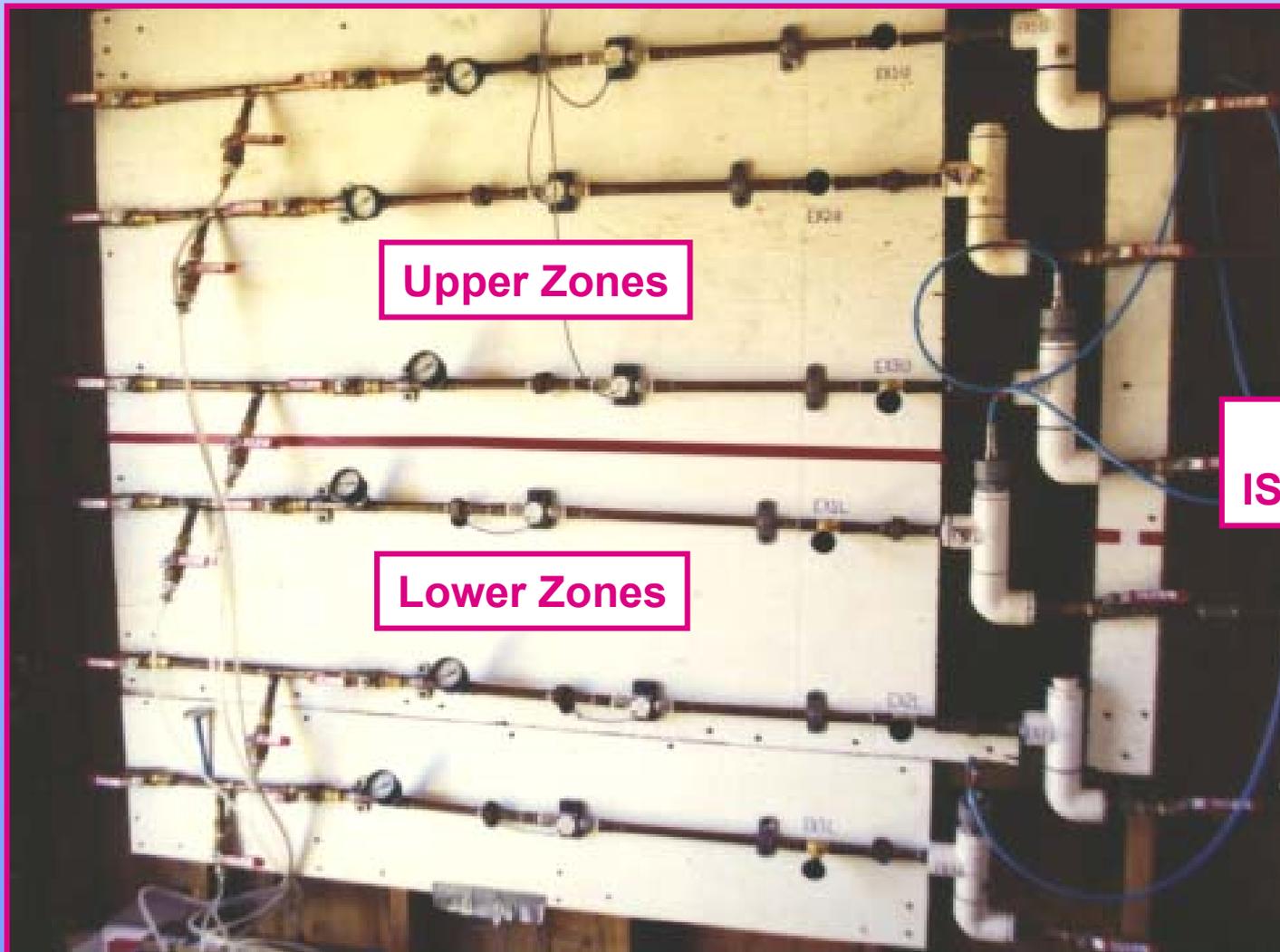
Heated-injection-fluid tubing coming from end of heaters and going into control shed

Heater elements
(black material is insulation)
(fluid flow is left to right in heaters)

Upper and lower zone heater control panels

Injection fluids from mixing tanks

Extraction Panel

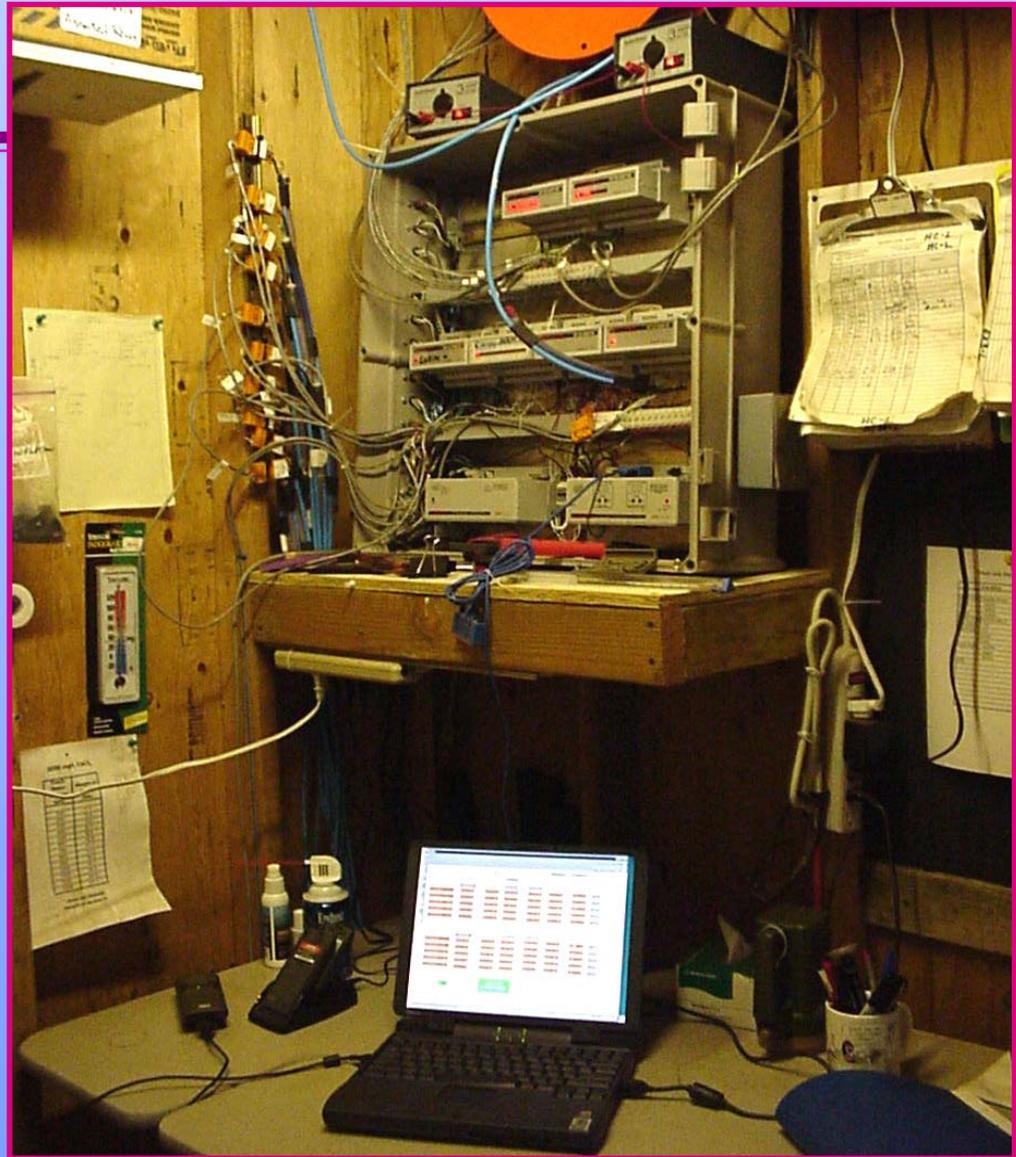


Upper Zones

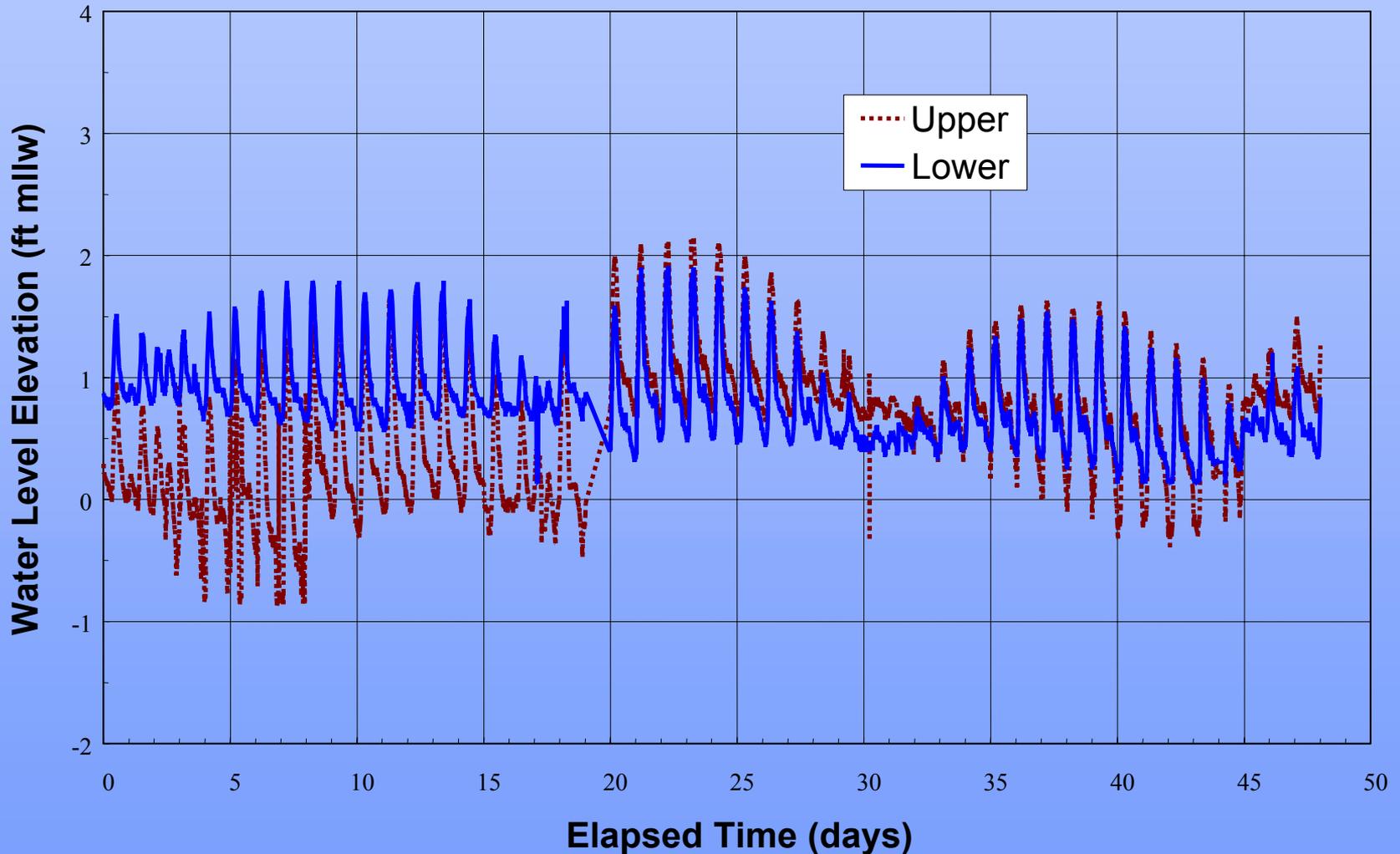
Lower Zones

In-Line
ISE Probes

SCADA



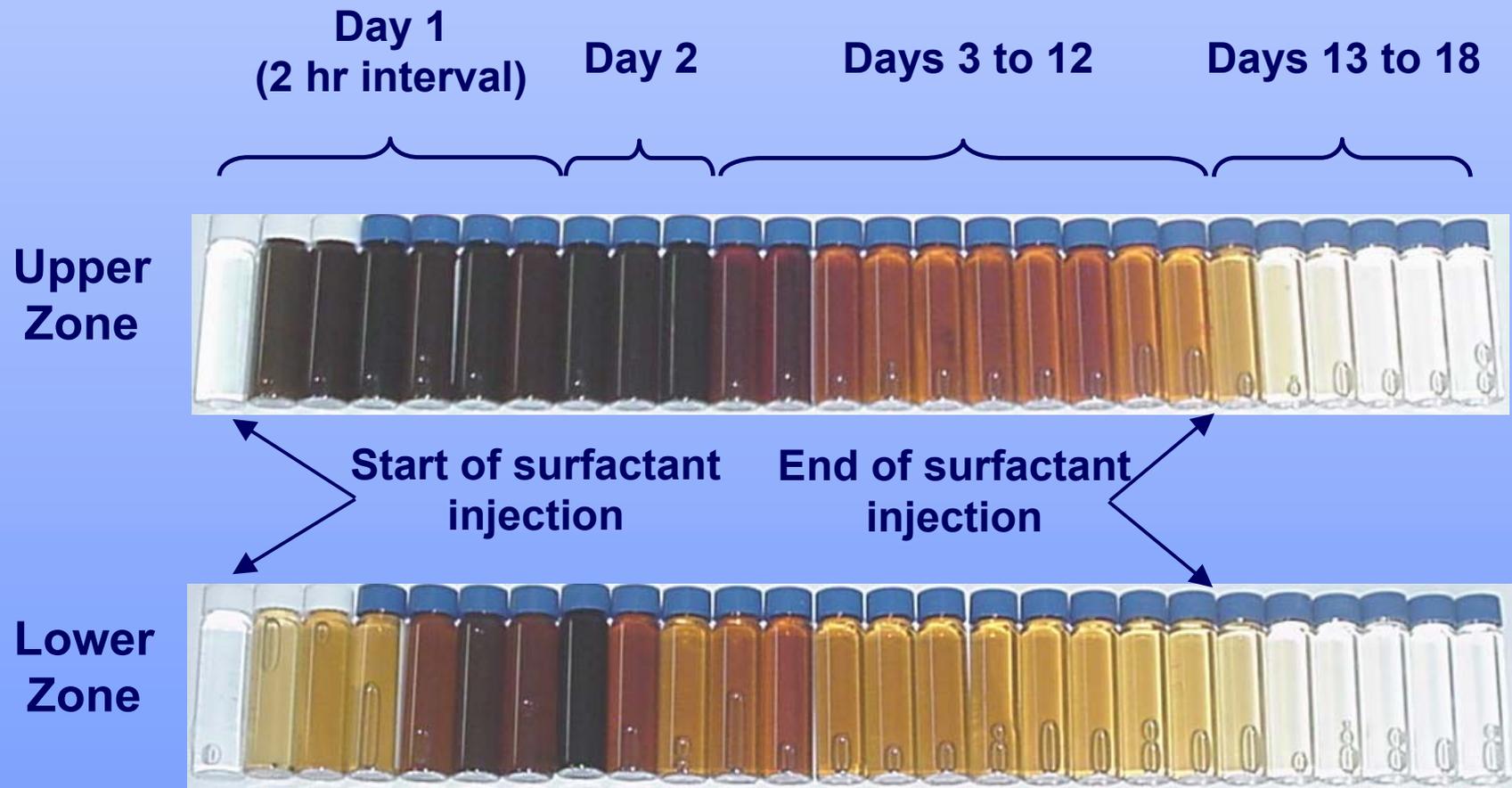
Extraction Well EX-2 (S-5) Water Level Elevation



Effluent Tank



Extraction Well S-4



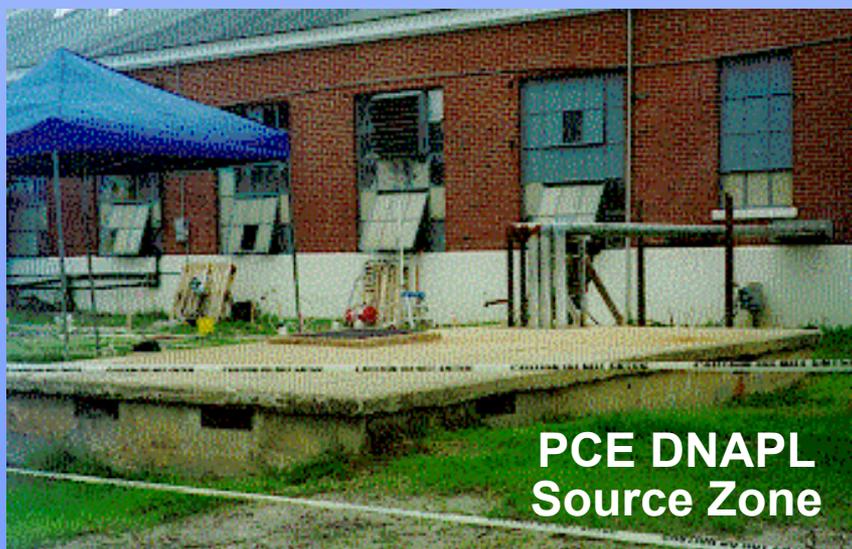
SEAR Demonstration: Site 88, MCB Camp Lejeune



**Bldg. 25
Base Dry Cleaners**



**Dry Cleaning
Operations**

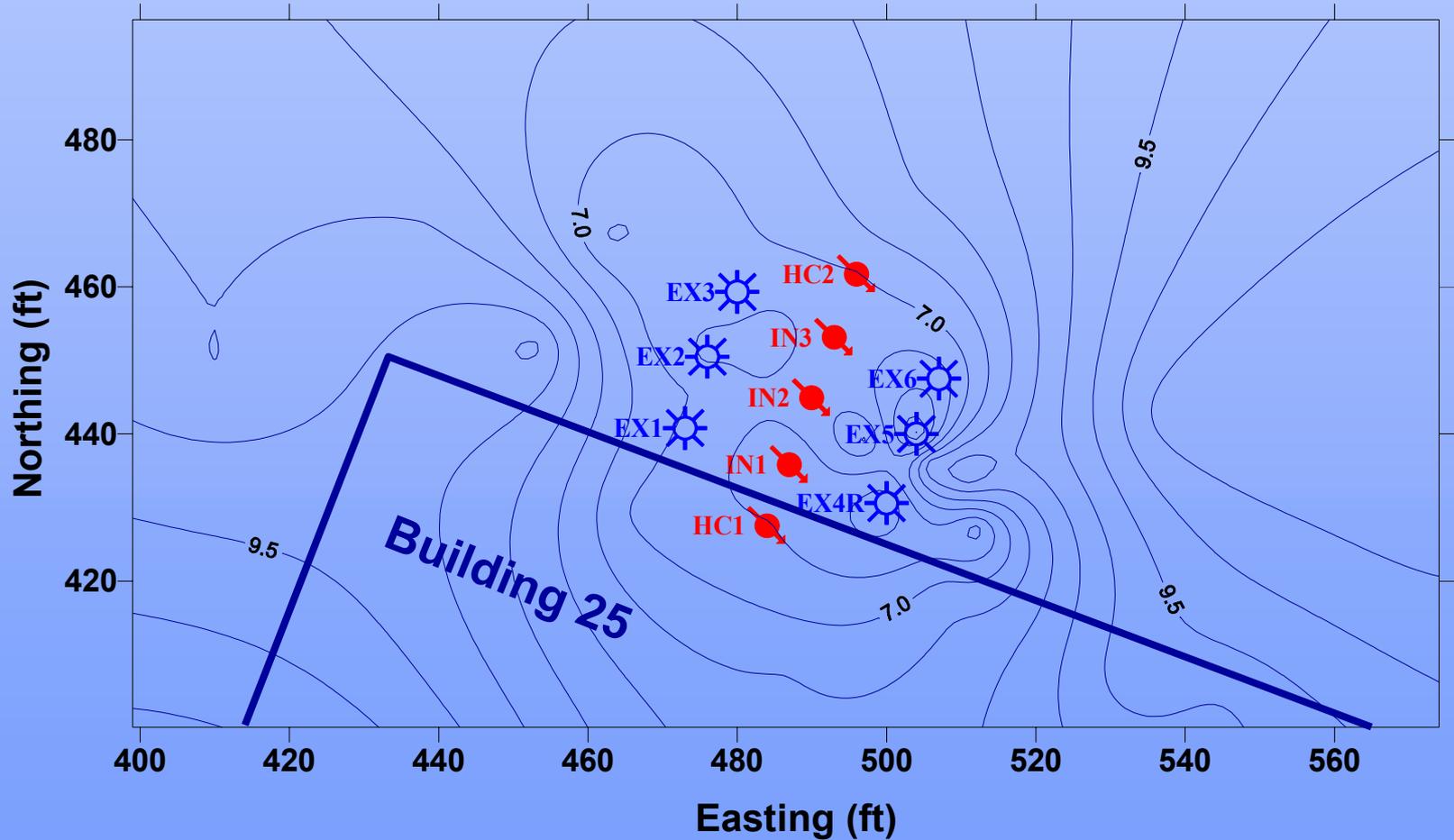


**PCE DNAPL
Source Zone**



**Floor
Drain**

Site Map



MCB Camp Lejeune SEAR Operations



Wellfield

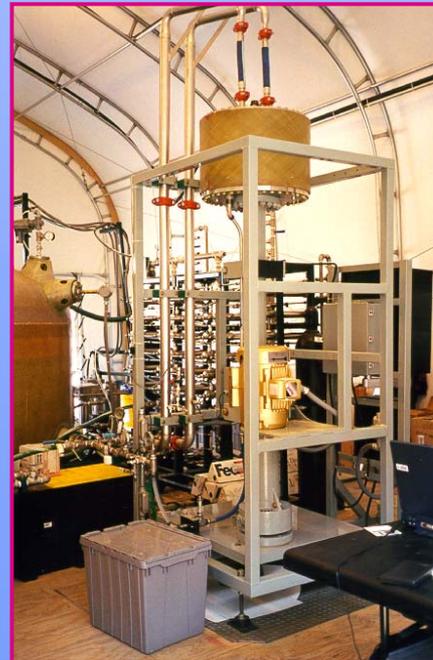
MCB Camp Lejeune SEAR Operations



Control System

MCB Camp Lejeune SEAR Operations

Effluent Treatment for Surfactant Recycle

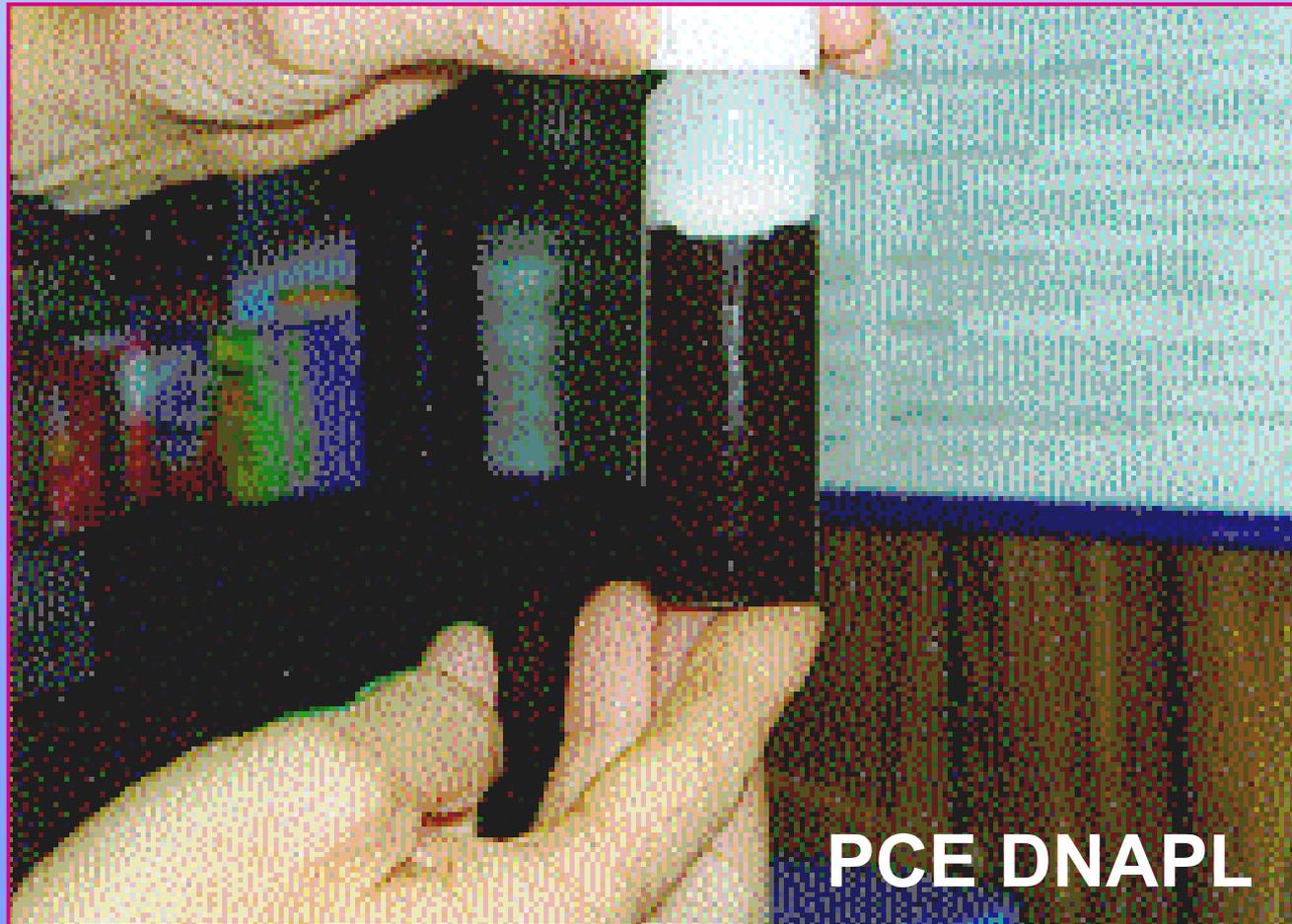


MCB Camp Lejeune SEAR Operations



Effluent Disposal

MCB Camp Lejeune SEAR Operations



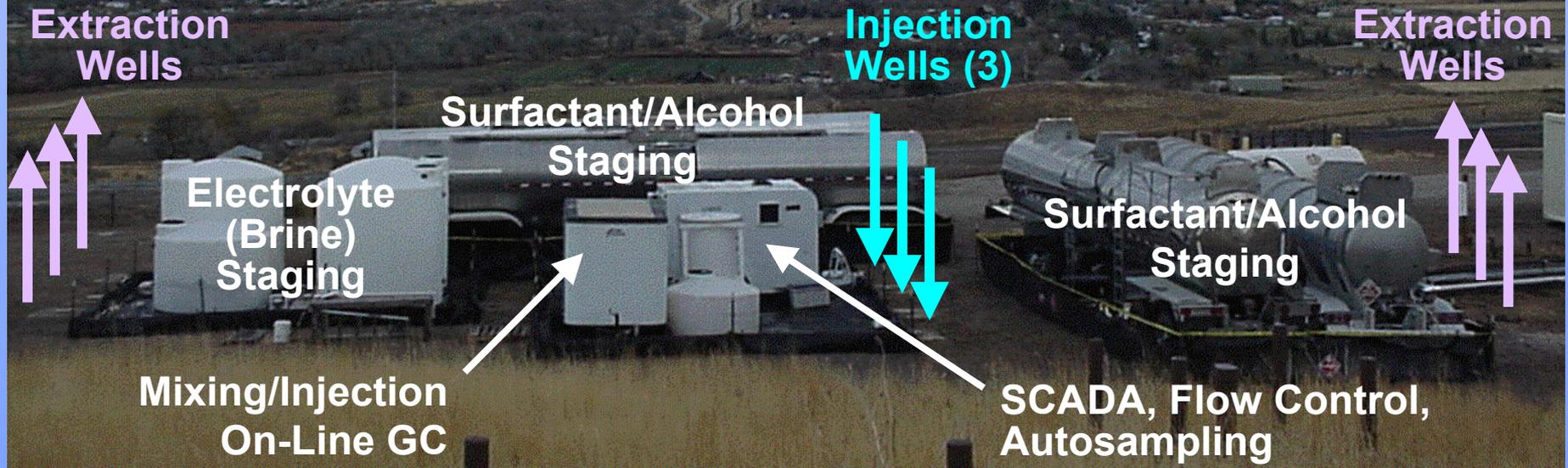
Full-Scale SEAR at OU 2, Hill AFB, UT

- 65,000 gal Swept Pore Volume
- 110 ft Divergent Line Drive
- Total Remediation Time = 40 days

North

South

Wasatch Range





BULK TAINER

THE NEW AMERICAN TANK TRUCK

UPTU 530 056 0
US 2275

ADR / RID

20040 L
70 US GAL

OPERATING PRESSURE
3 BAR / 43.5 P.S.I.

UPTU 530 056 0
US 2275

1999

UNION PACIFIC





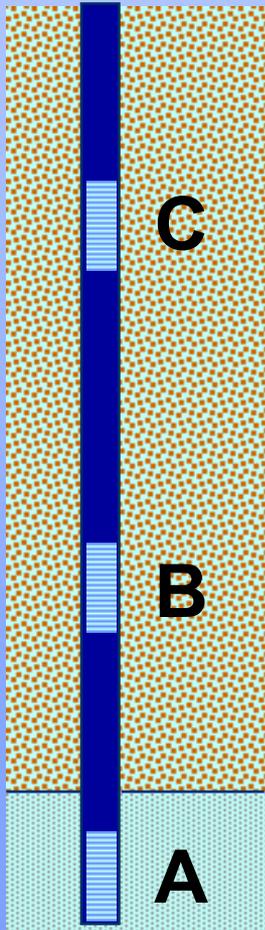




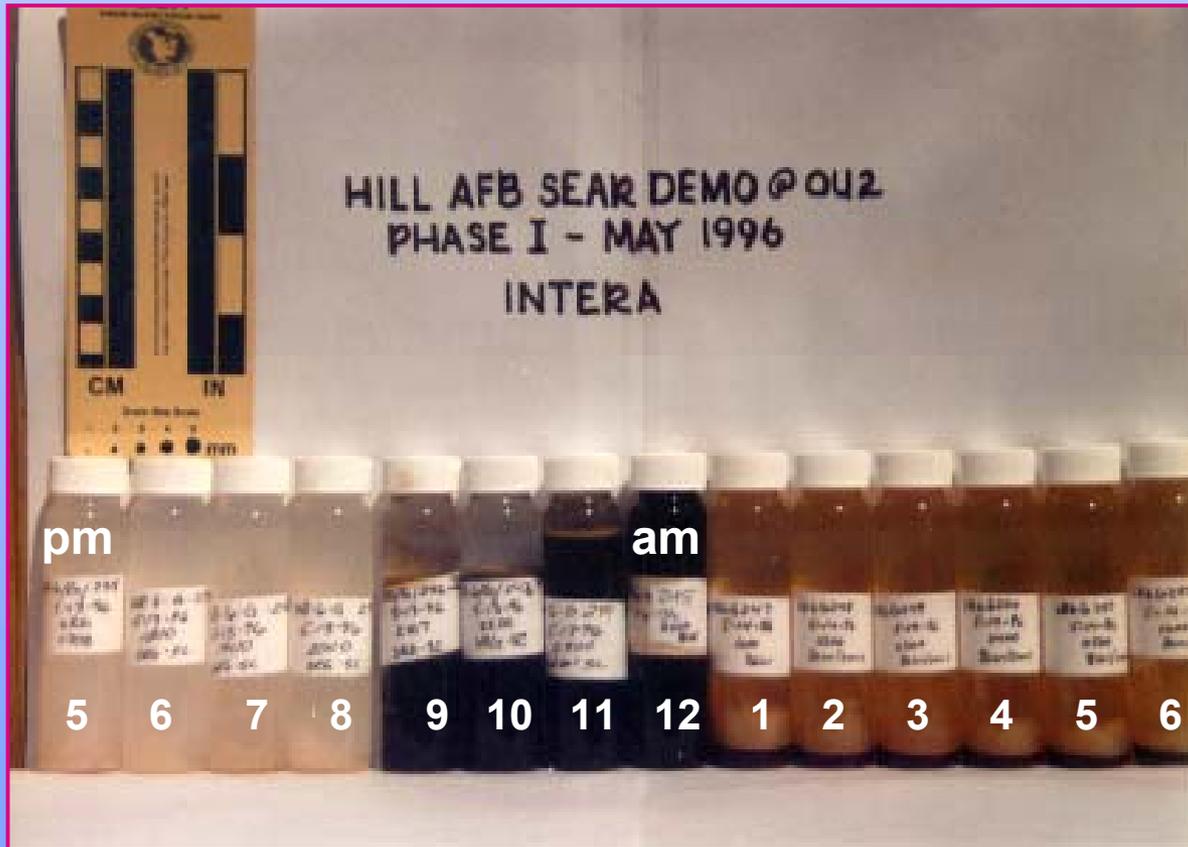
Process Control



AATDF Surfactant/Foam Process

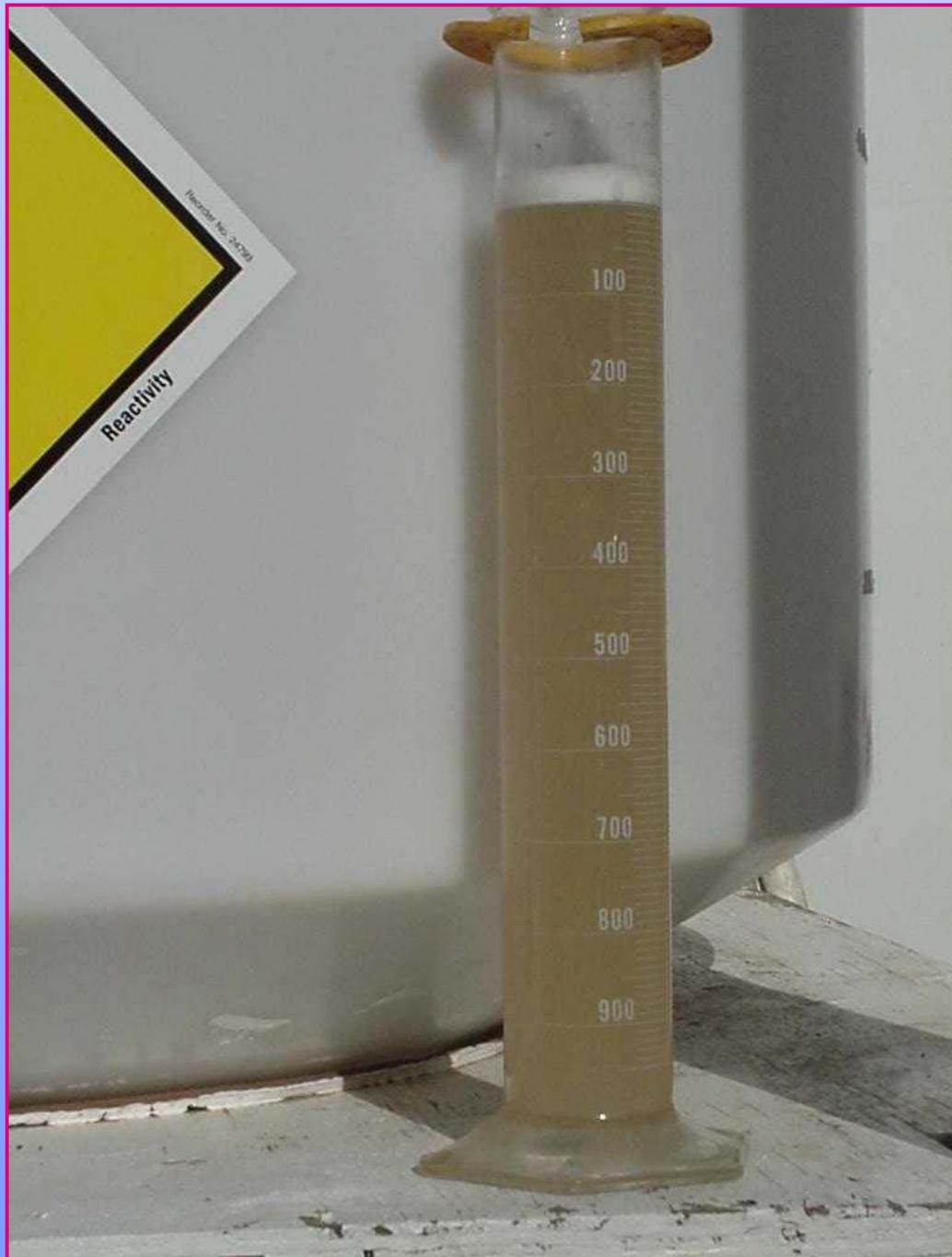


Phase 1: SB-6 Effluent

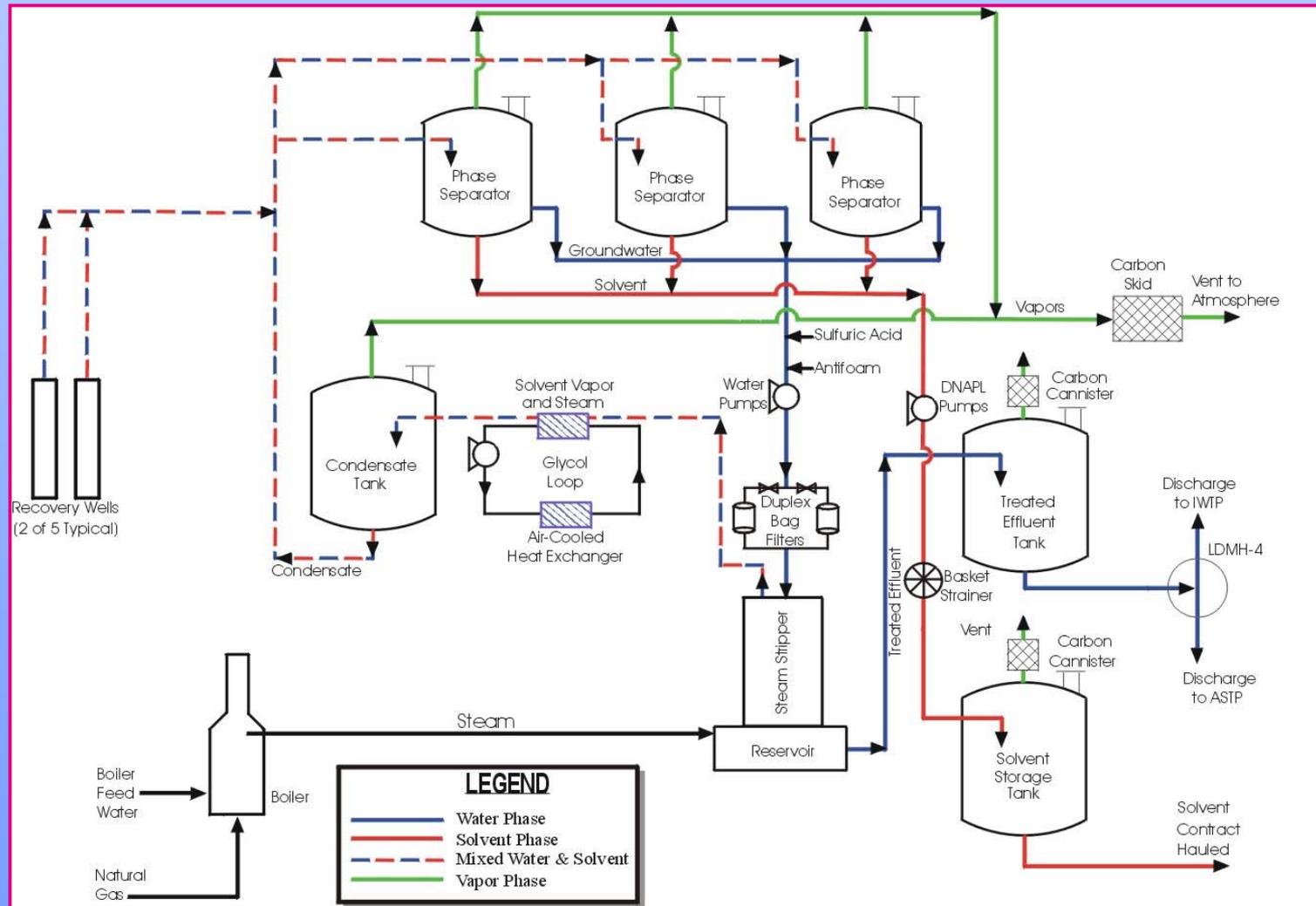


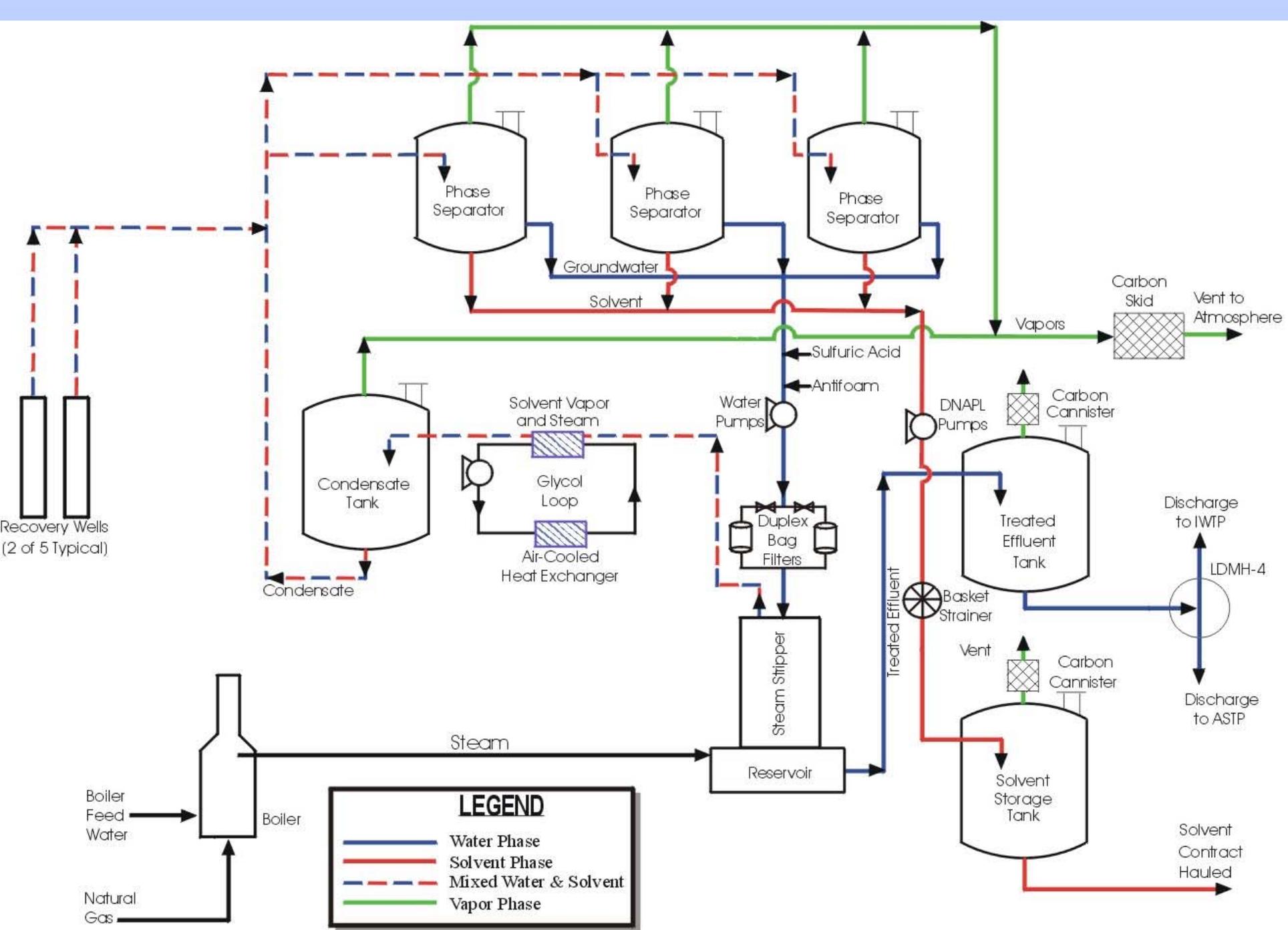
900 mg/L
Before SEAR

8 mg/L
After SEAR



Simplified Process Diagram for the SRS





Any Questions?

