

How Travis AFB Transformed its Cleanup Program into an Award Winning Green Sustainable Remediation Program

28 June 2018



Program History

- Travis AFB created its Environmental Restoration Program (ERP) in the early 1980's and was placed on the NPL in 1989.
- Interim RODs in the late 1990's allowed pump-and-treat operations to begin at several groundwater sites.



Program History

- Several Ground Water Treatment Plants (GWTPs) were built in the late 1990's and early 2000's.
- These GWTPs used various treatment technologies such as UV-Oxidation, Air Strippers and Granular Activated Carbon.



Program History

- At the Central GWTP, a Thermal Oxidation Unit that burned natural gas was set up to treat solvents in soil gas.
- These technologies were effective but expensive to maintain and very energy intensive.



Program History

- The ERP staff have always been interested in trying out new ways of cleaning up the environment, for example:
 - ❖ Phytoremediation-1999
 - ❖ Columnar Wall Jet Gouting-1999
 - ❖ Vegetable Oil Injections-2000
 - ❖ Solar Pump and Treat-2004
 - ❖ Subgrade Biogeochemical Reactors-2008
 - ❖ Gravel Chimneys-2015



A New Beginning

- In 2008, I took over as the Project Manager for the Ground Water Treatment Plants.
- It was at this time that the EPA Primer titled “Green Remediation: Incorporating Sustainable Environmental Practices into Remediation of Contaminated Sites” was published.



A New Beginning

- Everything I read in the primer made sense.
- With this new knowledge, I checked out the O&M of our GWTPs and realized that energy usage was not being tracked or reported.
- I started reading the electrical and gas meters monthly.



A New Beginning

- Using a Dept. of Energy electricity to CO₂ equivalency conversion, I began reporting energy usage and CO₂ production at the monthly RPM meeting.
- As a result of this reporting, the decision was made by all parties to shut down a GWTP that was creating tons of CO₂ annually but only removed ½ lb. of contamination in an entire year!



ASTM Greener Cleanups Documentation

- Travis AFB was the first DoD installation to complete the *ASTM Greener Cleanups* self-declaration process
 - Develop best management practices
 - Implement greener cleanups project(s)
 - Document results and post to administrative record



Core Elements of Greener Cleanups

- Minimize total energy use and maximize use of renewable energy
- Minimize water use and impacts to water resources
- Reduce, reuse, and recycle material and waste
- Protect land and ecosystems



Putting GSR into Practice

- We hold monthly team meetings to track remediation progress
 - Identify optimization opportunities
 - Foster innovative concepts
 - Develop green and sustainable best management practices
 - Work as a team to turn our ideas into optimization actions or technology demonstrations



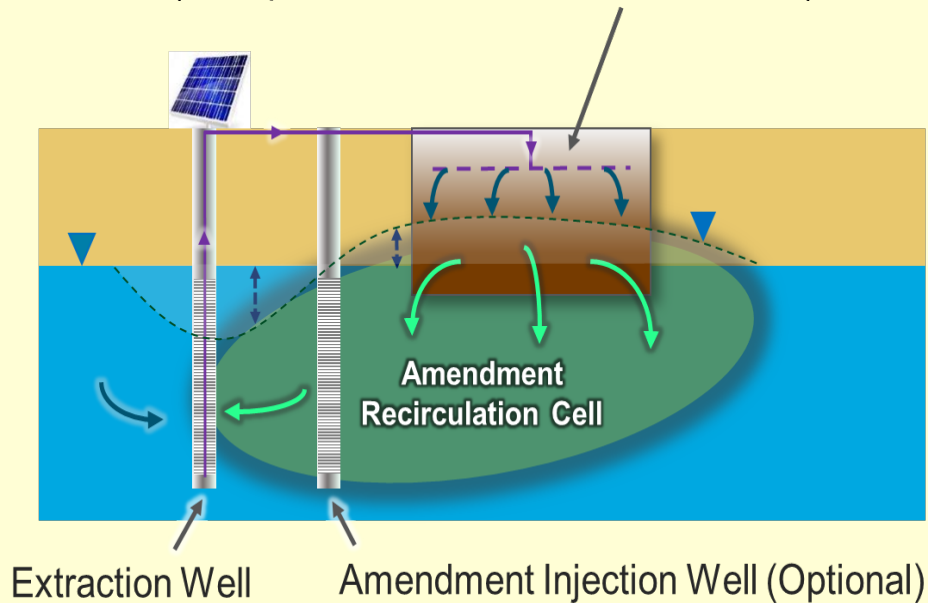
Putting GSR into Practice

- When properly implemented, Green and Sustainable Remediation (GSR) goes hand-in-hand with accelerating cleanup timeframes and reducing costs
- Passive or solar-powered systems, such as subgrade biogeochemical reactors (SBGRs), meet these objectives



SBGR

Subgrade Biogeochemical Reactor (SBGR) is filled with gravel and in-situ treatment amendments (site-specific and based on contaminant)



SGBR

**Site
DP039**



Starting TCE = 8,000 $\mu\text{g/L}$

**Site
SS016**

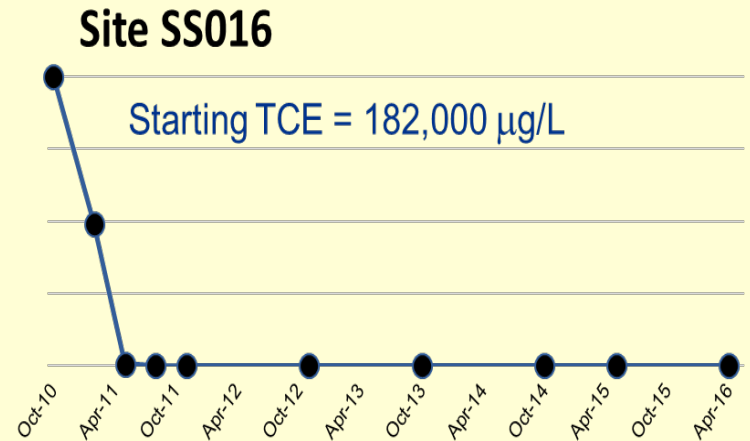
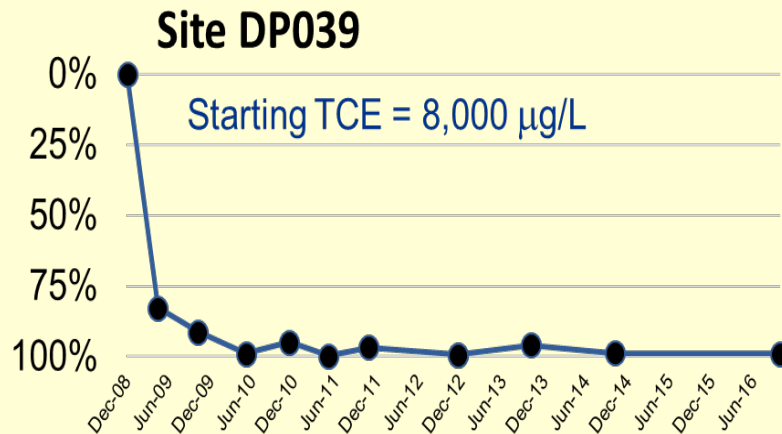


Starting TCE = 182,000 $\mu\text{g/L}$

SBGRs replaced dual-phase extraction systems



SGBR



Graphs show performance from wells within aquifer, between SBGR and extraction well

Site	CVOC Total Molar Concentration Reductions in Groundwater		
	Inside SBGR	~25 feet from SBGR	~100 feet from SBGR
DP039 (left)	96-98%	99%	99%
SS016 (right)	99%	99%	47-97%



Site SS014 Technology Demonstration

- Subgrade biogeochemical reactor (SBGR) for remediation of fuel contamination
 - Drywall as a safe and sustainable source of sulfate



Initial Source Area Reductions (12 Months)

- TPH-G: 1,900 ug/L to ND (99%)
- TPH-D: 5,500 to 190 J ug/L (97%)
- Benzene: 74.5 ug/L to ND (99%)
- Electricity and GHG reduction
 - ~9,000 kWh/year
 - ~3 tons CO₂/year



Aerobic SBGR Technology Demonstration

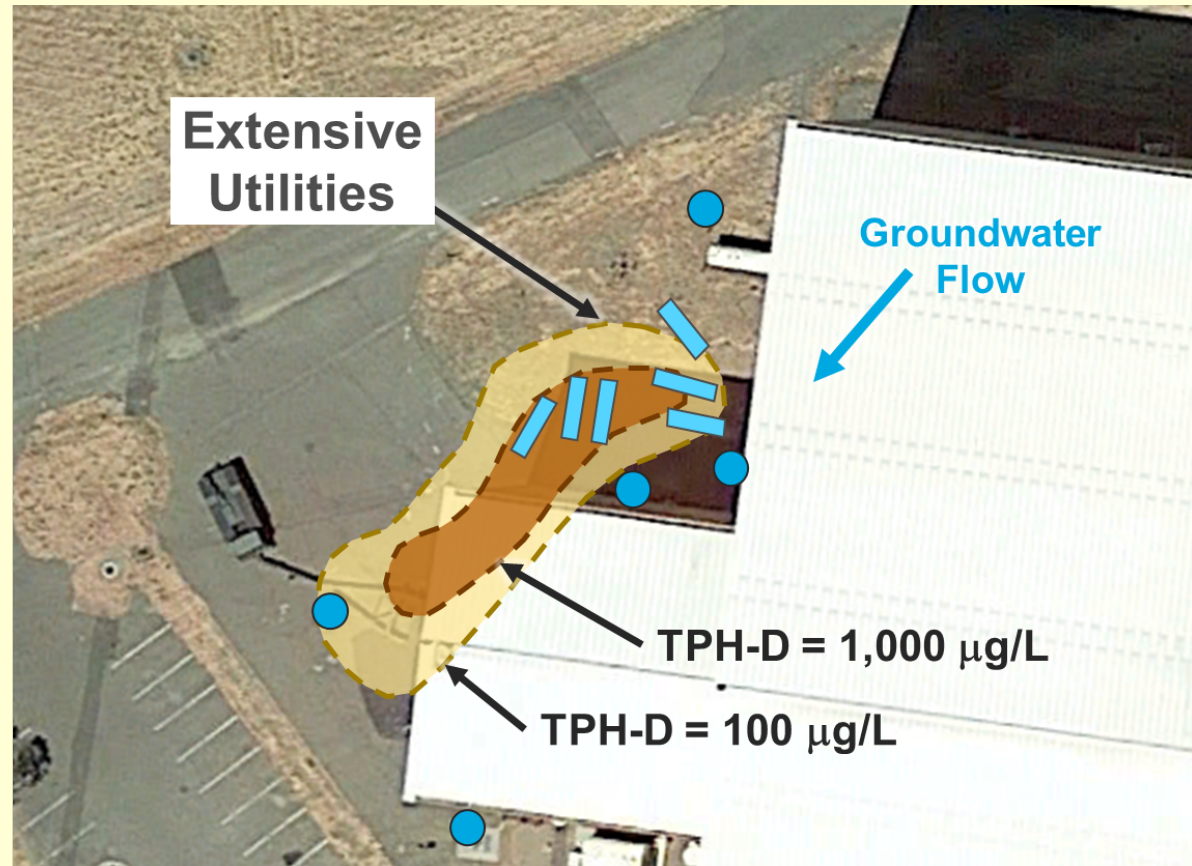
- Incorporated several aerobic processes to treat Stoddard solvent hydrocarbon source area and plume
- Adjacent to large hanger with complicated utilities



Aerobic SBGR Technology Demonstration


SBGR
Trench


EX Well



Initial Source Area Reductions (12 Months)

- TPH-D: 9,600 to 120 J ug/L (99%)
- TPH-O: 2,300 to 65 J ug/L (97%)
- Electricity and GHG reduction
 - ~38,000 kWh/year
 - ~14 tons CO₂/year



Green and Sustainable Results

- Annual electricity reduction of ~790,000 kWh/yr
 - Equivalent to annual consumption of ~120 CA homes
 - Saved over \$50,000/year in electrical costs
- Greenhouse gas reduction of ~930 tons per year
 - Equivalent to annual emissions of ~200 cars
- Use of non-refined, recycled, or waste materials
 - Avoid impacts from manufacturing new materials
 - Used fast food fryer oil, recycled drywall, bark mulch, straw, repurposed pump and treat system components



Solar Pump and Treat

- LF007C solar system reduction ~158,000 kWh/year
~59 tons CO₂/year
- ST018 solar system reduction ~35,000 kWh/year
~13 tons CO₂/year



Phytoremediation System

- Phytoremediation of TCE included in Groundwater Record of Decision
- Trees must be maintained, even during periods of drought
- Solar-powered recirculation system supports health of trees and increases residence time of treatment



Literature Related to Travis AFB Work

- SERDP/ESTCP Environmental Restoration Wiki
 - <http://www.environmentalrestoration.wiki> (and then click on SBGR) or Google “SBGR ER Wiki”
- “Design and Performance of Subgrade Biogeochemical Reactors” in *Journal of Environmental Management*
- “Utilization of waste materials, non-refined materials, and renewable energy in in situ remediation and their sustainability benefits” in *Journal of Environmental Management*
- “Travis Air Force Base: A Greener Cleanups Case Study” in *Remediation Journal*



California Air Force Bases. Leading the Way Using GSR!

Dept. of Defense Environmental Restoration
Award for Installations

- 2016 Beale AFB, Ca
- 2017 Travis AFB, CA
- 2018 Vandenberg AFB, CA



California Tiger Salamander

Thank you for participating!

