Land Use and Remediation Strategies for LNAPL Sites

Presented by

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Parsons

Introduction

This presentation summarizes remediation strategies recommended in the "Air Force Handbook for Remediation of Petroleum-Contaminated Sites (Parsons,1998). Three case studies are used as examples to explain how these strategies apply to LNAPL sites.

Overview of the AF Handbook Strategy

Match Remedy to Available Land Use Controls to Eliminate Potential Exposure

Promote Site-Specific and Chemical-Specific Standards (RBCA)

Utilized Low-Cost Site Characterization Tools to Build Remedy Confidence

Document Natural Attenuation Process and Their Contribution to Risk Reduction

Promote Cost-Effective Technologies for Source Reduction (LNAPL driven)

Primary Land Use Scenarios

1. **Continued Control of LNAPL Area**

2. **Potential Sale to Industrial User**

3. **Potential Sale to Residential/Commercial User**

Assumptions

- **Traditional LNAPL recovery in most aquifers has rarely achieved 50 percent recovery. High-cost for limited risk reduction.**
- **Sites that are still handling fuels are still leaking fuels. Hopefully less than before leak testing and upgrades.**
- **Free product treatment/removal should be risk driven except for redevelopment sites where land value is decreased by the presence of LNAPL.**

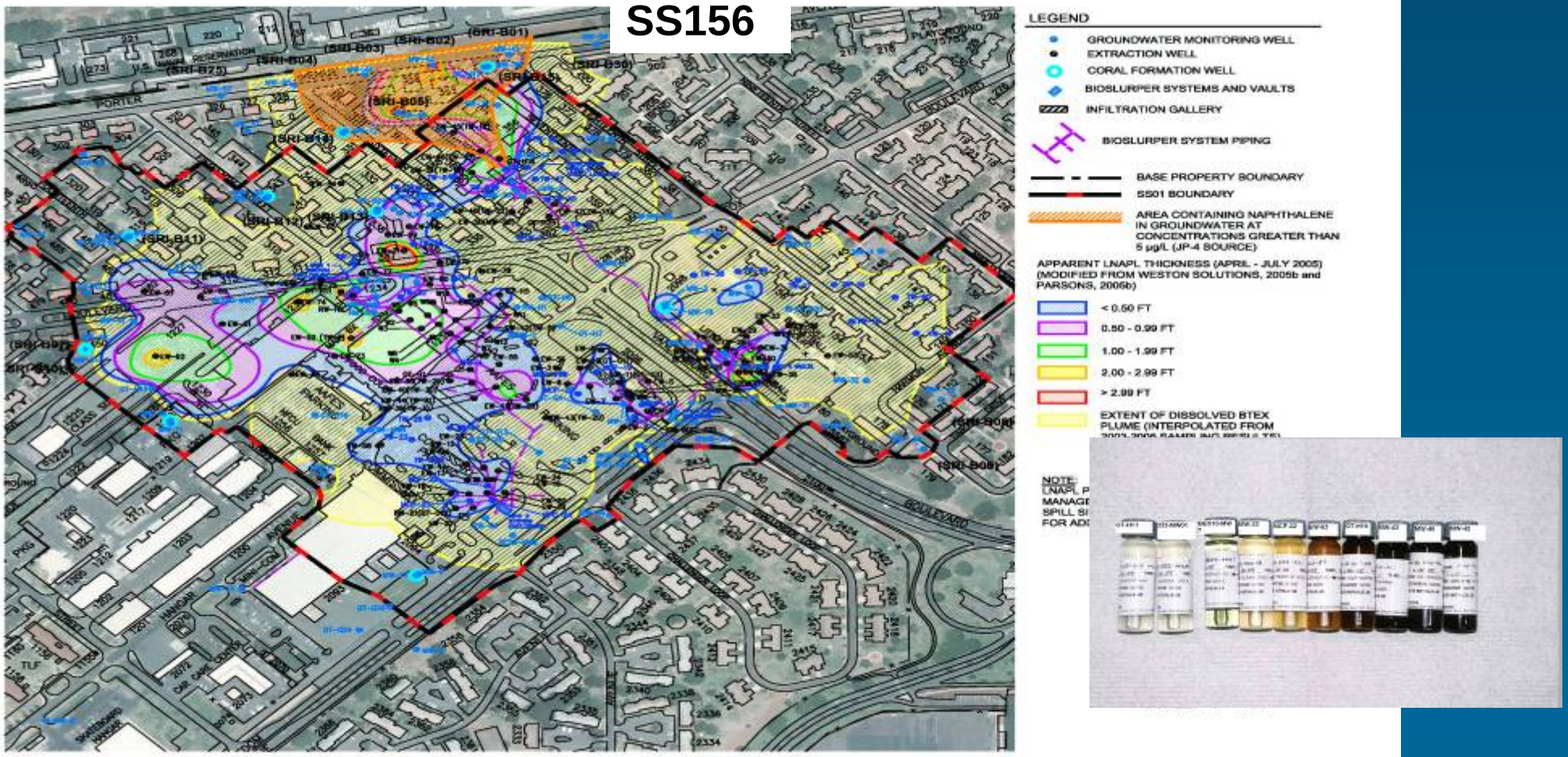
Continued Land Use Control Scenario

- **Focus on minimizing worker exposure and preventing LNAPL/BTEX migration off property**
- **If you must attempt LNAPL recovery, start with simple bail down test and avoid expensive systems**
- **Strict control of excavation (permits) and maximum monitoring to prevent occupational exposures**
- **Source decay modeling and groundwater perimeter monitoring to demonstrate containment and natural attenuation**

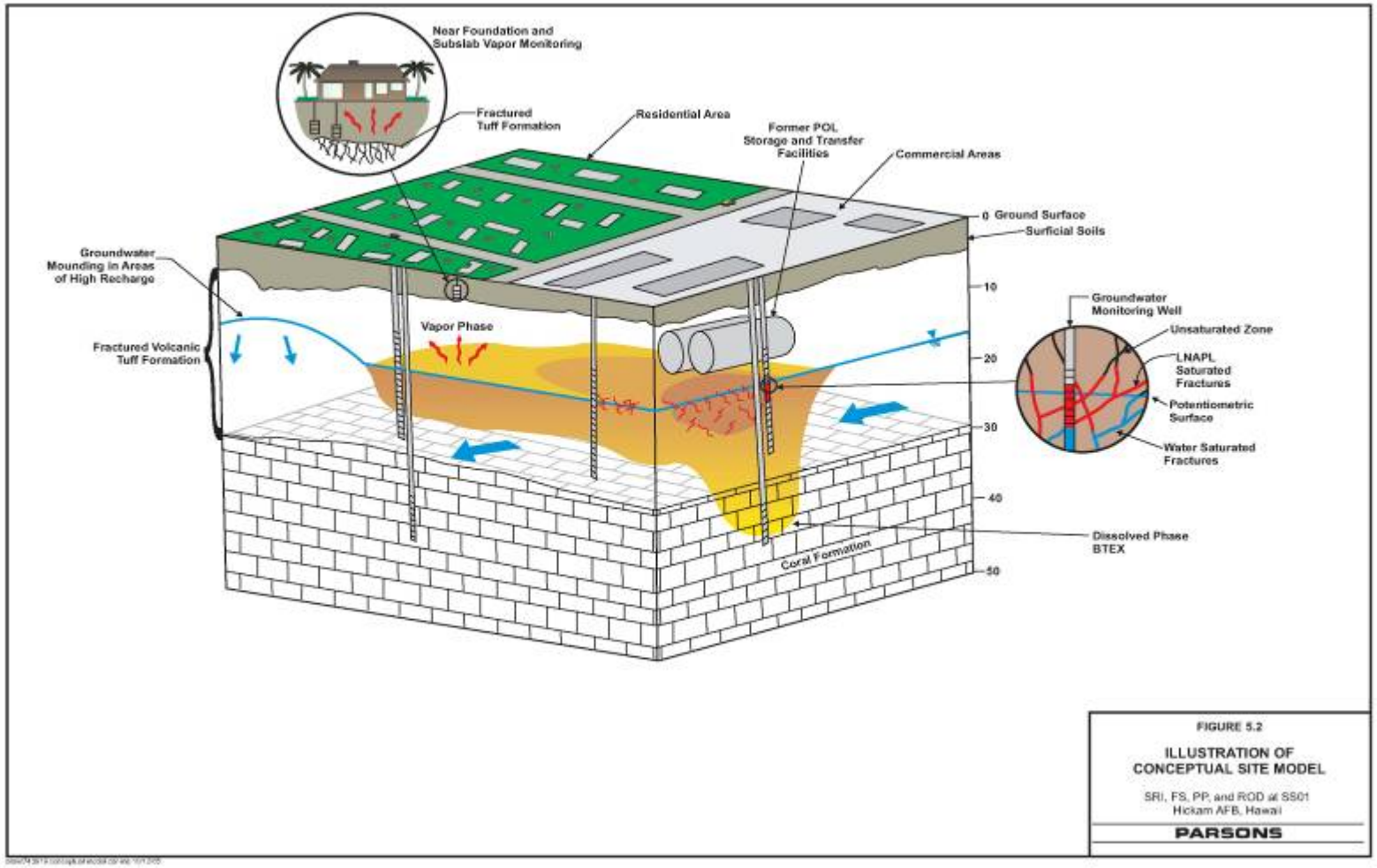
Hickam AFB Site SS01 Example

- **Used for bulk fuel storage and distribution between 1940 and 1974**
- **Primarily AVGAS with some JP-4 in latter years**
- **LNAPL covers 23 acres**
- **Up to 3 ft apparent thickness remains**
- **10 years of DPE product recovery/skimming**
- **Current land use residential and commercial**

Extent of Contamination



Site Risks


Near Foundation and
Subslab Vapor Monitoring
Fractured
Tuff Formation
Residential Area
Former POL
Storage and Transfer
Facilities
Commercial Areas
0 Ground Surface
Surficial Soils
Groundwater
Mounding in Areas
of High Recharge
Fractured Volcanic
Tuff Formation
Vapor Phase
10
20
30
40
50
Groundwater
Monitoring Well
Unsaturated Zone
LNAPL
Saturated
Fractures
Potentiometric
Surface
Water Saturated
Fractures
Dissolved Phase
BTEX
Coral Formation
FIGURE 5.2
ILLUSTRATION OF
CONCEPTUAL SITE MODEL
SRI, FS, PP, and ROD at SS01
Hickam AFB, Hawaii
PARSONS

Site Risks

- **Direct Contact with Potentially Contaminated Soils and LNAPL by Intrusive Workers**
- **Inhalation of Vapors by Intrusive Workers**
  - ***Not a Potable Water Source***
  - ***Soil Gas Concentrations Below Screening Levels for Indoor Air Intrusion***
- **Need to Confirm:**
  - **Seasonal changes in soil gas concentrations do not exceed screening levels**
  - **Stability of LNAPL and dissolved phase plume**

RAOs

- Prevent uncontrolled contact with potentially contaminated soils and LNAPL by intrusive workers
- Prevent uncontrolled inhalation of VOCs by intrusive workers
- Control further degradation of groundwater by ensuring dissolved phase contamination is not migrating off-site
- Control further degradation of groundwater by ensuring LNAPL is not migrating off-site
- Confirm soil gas concentrations do not pose an indoor intrusion threat

Recommendation

- **Alt. 2 - LUCs/MNA**
  - **Protective of Human Health and Environment**
  - **Meets ARARs**
  - **Best Balance of Evaluation Criteria**
- **Source Removal Options (Alt. 3 and 4)**
  - **Did not alter long-term risk at Site**
  - **Exhibited higher short-term risk to workers**
  - **Did not lower life-cycle costs**

Recommendation (cont.)

- **Land Use Controls**
  - **Notification to Intrusive Workers of Potential Threats through *Work Clearance Request* Process**
  - **Workers to Use Appropriate Personnel Protective Equipment and Monitoring as Needed to Eliminate Risk**
  - **Construction in Areas with Potential Soil Contamination Needs to have advanced characterization (soil and soil gas)**
- **MNA**
  - **Long-Term Monitoring (LTM) Program of Groundwater to Ensure the Plume is not Expanding**
  - **Short-term Monitoring Program of Soil Vapor to Ensure Temporal Variations are Below Screening Values**

Land Transfer with Future Industrial/Comm Land Use - Pease AFB Site 8 Case Study

- **BRAC Base with mandate for land transfer (industrial/commercial)**
- **Several acres of LNAPL**
- **One foot of apparent thickness**
- **Sandy aquifer with groundwater at 25 ft bgs**
- **Limited BTEX plume**
- **Strong evidence of natural attenuation and stable plume**
- **ROD requiring free product removal**

Pease AFB Site 8 Remedy

- **Remove LNAPL**
- **189 DPE and SVE wells**
- **Groundwater extraction to prevent plume expansion**
- **10 years of operation**
- **Annual O&M Cost $900,000**
- **Source benzene is 100 ppb at 25 feet bgs**
- **MNA removes more BTEX than pumping system**

Pease Site 8 DPE System

Pease AFB Site 8 Results

- **Over 40,000 gallons removed in 10 years**
- **95% removed by SVE system**
- **21 wells still have LNAPL**
- **LNAPL is obstacle to land transfer**
- **Over $10M spent and site still not ready for transfer**
- **Risk has been minimized but this was never the focus**
- **Estimated Excavation Cost $3M**
- **Lesson Learned – If LNAPL must go - Excavate**

Stapleton
Remediation Project Case Study
- Transfer for Residential Use

General Project Description/Summary

- Client: City/County of Denver
- Start date: 14 April 2000
- Finish date: 1 April 2004
- Scope of work:
  - Clean up over 500 acres of industrial/airfield property for immediate residential development.
  - Obtain No Further Action (NFA) letters from state regulators for 7 major sites so that developer will purchase land for development

General Project Description

- **Key Contractual Values, Terms and Conditions**
  - **Contract value: $42M**
  - **Lump Sum and Performance Based**
  - **Four-Year Period of Performance**

General Project Scope

- **Scope of work:**
  - **Complete site characterization and design remedy**
  - **Relocate in-service utilities**
  - **Remove contaminated soil and LNAPL – 7 major sites with LNAPL covering over 100 acres**
  - **Sample to confirm TEPH and BTEX standards have been met**
  - **One year of groundwater compliance monitoring to demonstrate all LNAPL removed**
  - **Negotiate NFA determinations for each site.**

Innovations

- **Streamlined Design/Build Process Has Cut Schedule By One Year for Many Sites**
- **Negotiation of Analytical Screening Methods with Regulatory Agencies Allows Real-Time Soil Handling Decisions**
- **Negotiation of Free Product Saturation Cleanup Criteria Based on Grain Size Allows TEPH up to 6,000 mg/kg to remain in place below 20 feet**
- **Well-Point Dewatering of Massive Excavations has Lowered Water 6–10 feet Allowing Equipment To Operate Efficiently**
- **Monthly Regulatory Meetings Accelerated NFA Process**

Concourse C – 20-Acre Excavation

Backfilling Small 135,000 CY Fuel Farm Excavation

Examples of LNAPL Site Transfers

- **Concourse B**
  - **Completed 300,000 CY Excavation to 30 feet (05/01)**
  - **Conduct Groundwater Monitoring for 9 Months**
  - **NFA Granted and Land Transferred (03/02)**
- **Pipelines and Hydrants**
  - **Removed and Characterized 50,000 LF of Fuel Pipeline**
  - **Identified and Remediated Over 150 Leak Sites**
  - **NFAs Have Been Granted for all fuel pipelines**
- **Concourse D**
  - **Completed 800,000 CY Excavation to 28 feet (09/01)**
  - **Conducted Groundwater Monitoring 9 Months**
  - **NFA Granted and Land Transferred (6/02)**

Stapleton Total Costs

- Contaminated Soil Removal and Disposal- $35 per CY
- Clean Overburden Removal and Backfill - $4 per CY
- Cost to Client - $8-$9/square foot based on 100-acre LNAPL area
- Average residential build out value $35/square foot
- Over 2,000 new homes have been completed

Summary

- Future Land Use Is A Key Factor in LNAPL Remediation Strategies
- If Land Ownership Remains the Same, Focus on Risk Reduction, Digging Restrictions, and MNA. Don't Spend Money for Partial LNAPL Removal.
- If Land Transfer for Industrial/Comm Use is Anticipated
  - Include Institutional Controls to Protect Workers
  - Focus on Chemical-Specific Risk Reduction
  - Use MNA or Boundary Controls for Dissolved BTEX
- If Land Transfer for Residential Use
  - Excavate the LNAPL Area
  - Use MNA and Soil Vapor Barriers for GW residual
  - When LNAPL is excavated, the plume will quickly attenuate