THERMAL REMEDIATION:
TWO ERH CASE STUDIES

NEWMOA
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Groveland Wells No.s 1 & 2 Groveland, MA
• 850 acre site
• 1979 2 municipal wells shut down
• Primarily TCE and DCE from manufacturing facility
• Listed on NPL 1982

Silresim Lowell, MA
• 12 acre site
• 100’s of chemicals primarily chlorinated VOCs
  Spills, leaking drums, USTs
• Listed on NPL 1983
Groveland Wells – History

• 2 Municipal wells shut down due to VOC contamination
• Town implemented water rationing
• One PRP – Valley Manufacturing
  ➢ Used solvents on-site for parts cleaning
  ➢ Subsurface disposal system (leach field)
  ➢ UST suspected leak
  ➢ Spills and discharges to ground (defoliant)
Groveland Wells History

- 1987 one water supply well brought back on-line with GAC treatment (well #1)
- State Order with PRP in 1987
  - PRP installed 2 extraction wells
  - Air stripper
- Valley property
  - 1988 – SITE Demonstration Program
    - SVE pilot tested (56 days) - removed 1,300 pounds VOCs
  - SVE chosen as remedial method for source area soils
  - SVE operates 10 years, only minimally effective

Groveland Remedy

- EPA Remedy Decisions (RODs) 1988 & 1991
  - OU#1 GW P&T – 400 GPM plant downgradient of Valley property
  - OU#2 separate GW P&T w/ SVE on Valley property
- 1995 additional monitoring - plume has shrunk significantly
- 1996 EPA 2 groundwater treatment systems combined into one
Groveland Groundwater Remedy

- 150 GPM plant w/ metals removal (iron) and GW treatment by UV oxidation (H₂O₂)
- Plant operates between 80 & 120 GPM
- 2001 – May 2011 EPA operates GWTF
- June 1, 2011 State takes over O&M of GWTF
Groveland Soil Remedy

- 2002 Valley no longer operating SVE system & abandons site
- 2004 EPA investigates remaining soil contamination in source area
- 2006 Pilot test - Chemical Oxidation
  - Not successful due to heterogeneity of source area soils and sorption of VOCs to fine-grained soils
- Sept 2007 EPA chooses thermally enhanced SVE in source area to reduce soil contamination

Source Area Remedy

Terra Therm - Electrical Resistance Heating (ERH)

- 2009 – 2010 Construction of ERH system
  - 64 electrodes, 29 shallow VE wells, 15 MPE wells, 28 TVP sensor wells
- Treatment Zone
  - 14,830 sq ft, with a total volume of 17,450 cu yds
  - 10 feet to 45 feet deep – to top of bedrock
- August 2010 – February 2011 ERH Operations
Groveland ERH Performance Goals:

- **Vadose Zone**
  - Min target temp 90°C (194°F) 0 to 25 ft bgs
  - 85% of temp sensors reach 90°C

- **Saturated Zone**
  - Min target temp 100°C (212°F) 25 to 45 ft bgs
  - 85% of temp sensors reach 100°C

- **Both Zones**
  - 100% of temp sensors reach 60°C (140°F)
Groveland Treatment Objective:

- Reduce contaminant concentrations in soils and overburden groundwater to below cleanup goals specified in 2007 ESD
- Alternate performance endpoint - “point of diminishing returns”

Groveland ERH Remedy Results

- 1,300 pounds of VOC’s removed
- 18 gallons of NAPL
- 311 million cubic feet of vapors
- 2 million gallons of groundwater & condensate
- 97% reduction of TCE in groundwater
- One monitoring well in source area went from a baseline concentration of 11,000 ppb to 15 ppb
- 3 M Kwh
Groveland Current & Future

• Current O&M by MassDEP
  ➢ Approx 55 GPM
  ➢ Low Conc (<30 ppb) TCE in source area wells
  ➢ Ambient temperatures not yet achieved in source area
  ➢ Will conduct “baseline” monitoring fall 2012 (including source area MWs)
  ➢ Optimization Report completed for EPA
    – < 5 years

Silresim – Site History

• Operates from 1971 to 1977
• Facility granted permit by State in 1973 to operate “recycling” and “treatment” facility of hazardous waste
• Numerous spills and severe storage capacity issues
• Several violations of permit - State tries to shut down facility in 1976
Silresim Site History

- Company declares bankruptcy in 1978
- 30,000 decaying drums and tanks with 1,000,000 gals of liquid waste remain on site
- State removal 1978 to 1981 starts investigation of soil/gw contamination
  ➢ Act of Legislature needed to fund removal of drums
- EPA removal (1983 – 1986) installs “temporary” clay cap over site, gravel on portions of adjacent properties, and expands fence (dioxin areas)
- Silresim Trust (PRP group) performs RI/FS 1985 - 1990
Silresim Cleanup Remedy Selected

- Cleanup Decision issued by EPA - September 1991
  - Management of Migration (MOM) - Groundwater P&T
    - P&T lower water table to enhance performance of SVE
  - Source Control (SC) - SVE of soils
    - Remove VOCs
    - Excavate non-VOCs from adjacent properties
    - Cap wastes on-site
- 1993 Settlement - $28 million

Silresim Groundwater Cleanup

Management of Migration (MOM)

- 1994-1995 Construction GWTP and extraction system
- Nov 1995 GWTP begins continuous operations
- Sept 2007 MassDEP takes over O&M of GWTP and groundwater monitoring
Silresim Soil Cleanup

Source Control (SC)
- 1996 Soil Vapor Extraction (SVE) pilot test
- 1998 SVE implementation/expanded pilot test and cap drainage improvements
- 1998 DEP GW Use & Value
- 1999 ROD remedy review, Phase I SVE completed

Silresim Cleanup

- 2002 additional site investigation & revision of Cleanup Goals (CUGs)
- 2002-2003 Electrical Resistance Heating (ERH) pilot test
- Sept 2008 ESD for ERH, final cap, and revision of CUGs
- ERH remedy for additional source removal
Terra Therm awarded contract for ERH
Construction of ERH system 10/10 – 7/11
- 304 electrodes, 77 multi-phase EWs, 50 VE wells, 63 PTV sensors
Treatment Zone
- 47,369 sq ft with total volume of 59,565 cy
- Shallow & deep overburden
Operation of ERH system 7/29/11 – 2/24/12
Silresim ERH Performance Goals:

- **Vadose Zone**
  - Min target temp 85°C (185°F)
  - 95% of temp sensors reach 85°C

- **Saturated Zone**
  - Min target temp 100°C (212°F)
  - 95% of temp sensors reach 100°C

- **Both Zones**
  - 100% of temp sensors reach 60°C (140°F)

Silresim ERH Treatment Objectives:

- Achieve cleanup goals set forth in 2008 remedy decision document
- As with the Groveland site, a “Point of Diminishing Returns” was set
Silresim ERH Remedy Results

• Estimated 40,000 – 86,000 pounds of VOCs removed
  3,480 lbs (8 drums) of NAPL

• 9.6 mil Kwh electricity

Silresim Current & Future Activities

• Current Activities
  ➢ Removing rest of ERH-related materials
  ➢ GW & Soil monitoring events
  ➢ Temps still averaging 180° F at depth
  ➢ MassDEP not turned EWs back on
    – Electrical issues
    – Potential deformation of EW piping
Silresim Current & Future Activities

- Future Activities
  - Add’l Site Characterization
    - Mass remaining
    - Possible mass flux evaluation
    - EW placement
  - EPA Optimization Evaluation in Fall

Groveland & Silresim ERH – Achievements/Issues

- Groveland
  - concentrations in source area reduced
  - Small area; ability to install deep electrodes (to bedrock)
  - several of EWs may by shut off within 5 years
- Silresim
  - Significant mass removal
ERH Potential Issues - Things to be Aware of

- Infrastructure of technology inherent safety issues
  - Electrical hazards
  - Bright warning lights and noise
  - Wiring, conveyance piping, wells – slips, trips & falls
  - Steam – burns, geysering

- Compatibility of equipment
  - With site contaminants
  - Contaminants and high temperatures
Groveland ERH Wiring – Slips, Trips & Falls

Silresim – Steam Pressure Causes a Geyser
Potential Issues (Cont.)

- Make sure that sufficient power is available
  - Can be a long lead-time for power installation

- Not “green”
  - Tradeoff between green remediation and reduction in length of treatment (reduction in timeframe is reduction in long-term production of greenhouse gases)

Potential Issues (cont.)

- Elevated ground water temperature (steam) – potential for pre-existing infrastructure to melt
  - Silresim - wire shorts
  - Groveland - PVC melted
  - PVC wells replaced with steel

- Water temperatures elevated for some period of time
  - Groveland - conditions not yet returned to ambient
  - Silresim - temps still > 180°F - Unable to reinstall EW pumps
Groveland Issues

- NAPL discovered, not expected, clogged sand filters of GWTF
- Abandoned Valley building –
  - Mold (level C required)
  - Drill rig access (low ceiling)
- Operation during winter - add pipe insulation
- Steam spears added to get more heat

Groveland - Piping inside Valley Building
Silresim Issues

- MPE well screens - siltation
- Temperature sensors – materials melting
- Uncertainty in mass removal calculations
- Large source area – contamination in subsurface up to 60 to 80 feet deep
- 57 ft deep only in small area
- Inability to restart EWs (high temps)

Was it worth it?

- Groveland – Yes.

- Silresim – Too soon to tell.
  - Plume – only treated “doughnut hole”
  - Would push for more complete treatment, “whole doughnut.”
  - Only treated small portion of deep overburden
  - May have issues of back diffusion
  - If goal is solely mass removal, it is a good method
Groveland - Area where 6 USTs had been

Silresim ERH Area looking Northwest
Silresim ERH looking toward GWTP

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