Green Remediation Focus

Minimizing the environmental footprint of site cleanup

A Profile in Using Green Remediation Strategies

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Former St. Croix Alumina Plant
Kingshill, St. Croix, U.S. Virgin Islands

RCRA Corrective Action

Cleanup Objectives: Remove hydrocarbons from groundwater underlying a former alumina plant located in St. Croix's south shore industrial area. From 1978 to 1991, an estimated 900,000 to over 2 million gallons of petroleum were released from storage tanks and underground piping at the St. Croix Alumina facility and adjacent former Hovensa petroleum refinery.

Green Remediation Strategy: The strategy focuses on best management practices involving:

- Installing onsite, off-grid renewable energy systems to power equipment used for extraction and transfer of commingled oil and groundwater. Between 2002 and late 2011, four wind-driven electric generators (turbines), four wind-driven turbine compressors and photovoltaic (PV) arrays were installed incrementally. Since late 2011, all of the remediation electricity requirements have been met by PV arrays used to power four submersible pumps for total fluids recovery and six solar-powered skimming pumps that predominantly recover hydrocarbons.
- Designing the fluid extraction/transfer process to operate through an on-demand, direct-drive power system rather than on a continuous pumping basis.
- Processing the recovered petroleum product for beneficial use. The recovered groundwater and petroleum mixture is transferred via a pipeline to the adjacent petroleum facility where the petroleum is reclaimed.

Results:

Renewable Energy Use and Air Quality Protection

- Meeting the typical electricity demand of the submersible pumps used for fluid extraction through use of onsite solar power. Operation of each pump is estimated to demand 150-260 watts of electricity, depending on fluid levels and the column of fluids being raised by the pump.
- Using solar powered skimming pumps in six wells to recover hydrocarbons through floating intake filters.
- Reducing emission of greenhouse gasses such as carbon dioxide, as well as other pollutants such as sulfur oxides and nitrogen oxides, through avoided consumption of grid electricity generated by a fossil fuel-fired plant.
- Reducing air emissions associated with transporting recovered petroleum to a more distant facility rather than to the adjacent facility for onsite use or recycling.
- Balanced the project's changing power demand and budget by installing renewable energy components incrementally over a period of years.

Material Use & Waste Reduction

- Recovered approximately 493,000 gallons of free-product oil (approximately 40% of the estimated volume) from approximately 70 million gallons of extracted groundwater as of June 30, 2016.
- Reducing the volume of petroleum waste generated onsite that would otherwise be transported to a hazardous waste treatment or disposal facility where the recovered oil fraction would typically be incinerated as waste.
- Avoided use of construction materials and other resources needed to connect the fluid recovery system to the existing power grid, which was estimated to cost $100,000.
- Planning for future re-use of modular equipment, such as the PV panels, elsewhere after it no longer is needed

for this fluid extraction/transfer application.

Property End Use: Industrial operations

Point of Contact: Caroline Kwan, U.S. Environmental Protection Agency Region 2

Site Location: The former St. Croix Alumina plant site is situated at Estate Anguilla in Kingshill, on the south shore of St. Croix, adjacent to a 1,500-acre petroleum facility.

PV System: Use of modular PV panels allowed for easy expansion of the solar energy system to meet additional power needs of the fluid-gathering system over time. Each of the 24 PV panels now in place cost approximately $600, for a total cost of approximately $14,400.

Solar Sipper Unit: Each "sipper" unit includes an air compressor and controller powered by a PV panel and battery. The controller cycles the system between vacuum, pressure and delay modes to recover hydrocarbons through a floating intake filter. Six wells were equipped with these units, at a total cost of approximately $70,000. The units can be mobilized to different wells as needed.

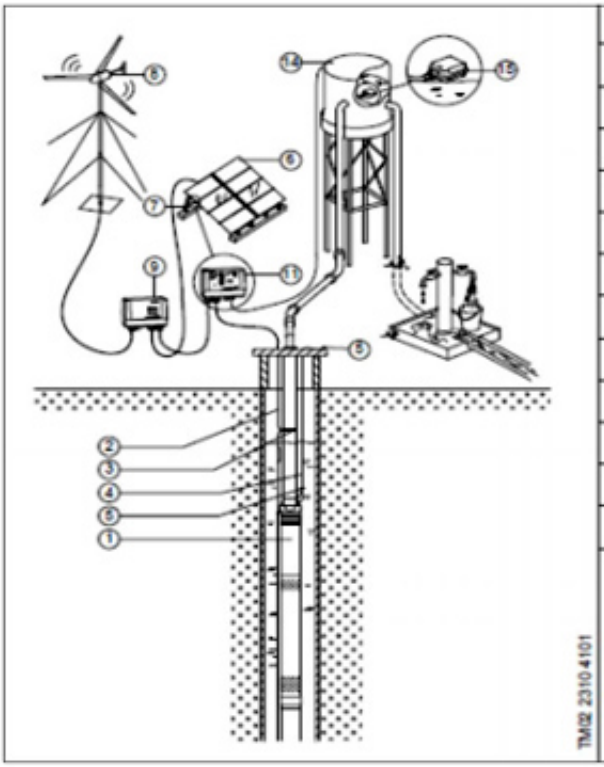
Fluid Handling: The recovered fluids containing commingled oil and groundwater are transported from the extraction wells to oil-water separation tanks at the adjacent petroleum facility via aboveground fiberglass lines that are coupled with steel lines for distributing the compressed air.

Recovered Product: Recovered subsurface fluid accumulates in aboveground tanks at the adjacent petroleum facility, where recovered oil is reclaimed for beneficial use.

Wind Field: Prior to 2011, when this wind field was taken out of service, trade winds averaging 11 mph brought nearly a constant source of renewable energy for remediation at the Former St. Croix Alumina site.

Wind Power Assembly: Prior to 2011, each turbine compressor was powered by a windmill that began rotating at a wind speed of 4 mph. When wind speed exceeded 30 mph, the blades furled and turned out of the wind. The air compressor was located behind the blades at the top of the tower, which was hinged to allow lowering of the full assembly for maintenance or protection from storms. Capital costs for the four units totaled approximately $20,000.

Wind Electric Generator: Four Whisper 200 mast-mounted wind electric generators provided electrical power for submersible pumps prior to 2011. Each generator provided 6.8 kWh per day in a 12 mile per hour average wind.



Pos.	Description
1.	SQF pump
2.	Submersible drop cable
3.	Cable clips
4.	Straining wire
5.	Wire clamps
6.	Solar panel(s)
7.	Support structure
8.	Wind generator
9.	Breaker box
11.	CU 200 control unit
14.	Water reservoir
15.	Level switch

Power Integration: Power generated by the wind and solar equipment prior to 2011 was combined using a controller unit for maximum pumping capacity.

Update: September 2016

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United States Environmental Protection Agency
Office of Solid Waste and Emergency Response (5203P)

For more information:
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