GoldSET© Evaluating your Sustainability Options



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GoldSET Projects

- GoldSET has been used in Canada, Europe, Australia and the United States for evaluating site remediation alternatives in different sectors
- Recent GoldSET applications:
 - Point Nepean Community Trust : SD evaluation to support the redevelopment of the site for incorporation into the Mornington Peninsula National Park (Australia) – 2006 to present
 - Railway company: Contaminated sites planning (North America) Ongoing
 - Federal Government: Customizing GoldSET to manage federal contaminated sites (Canada) – 2009
 - Municipality: SD assessment of a recycling project, as part of their Zero Waste Challenge (Canada) – 2009 to 2011





Sustainability: Two Levels of Application

- To integrate sustainability principles in 1. organizational management: Organization Benchmarking Sustainability corporate plan Carbon neutral strategies Community involvement p-do Bottom-up Eco-efficiency 2. To integrate sustainability at the project level: Decision support tools Life-cycle analysis
 - GHG inventory
 - Eco-efficiency
 - Evaluation of social impacts



level

Sustainable Organizations : What are the Drivers?

- Development of sustainable projects and businesses requires the management and cohesion of conflicting priorities:
 - Profit: Corporate and shareholder value, stakeholders, industry, bankers
 - People: Employees, Consumers, Communities, Countries (governments)
 - Planet: Meeting global and local agreed upon environmental standards





- There are multiple forums and groups working on the application of sustainable principles in remediation :
 - SURF (Sustainable Remediation Forum) US
 - CLARINET (« Contaminated Land Rehabilitation Network for Environmental Technologies ») - Europe
 - NICOLE (« Network for Contaminated land in Europe ») Europe
 - EURODEMO (« European Platform for Demonstration of Efficient Soil and Groundwater Remediation ») - Europe
 - CalEPA Green Remediation Symposium / Sacramento, CA February, 2009





Sustainability and Remediation

U.S. EPA guide on Green remediation : *Incorporating <u>Sustainable</u>* <u>Environmental Practices</u> into Remediation of Contaminated Sites (April, 2008)

Core elements

- 1) Energy requirement of the treatment system
- 2) Air Emissions
- 3) Water requirements and impacts on water resources
- 4) Land and eco-system impact
- 5) Material consumption and waste generation
- 6) Long-term stewardship of actions



Section 6 of the document addresses the future opportunities of Green Remediation

- -Building stronger communities
- -Expanding the options for site reuse
- -Increasing economic gains
- -Increasing environmental benefits of cleanup







Sustainability and Remediation

- The traditional method of evaluating remedial options was based on :
 - Objective
 - Advantage & drawback
 - Technical feasibility
 - Cost
- This traditional approach is now evolving. It now includes notions such as:
 - Sustainability principles
 - Wider environmental impact
 - Direct and collateral impacts and benefits
 - Socio-economic analysis

GoldSET was designed to take into account this new trend





- GoldSET was designed to bring Sustainable Development at the operational level so that organizations can "Walk the Talk"
 - Addresses the evaluation of the "Triple Bottom Line": Economic, Social and Environmental.
 - Transparent decision process for stakeholders, investors and regulators alike
 - Provides a quantitative and qualitative evaluation
 - Measures direct and collateral impacts and benefits
 - Efficient and effective decisions
 - Easy to communicate and understand
- Tailored to the organization undertaking the activities
- Balanced, impartial and comprehensive, yet simple to us
- Reduces overall economic impacts through optimization





GoldSET : Sustainability Evaluation Tool

Site Description

Conceptualization of site conditions
Evaluation is site specific
Objective definition

Option Description

•Fatal flaw analysis:

- Objectives
- Cost
- Duration
- Technical
- Legal

Indicators

Includes: •Int'l Standards & Best Practices • Corp. Objectives

Legal Requirements

Environmental -Natural Resources, Ecological Integrity, Energy, Waste, etc.

Social

 Health & Safety, QOL, Culture, Regulations

Economic - NPV, ROI, Technological Regiments, etc.

Scoring

Quantification of indicators: •Specific to client requirements

Evaluation of Options based on "Triple Bottom Line"

Structured system for ranking options: •Tailored scoring and weighing schemes •Results are given by ternary diagram

Eco-efficiency Cost Benefit Analysis Stakeholder Concerns

Interpretation & Reporting

OPTION A OPTION B OPTION C OPTION D

Recommendations to support decision making: •Tangible •Transparent •Optimized

Automated reporting (web version)





GoldSET: Quantitative Indicators

Energy Consumption

ENVIRONMENTAL ASPECT							
TYPE OF REMEDIATION	INDICATOR : Consumed Energy (MJ)						
Option 1: Interceptor sumps	459 266						
Option 2: Interceptor trench	2 094 332						
Option 3: Multi-phase extraction	5 245 628						
Option 4: Hydraulic barrier	1 908 088						
Option 5: Oxygenated water injection	1 144 772						
6 000 000 4 000 000 1 000 000 1 000 000 Type of	Consumed Energy (MJ)						

Greenhouse Gases



- Qualitative and Quantitative indicators may be quantified through customized GoldSET modules or other tools
- All quantitative indicators (\$, t CO2 e, KWh, water usage ...) can be calculated to compare relative scores of alternatives
- Can be customized to fit the company's tolerance to uncertainty





Actionable Result Output

- The best approach from a sustainability standpoint is based on:
 - The biggest, most balanced triangle.
 - Highest performance in each dimension
 - Balanced performance between all dimensions
 - Local specificities must be considered in selecting the option







- To provide a more detailed evaluation of remedial options a fourth dimension can be added to address technological aspects;
- Indicators for the evaluation of the technical dimension would be geared towards the evaluation of detailed engineering and operational aspects of the alternatives







GoldSET at a Glance







Site conceptual model:

•Approx. half a million litres of weathered diesel estimated to be in subsurface from leaks and spills from former ASTs and locomotive fuelling area

- •LNAPL thicknesses vary from 0 to 3 m in places.
- •Depth to product approx.16-18 m below grade
- •Dissolved phase impacts present above guideline.
- •Hydraulic gradient estimated to be 0.02 to 0.04 m/m
- •Silty SAND, fine to medium grained
- •Remedial action required as plumes appear to be migrating toward site boundary







Step 2 - Site Description : Conceptualization of the site conditions

Project Objective and Constraints

General Description

Zoning & Surroundings

Describe the zoning and the surroundings of the contaminated areas :
 The surrounding land use is generally commercial with some light industrial and agricultural. The nearest residendial property is approximately 300 m from the Site boundary.

Above Ground Infrastructure

Detail the above the ground infrastructure on and around the contaminated areas :

There is no above ground infrastructure on the contaminated area. There is one power line adjacent to the gravel road located north of the contaminated area running parallel to the road.

Underground Infrastructure

Detail the underground infrastructure on and around the contaminated areas :

There are no underground infrastructures on and around the contaminated areas however, the ground surface is rough and undulating which has been a tripping hazard in the past.





Step 2 - Site Description : Conceptualization of the site conditions

Project Objective and Constraints

General Description

Site Geology & Hydrogeology

Site Contamination

Contaminants

Describe the contaminants on site :

Contaminants are petroleum hydrocarbons; BTEX and F1-F4. The LNAPL at the site is weathered diesel.

Soil and groundwater have been sampled for PAHs, VOCs and lead, these compounds have NOT impacted the on-Site media.

Media Affected

Describe the media affected on site :

0

Media affected include soil and groundwater. Surface water is NOT affected.





Done

3	Winterized VER Unit and annu	al O&M Selected	○ ☆
	Option Description		
	General description of the approach versus	objective(s)	
	Provide a general description of the approach and explain how the approach will meet the project objective(s):	A system of four networks of recovery wells tie into the main VER unit to recover LNAPL.	
	Is the proposed approach expected to meet the objectives ?	Yes 💌	
	Description of technology		
	Technology		
	Provide a summary of the technology and explain how the technology will meet physical site constraints if any :	With product at depths of >12 m below grade, VER with air lines are known to produce enough lift to recover large volumes of LNAPL.	
	Additional Testing Required		
	Detail additional testing required if any :	A pilot test should be conducted at the site prior to system design.	
	Machinery and System Components		
	Describe the machinery and physical components required (succinct description of main components only) :	VER unit in series with a biological percolation unit, followed by a water treatment unit (activated carbon and clav). followed by an	
	Is the proposed approach technically feasible given	Yes 🔽	
	site constraints ?		~
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			1		1	
oject Select	tion General Information Site Descr	iption Option Definition	Indicator Selection Quan	titative Indicator Evaluatio	n of Options	Results and Rep
tep 4	- Indicator Selection	8				
M	anage Indicators	Free Product				
		Assesses the recoverable	and mobile free			
Environn	nental Aspect	managed by the option. I	Not applicable if			
election	n Indicator	there is no free product o	on site.		Descriptio	on Reference
-	Soil Quality	Scoring Schome I		of Affected Media	0	0
0	Sediment Quality	0 = No removal		of Affected Media		0
J.	Soil Vapour Intrusion	50 = Partial removal	of Affected Media			
	Groundwater Quality	90 = Free product is not	of Affected Media	0		
/	Free Product	no risk 100 = Complete removal	of Affected Media	0		
/	Surface Water Quality	recoverable free product	of Affected Media			
-	Water Usage			Vater Usage		
			Ok	tion on Sensitive	-	
600	Drinking Water Supply	9	Migration	htion of Off-Site		0
			Impact Redu	ction on Sensitive		
~	Off-Site Migration	Water	vention of Off-Site			
	-	2				
	Short-Term Impacts on		Impact Reduction on Sensitive			
6	Biodiversity and Species Status	Ecological Integrity	ological Integrity Areas & Prev		0	0
			Impact Redu	ction on Sensitive	·	
	Long-Term Impacts on	Ecological Integrity	ention of Off-Site			





Energ Winte	Energy & GHG Estimation Module Winterized VER Unit and annual O&M									·		
	Energy Consumed GHG Emissions											
SUB TO	DTAL (Without Renev	vable Energy) :	83	(GJ PFE)		<mark>6</mark> (t CC)2 e)					
GRAND	TOTAL (With Renew	vable Energy) :	83	(GJ PFE)		<mark>6</mark> (t CC)2 e)					
Construc	tion											
		Equipment			Duration	Frequ Dist	uency / tance	Energy , Consum	/ Fuel ption	Energy Consumption	GHG Emissions	
Activity	Туре	Size	Qty	Energy Typ	e (days)	Qty	Unit	Qty	Units	GJ	t CO2 e	
Drilling	Drill rig	Medium - 3,75 to 12,5 L/hr or 1	1	Diesel	20	10	hr/day 💌	8	Uhr	61.28	4.2608	~
Drilling	Drill rig	Select a category		Gasoline	~		hr/day 💌		Dhr			
Drilling	Drill rig	Select a category		Gasoline	~		hr/day 💙		Uhr			
Drilling	Trucks / Cars	Light-Duty Diesel Trucks 3 and	1	Diesel	20	200	km/day 💌	0.1389	L/km	21.2778	1.4794	
Drilling	Trucks / Cars	Select a category		Gasoline	~		km/day 💌		L/km			
Drilling	Trucks / Cars	Select a category		Gasoline	~		km/day 💌		L/km			
Drilling	Power Generator			Gasoline	×		hr/day 💌		Uhr			
Drilling	Power Generator			Gasoline	~		hr/day 💌		Uhr			
Drilling	Other Equipment			Gasoline	×		hr/day 💌		Uhr			
Drilling	Other Equipment			Gasoline	~		hr/day 💌		Uhr			
Drilling	Other Equipment			Gasoline	×		hr/day 💌		Uhr			
Drilling	Other Equipment			Gasoline	~		hr/day 💌		Uhr			~
Done											golder.gold-se	ət.com 🔒





CodeIndicatorRecovery property boundary &property boundary &property boundary &productPump and Treat prevent offsite migrationWinterized VER Unit and annual O&MDo NothingWeighENV-1I Soi QualityI O II OI O </th <th>Environme</th> <th>ntal Aspect</th> <th></th> <th></th> <th></th> <th></th> <th></th>	Environme	ntal Aspect					
ENV-1 Image: Soli Quality Image: Soli Quality <td< th=""><th>Code</th><th>Indicator</th><th>Recovery Trench at property boundary&pump product</th><th>Pump and Treat prevent offsite migration</th><th>Winterized VER Unit and annual O&M</th><th>Do Nothing</th><th>Weight</th></td<>	Code	Indicator	Recovery Trench at property boundary&pump product	Pump and Treat prevent offsite migration	Winterized VER Unit and annual O&M	Do Nothing	Weight
ENV-2 Image: Second water Quality Image: Second wa	ENV-1	(1) Soil Quality	0 💌	✓	2 50 -	⊘ 0 ∨	✓
ENV-3 Image: Free Product Image: Surface Water Quality Image: Surface Water Qu	ENV-2	(1) Groundwater Quality	0 💌	🧭 90 💌	2 100 🔽	⊘ 0 ∨	2 🗸
ENV-4 Image Image <td< td=""><td>ENV-3</td><td>(1) Free Product</td><td>50 🗸</td><td>Ø0 ▼</td><td>2 100 💌</td><td>⊘ 0 ✓</td><td>2 3 ✓</td></td<>	ENV-3	(1) Free Product	50 🗸	Ø0 ▼	2 100 💌	⊘ 0 ✓	2 3 ✓
ENV-5 Image Image <td< td=""><td>ENV-4</td><td> Surface Water Quality </td><td>0</td><td>⊘ 0 ∨</td><td>0 🗸</td><td>⊘ 0 ✓</td><td>2 1 ✓</td></td<>	ENV-4	 Surface Water Quality 	0	⊘ 0 ∨	0 🗸	⊘ 0 ✓	2 1 ✓
ENV-6 Image: Off-Site Migration Image: Omega	ENV-5	🕕 Water Usage			<i></i>		2 1 ✓
ENV-7 Image: Consumption Image: Consumption <td>ENV-6</td> <td>(1) Off-Site Migration</td> <td>0 🗸</td> <td>✓</td> <td>2 100 ▼</td> <td>0 🗸</td> <td>2 1 ✓</td>	ENV-6	(1) Off-Site Migration	0 🗸	✓	2 100 ▼	0 🗸	2 1 ✓
ENV-8 (1) Energy Consumption	ENV-7	I Greenhouse Gas Emissions	2100	2 100	⊘	2 100	2 1 ✓
	ENV-8	Inergy Consumption	2100	2 100	0	2 100	2 1 ✓





Code	Indicator	Recovery Trench at property boundary&pump product	Pump and Treat prevent offsite migration	Winterized VER Unit and annual 0&M	Do Nothing	Weight	
50C-1	🕕 Public Safety	0 💌	50	2 100 💌	⊘ 0 ∨	2	
50C-2	🕕 Worker's Safety	0 💌	50	2 50 💌		2 💌	
50C-3	Ouration of Work	0	0	2 100	<i>≥</i>	2	
SOC-4	Quality of Life (During the Project)	2 100 💌	2 100 /	2 100 💌	2 0 💌	1	
SOC-5	Reuse of the Property by the Corportation	2 50 💌	⊘ 50 ∨	2 100 🔽	0	2 1 🗸	
SOC-6	🕕 Use for the Public	2 50 💌	2 50 💌	2 100 💌	2 0 🔽	1	
SOC-7	🕕 Cultural Heritage	0 💌	0	2 100 💌	2 0 🔽	2 1 💌	
SOC-8	Iocal Job Creation and Diversity	0 💌	2 100 💌	2 100 🔽	2 0 🔽	1	
SOC-9	Response to Social Sensitivity	2 50 💌	50	2 100 💌	≥ 0 ∨	2 1 💌	
SOC-10	Istandards, Laws and Regulations	2 50 💌	2 50 M	100	0	1	
50C-11	Impact on the Landscape	50	Ø 50 ▲	50 🗸	2 150 💌	2 1 💌	
SOC-12	Management Practices	Z 50 💌	≥ 50 ⊻	2 100 /~	0	1	
Economic /	Aspect						











What did we learn?

- Is the basis for a good understanding of the site conceptual model
- Anticipate Health and Safety or logistical issues for design and construction
- Tweak the energy consumption by installing other equipment, to renewable energy source
- VER option scores well on Environmental indicators
- VER option scores well on many Social indicators
- Helped client to participate and 'believe' in the remedial option chosen transparent and visual
- Efficient reporting





GoldSET :

- Is a hands-on visual tool
 - Transparent decision making
 - Simplifies an abstract concept
 - Helps manage business risk
- Provides tangible benefits
 - Saves money by identifying improvements
 - Re-engineering & optimization
 - Positive corporate image
 - Good communication tool of impacts & benefits









- Effective Performance
- Responsible Development
- Sustainable Communities

Questions?



