

THERMAL REMEDIATION: TWO ERH CASE STUDIES

NEWMOA
In-Situ Thermal Remediation Workshop
June 14, 2012
Westford, MA
Presentation by Janet Waldron, MassDEP



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)



3



Groveland Wells No.s 1 & 2 Superfund Site



4

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



5

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



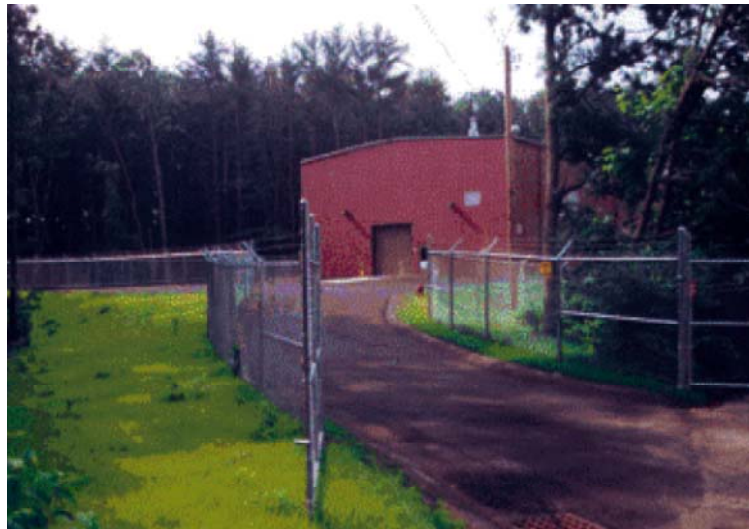
6

Groveland Groundwater Remedy

- 150 GPM plant w/ metals removal (iron) and GW treatment by UV oxidation (H_2O_2)
- Plant operates between 80 & 120 GPM
- 2001 – May 2011 EPA operates GWTF
- June 1, 2011 State takes over O&M of GWTF



7



Groveland Groundwater Treatment Facility



8

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



9

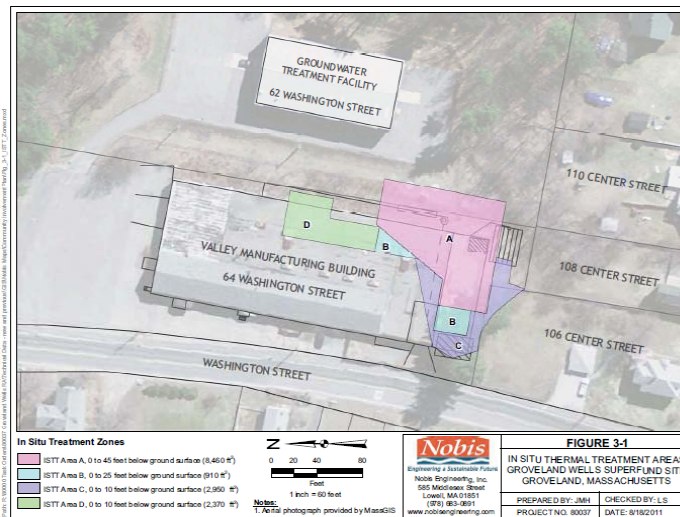
Source Area Remedy

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



10



Groveland Wells ERH Layout



11

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)



12

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”



13

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



14

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



15

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



16

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



17



Silresim at time of abandonment –
30,000 decaying drums



18

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



19

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



20

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



21

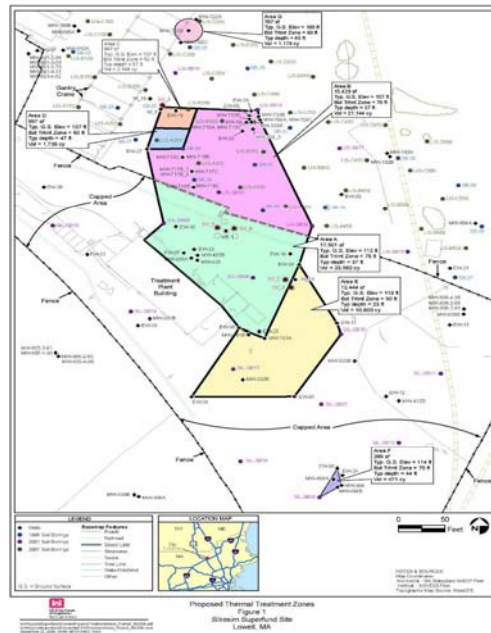
Silresim Cleanup

- 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



22

Silresim ERH Layout



23

Silresim Cleanup

- 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



24

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)



25

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



26

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



27

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



28

Silresim Current & Future Activities

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



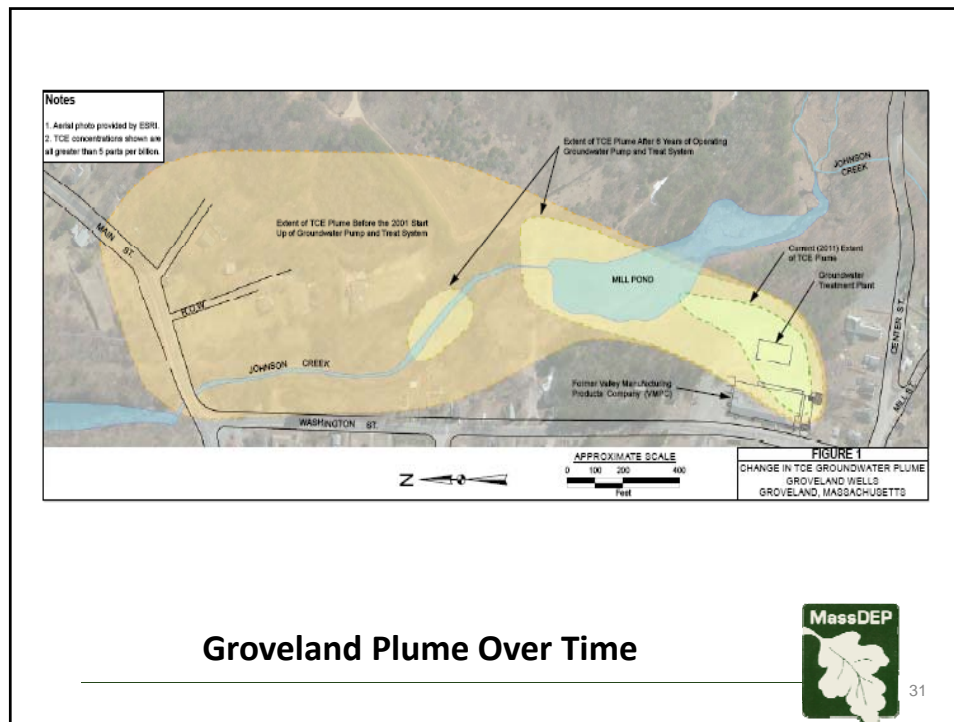
29

Groveland & Silresim ERH – Achievements/Issues

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



30



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



33



Silresim – Steam Pressure Causes a Geyser



34

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)



35

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



36

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



37



Groveland - Piping inside Valley Building



38

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)



39

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



40



Groveland - Area where 6 USTs had been



41



Silresim ERH Area looking Northwest



42



Silresim ERH looking toward GWTP



43

Acknowledgements

- US EPA – Derrick Golden
- Nobis Engineering, Inc. – Lauren Soos, Diane Baxter, Boyd Allen
- Terra Therm – Robin Swift, Devon Phelan



44