Vineland Chemical: Focus on Cost-Risk Analysis

EPA SRC - 2007

US Army Corps of Engineers

Superfund Nine Criteria for Evaluation

NCP 300.430e(9)(A)

- Human Health Risk/Environmental Protection
- Compliance with ARARs
- Long-Term Effectiveness/ Permanence
- Reductions of Toxicity, Mobility or Volume through Treatment
- Short-Term Effectiveness
- Implementability
- **Cost**
- State Acceptance
- Community Acceptance

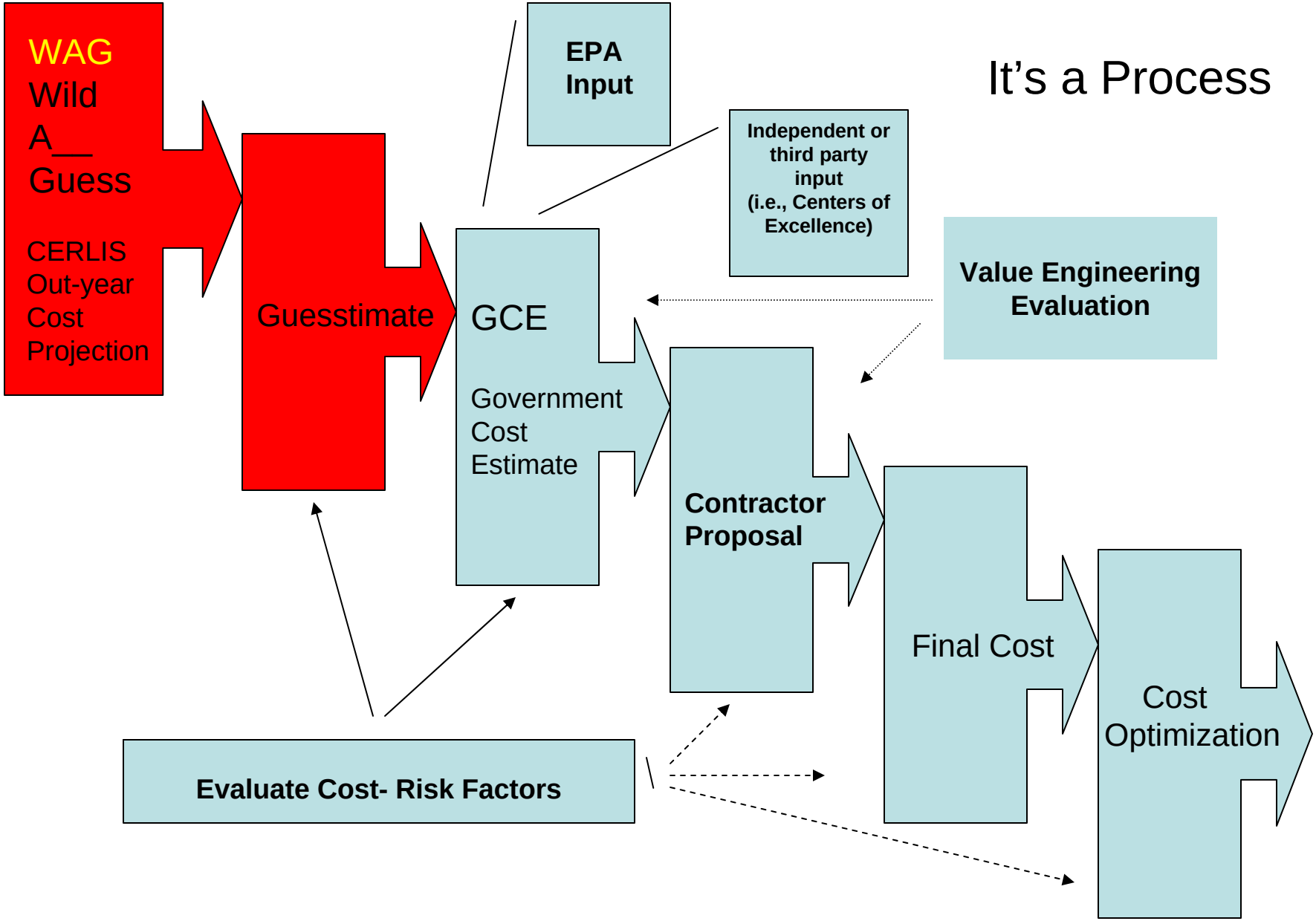
Costing Guidance at the RD/RA Stage

1. Describe the alternative
2. Identify the cost element structure for capital, annual O&M, and periodic costs
3. Estimate construction/O&M activities costs.
4. Apply contingency
5. Estimate professional/technical services costs
6. Estimate institutional controls costs, if applicable
7. Conduct present value analysis
8. If appropriate, conduct a sensitivity analysis
9. Review estimate

Risk Terms

- Risk Analysis
  - "Risk assessment" refers to a formal or informal procedure producing a qualitative or quantitative evaluation of the risk posed to human health or the environment by the actual or potential presence and or use of specific pollutants
  - "Risk management" is the process of evaluating and selecting alternative regulatory and non-regulatory responses to risk. It also refers to decision making at the program or agency level, for example, deciding which hazards should be managed and in what order
- Cost-Benefit Analysis
  - A quantitative evaluation of the costs which would be incurred by implementing an environmental regulation versus the overall benefits to society of the proposed action
    - Putting a dollar value on human life
    - Valuation of non-fatal health hazards is conceptually and technically flawed
- Cost-Risk/Cost-Risk Analysis
  - A process which allows us to better understand and assess estimated project costs
    - Provides some information on the potential range of costs and the probability that the cost for action will exceed or be less than the estimated cost
  - Tools available to ensure appropriate costs are developed

It's a Process



Initial Funding - Preliminary Design - IAG - Final Design - - Implementation - - - Operations and Optimization

Potential Cost-Risk Control Areas

- Project Scoping Adequacy
  - Support funding constraints
- Technology Evaluations/Value Engineering
  - Changes in technology through ESD
- Changes in Field Conditions
  - Changes in waste quantities/types
  - More “detailed” characterization to reduce some of the cost-risk
- Waste Characterization
  - Declassify treated environmental materials (K031 to non-hazardous)
  - Treating some waste types to reduce their classification
- Procurement Type
  - Cost-plus (CPFF/CPAF/Fixed Price) – Who holds the risk?
  - Other: Inflation related - materials cost growth issues (i.e., fuel costs/labor rates)
- Access: Large River/Lake Area
- Optimization

Potential Cost-Risk Control Components

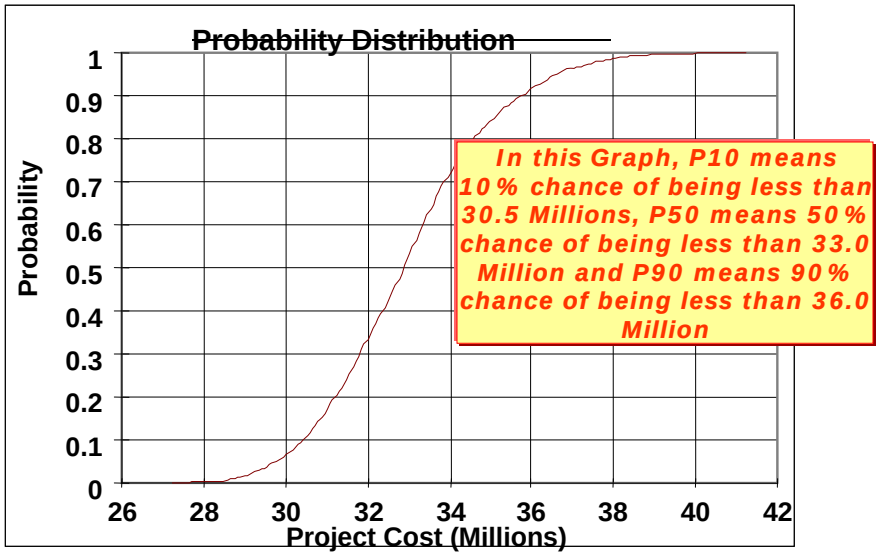
- Project Personnel
  - Competent/Experienced Professional Project Staff
    - Input from ACOE (Philly District, KC District Support, HTRW Center of Expertise), Contractors, EPA (RPM, Mgmt.) EPA Program Technical Support/ERT
  - Experience on Similar Projects/Specific area knowledge
- Site-specific Field Measurements
  - Detailed delineation of extent of contamination
  - Technical modeling to support cost estimates
- Technology/Vendor information
- Other Cost Control/Cost Risk Reduction Tools
  - Cost Estimate Guides
  - Cost Estimating Software
    - Parametric – Spreadsheet analysis
      - » MCACES (Micro Computer-Aided Cost Engineering System) or Equivalent
    - Probability analysis
      - » Crystal Ball
    - Scheduling software such as Primavera
    - Other - nonparametric
  - Historical Cost Analysis
  - Multi-level review (USACE District, USACE HTRW Center of Expertise, EPA

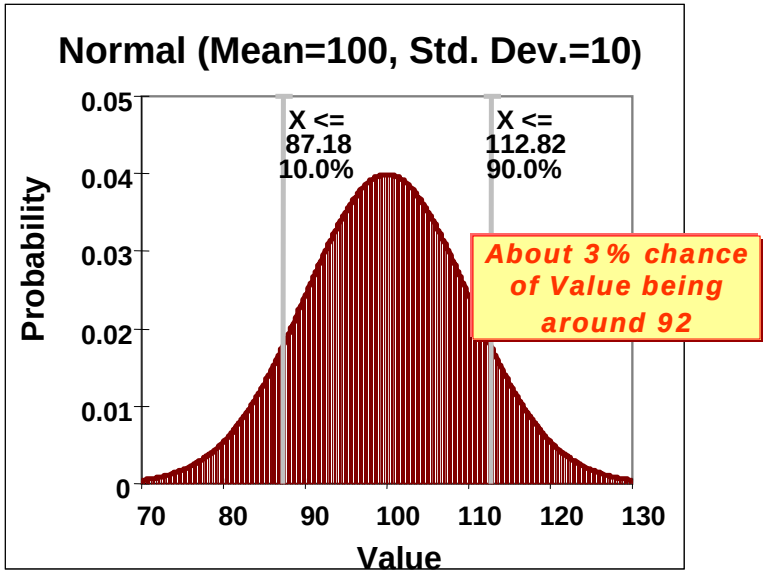
Evolution of Risk Analysis

- ***Deterministic Model – single number***
- ***"Best Case – Worst Case" Scenario (all optimistic, all pessimistic)***
- ***"What if" Scenario (if a particular event happens)***
- ***All Possible Scenarios (Simulation of all risk variables)***

Parametric (Spreadsheet) Cost Estimate
"Simulation"
The "Human" Element

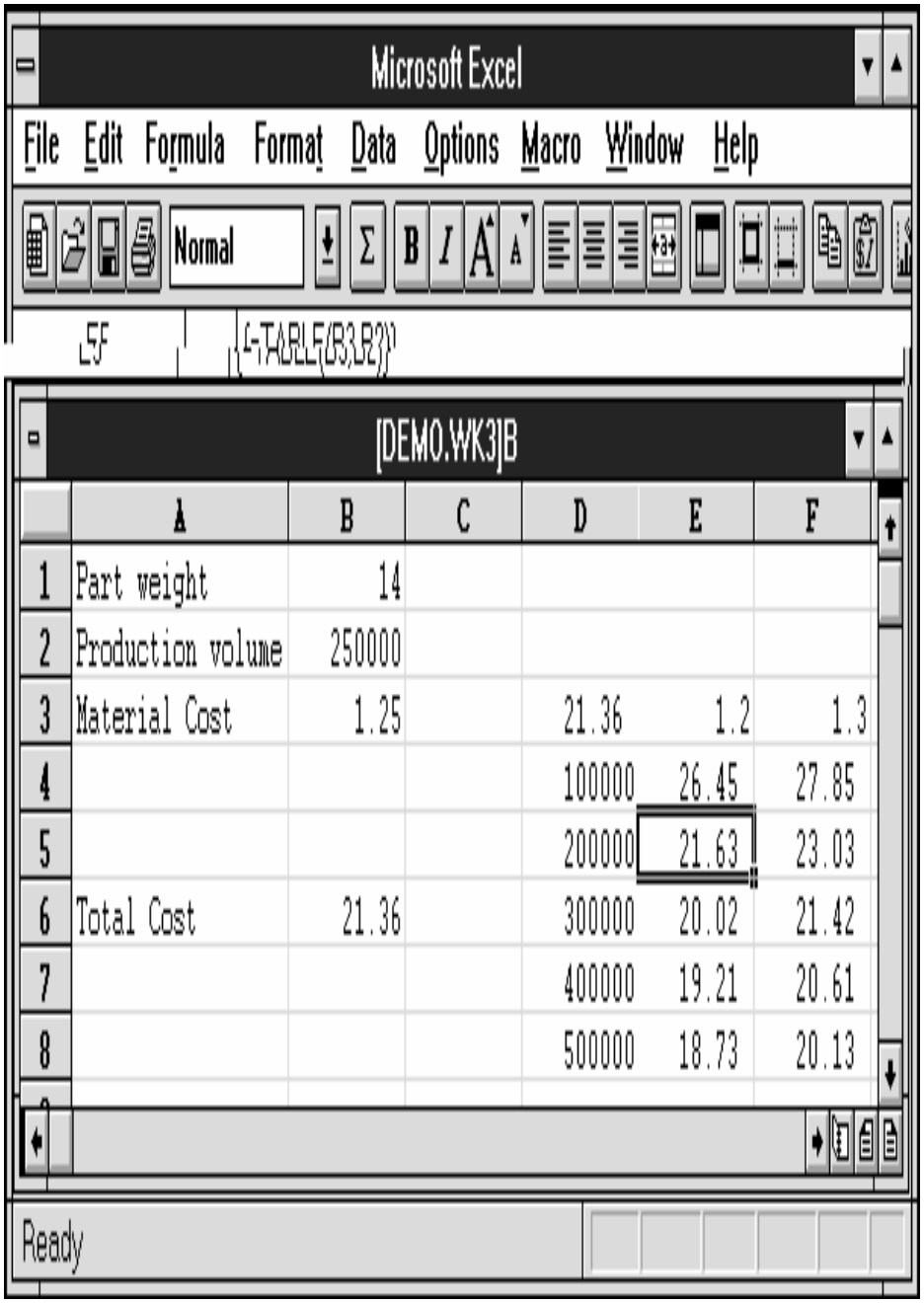
Cumulative Distribution Function (CDF)





Probability Distribution Function (PDF)

Simulation Example



Spreadsheet Example

Project Examples

- Plant Site RA Operations Scenarios
  - Scenarios for 5-day, 7-day operation for 8, 16 and 24-hour operations
    - Today we actual run a 4-day 10 hour shift, with night shift doing maintenance
- Waste Quantity Models
  - 180,000 to 268,000 to 317,000 tons
    - More complete field investigations
    - Removal of more contaminant mass
  - But we adjusted excavation schedule and process rate (through optimization) to accommodated increased volume within the same schedule
- Combined/Co-mingled OU1 and OU3 activities
  - Need-based blending of lesser contaminated material from OU1 mixed with OU3 material to meet desired plant feed concentration
- Used clean peat material to make topsoil
- Used proprietary on-site treatment technology to reclassify waste materials
  - Backfill
  - Oversized material

VINELAND CHEMICAL SUPERFUND PROJECT

OPERABLE UNIT 2

GROUNDWATER REMEDIATION

MINIMIZING COST RISK

Groundwater Remediation System Background

- Extraction well system pumps 800-1000 gpm of arsenic-contaminated groundwater to onsite treatment plant

- Plant includes the following unit processes:
  - Chemical oxidation
  - Flocculation and coagulation
  - Dissolved air flotation
  - Sludge dewatering

- Plant is operated to reduce the groundwater concentration to less than 50 ppb As prior to discharge to local creek

- Plant staff consists of two plant operators, chemist, maintenance mechanic, and lead operator/H&S officer

Groundwater Treatment Plant

Groundwater Treatment Plant

Groundwater Treatment Plant

COST REIMBURSABLE TASK ORDERS

- All GWTP O&M task orders at Vineland project since 2000 have been CPFF
- Contractor is guaranteed his fee and reimbursement for actual costs
- Lower risk for contractor results in lower proposal costs and negotiated fees

- (…but most of cost risk is on Govt!!??)

Plant Optimization Study

- Contractor hired independent engineering consultant to evaluate GWTP operations procedures and make recommendations for cost saving improvements
- The following recommended measures were adopted:
  - Optimization of chemical usage
  - Automatic computer control of wells to optimize water levels and flows from wells
  - Automatic computer controls of plant operations to allow for unmanned night shifts
  - Magnetic flow meters are more accurate
  - Equalization tank – allows for more efficient plant operations
  - Cleanout vaults – aids in cleaning clogged pipes
  - Reduction in environmental sampling requirements

Cleanout Vault

Equalization Tank

REAL-TIME ARSENIC MONITOR

- State-of-Art Arsenic monitor (OVA) provides continuous real-time info on plant effluent arsenic concentrations
- Provides for immediate shutdown of plant if arsenic concentration standard is not being met
- Prevents possibility of discharge of large quantity of arsenic contaminated water to local creek

Real-Time Arsenic Monitor

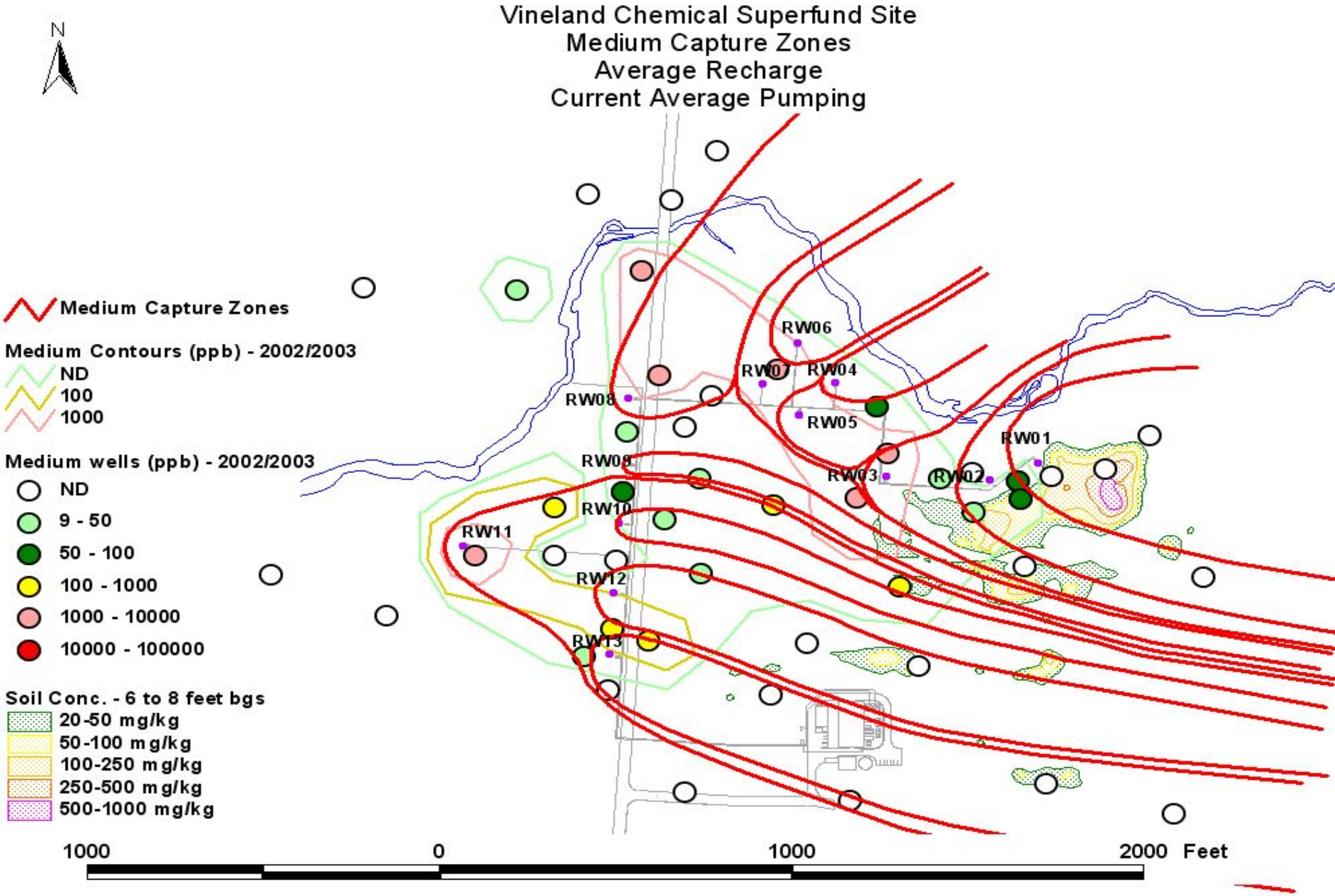
USACE QUALITY ASSURANCE SAMPLE ANALYSIS

- USACE performs QA analysis of 5% of site samples at QA lab in Vicksburg MS
- Minimizes risk of any repetitive problems with the subcontracted lab
- Reduces the chances of a laboratory error allowing a release of arsenic contaminated water to the local creek

GROUNDWATER MODELING

- CENAP hydrologists use GIS database and model to predict groundwater flow patterns and capture zone
- Model is used to identify optimal locations for new extraction wells when needed, minimizing the number of wells
- Predicts optimal pumping rates for existing wells

Model Predicted Flows

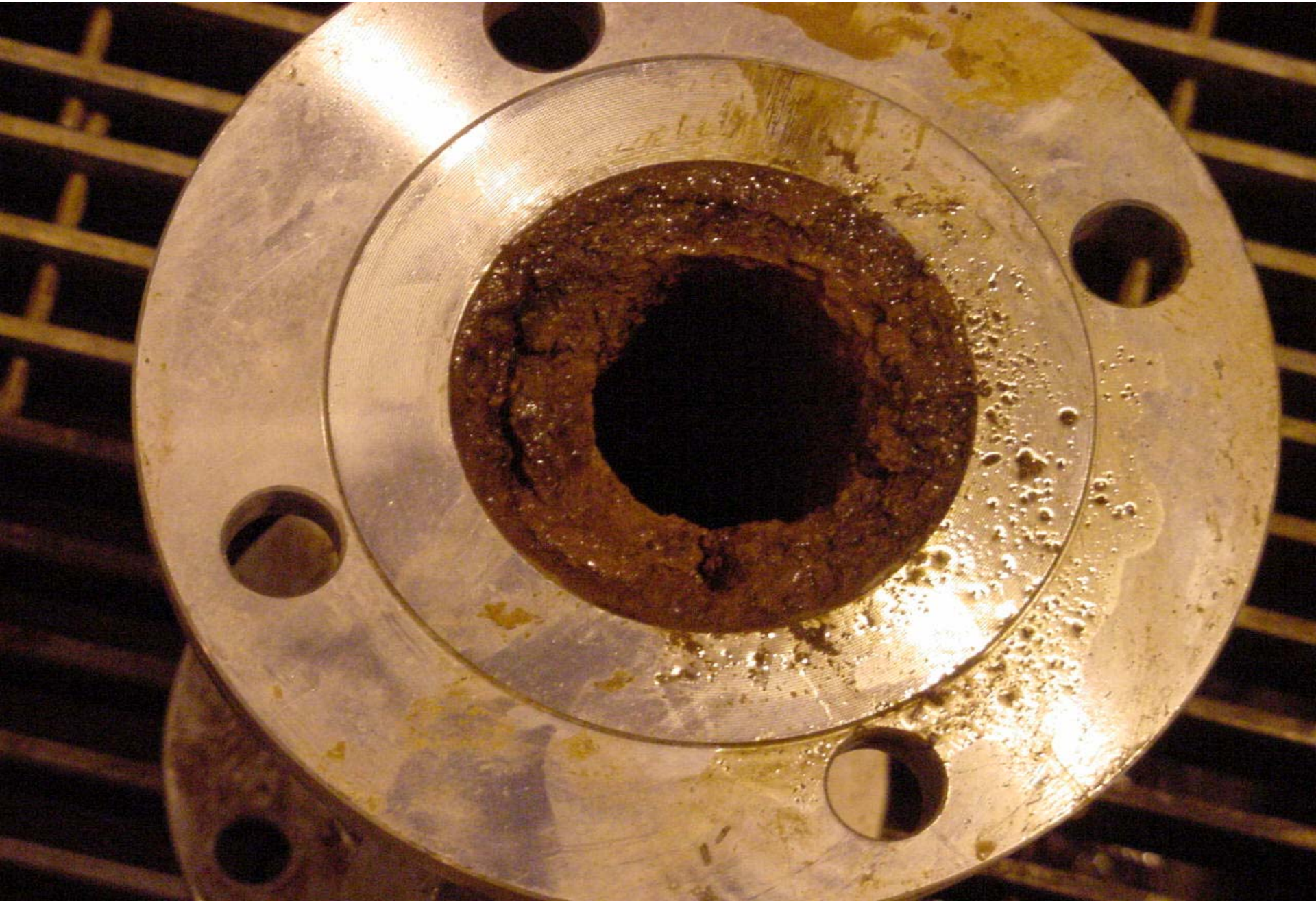


ANTI-FOULING CHEMICALS

- Use of “Redux” and other proprietary anti-fouling chemicals in the extraction wells reduces need for periodic cleaning of the wells and piping
- Cleaner pipes result in higher continuous extraction flow rates, which will allow overall shorter cleanup duration over life of plant – lower total cost
- No shutdown of wells necessary as would be case for well redevelopment
- Still in testing stage, has not entirely eliminated need for well development yet

Fouled Extraction Well Pump

Fouled Extraction Well Discharge Pipe



Future Actions

- Monitoring Wells
- Full-Scale Redux
- Evaluation of Plant Operations in light of new groundwater MCL
  - Cost evaluation of increased chemical usage vs alternate technologies

Vineland Chemical Flood Plain - Before

Ongoing Construction – Current View

Contract Type

- Cost Reimbursement
  - Vs. Fixed Price
  - More Risk to Government
  - OU-1: Award Fee
  - OU-2: Fixed Fee
  - OU-3: Fixed Fee

Cost Realism

- MCASES
- MEANS
- Multi Level Review
  - Professional Judgment
  - Years of Field Experience
  - USACE CX
  - Contractor Input

Cost-Risk in Design

- Stream Diversion Types
  - Coffer Dam and Pump
  - Sheet Pile Wall
  - Dredging Scenarios
- Haul Road Construction
  - Constraints in soft Peat
    - Use Geotextile – slower
    - Dig out extra few feet of Peat - faster

Sheet-Pile Wall Diversion

Haul Road Construction

Remediation of Arsenic-Contaminated Soils

- Peat Material (58,000 c.y.)
  - Oversize separation
  - Stockpile/dry on-site (reduce moisture by 30%)
  - Off-Site Disposal ($75/ton)
- Sand Material (50,000 c.y.)
  - Soil Wash
  - Reuse as backfill

Wetland Mitigation

Wetland Mitigation

Wetland Mitigation

- Backfill
  - Native Clean Peat/Treated Sand Mix
- Plantings
  - Indigenous to the Region
- Protective Fencing
  - Deer/Geese
- Plantings Maintenance
  - 1-year warranty
- Re-establishment Monitoring
  - 5 Years

Backfill: Native Peat/Sand Mix