Air Force Center for Engineering and the Environment

Integrity - Service - Excellence

AFCEE Sustainable Remediation Tool (SRT)

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International Conference on Green Remediation

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AECOM GSI ENVIRONMENTAL CH2MHILL

Project Team

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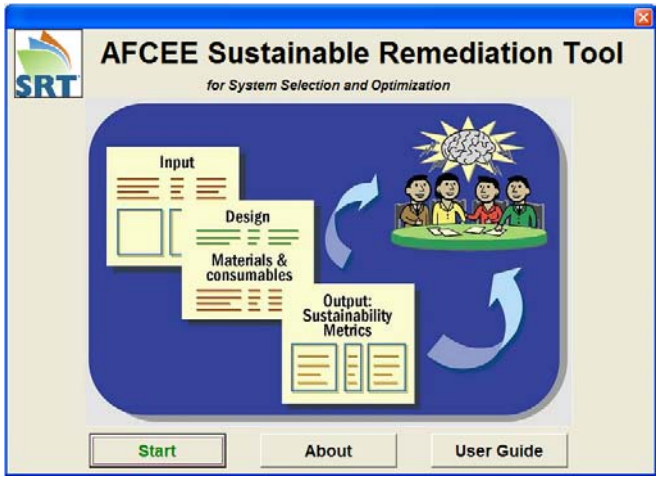
SRT Overview

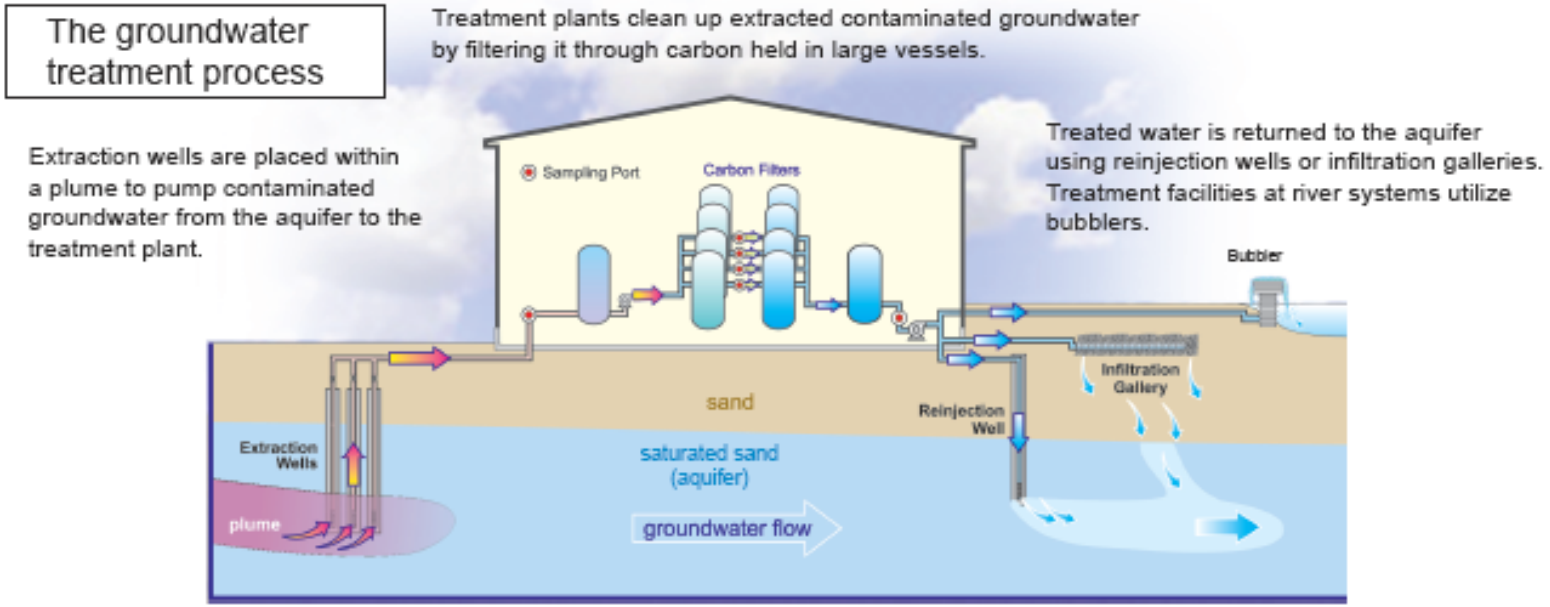
- ***Motivation and Purpose***
- **Tool Functionality**
- **Optimization Scenario**
- **Conclusions**



Motivation and Purpose

The Problem…

Historical approach to contaminated sites does not fully consider sustainability concepts. Plus, remediation system performance not routinely tracked.



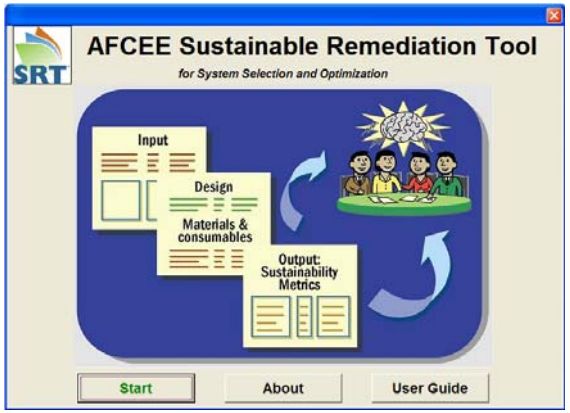
Motivation and Purpose

Solutions…

Develop tools to help AFCEE environmental professionals incorporate sustainability concepts into their remediation decision making process (e.g., Performance Based Management, Remedial Risk Management, Environmental Restoration Program – Optimization) and track performance

i) Plan future remediation implementation

ii) Optimize operating remediation sites



Tools…

- ✓ Sustainable Remediation Tool (SRT)
- ✓ Performance Tracking Tool (PTT)
- ✓ Alternative Energy Siting Tool
- ✓ Environmental Restoration Program-Optimization (ERP-O) Initiative

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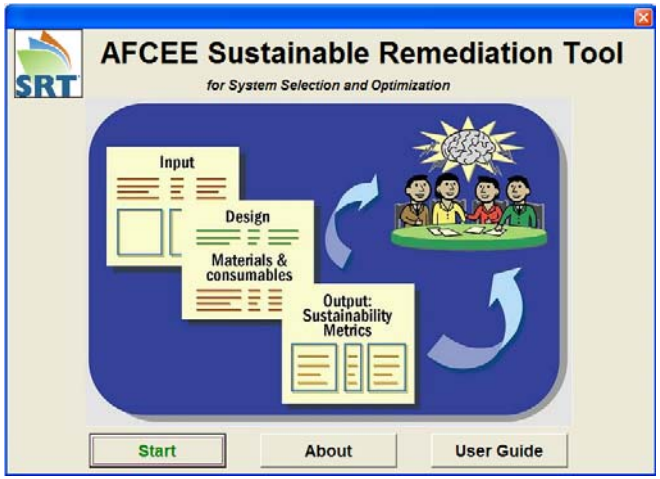


SRT Functionality

SRT Design Principles:

- No replication of design tools (simply calculate metrics)
- Develop with tiered approach for parameter inputs
  - Easy Tier 1 with Rules of Thumb for technology estimates
  - Tier 2 can estimate but not intended to replace design tools
  - Allow user override of estimated values at any time to accommodate real design parameters
- Include cost as a sustainability metric

SRT Functionality

Technologies in the SRT:

- Excavation
- Soil Vapor Extraction (SVE)
- Pump and Treat (P&T)
- Enhanced Bioremediation
- In Situ Chemical Oxidation (ISCO)
- Permeable Reactive Barrier (PRB)
- Long-term Monitoring (LTM) / Monitored Natural Attenuation (MNA)
- Thermal Treatment

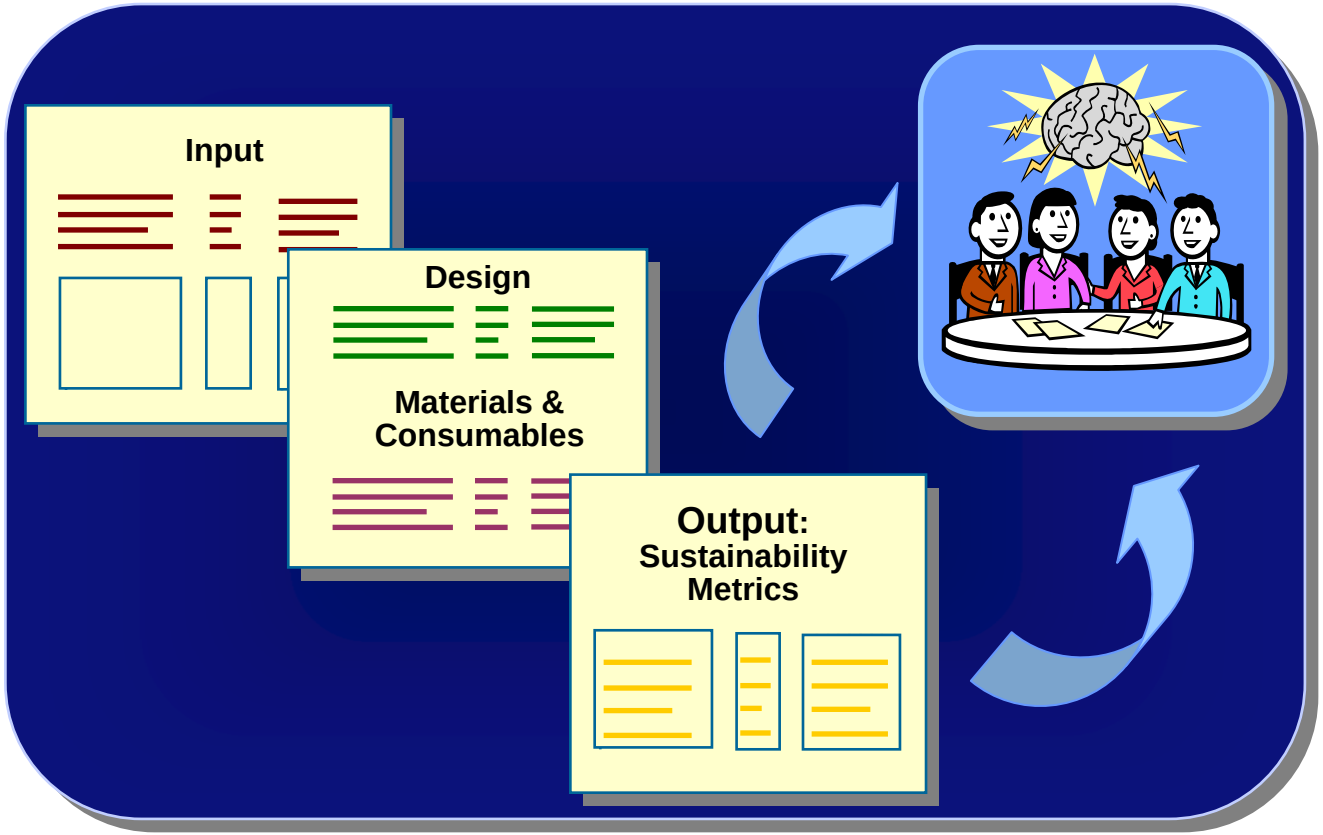
SRT Functionality

Sustainability metrics estimated by SRT:

- Emissions to atmosphere
  - CO_2
  - NO_x
  - SO_x
  - PM_{10}
- Total energy consumed
- Change in resource service
- Technology cost
- Safety / Accident risk

SRT Functionality

Tool Structure



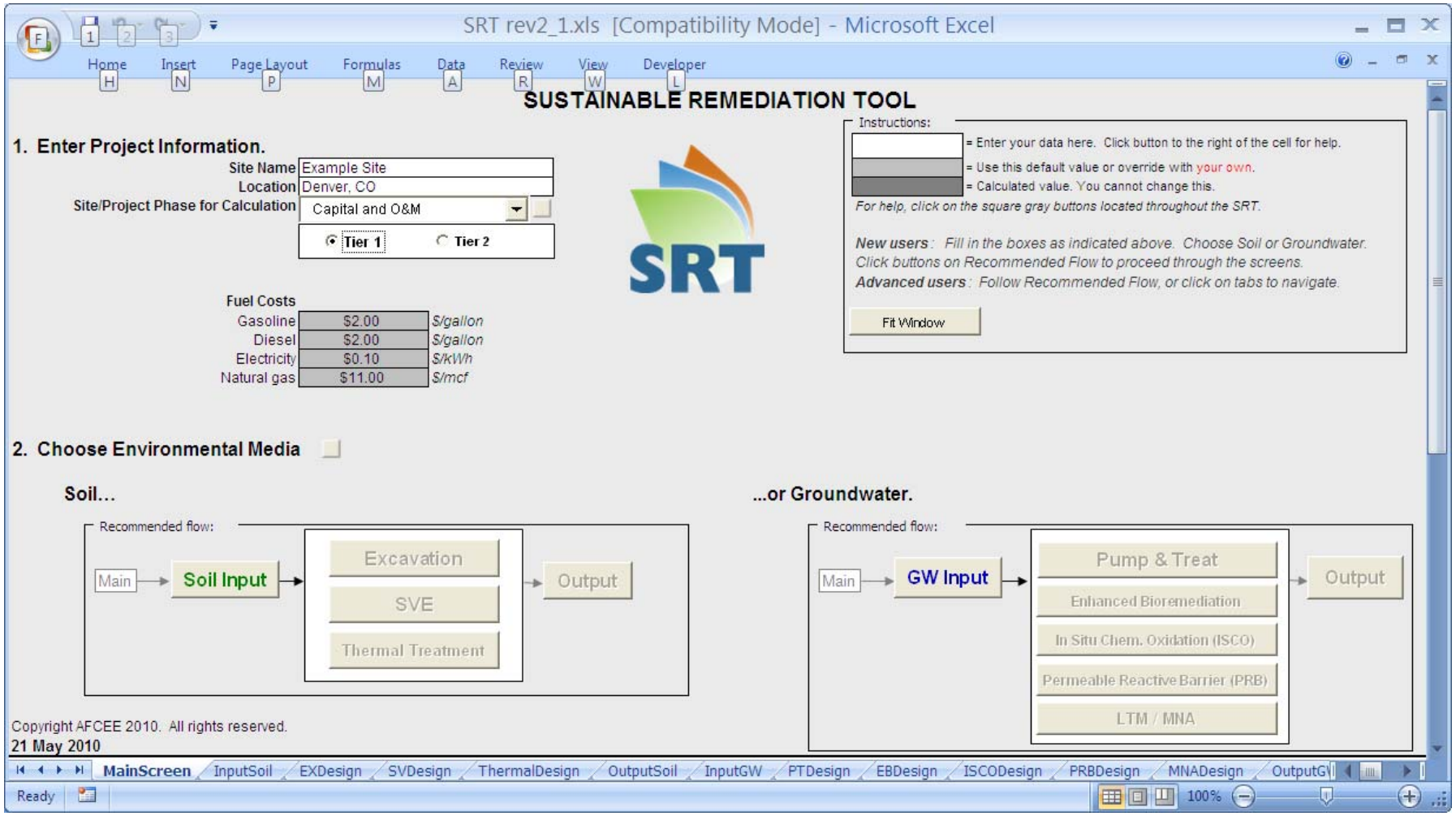
SRT Functionality

Framework: Tiers of Varying Detail

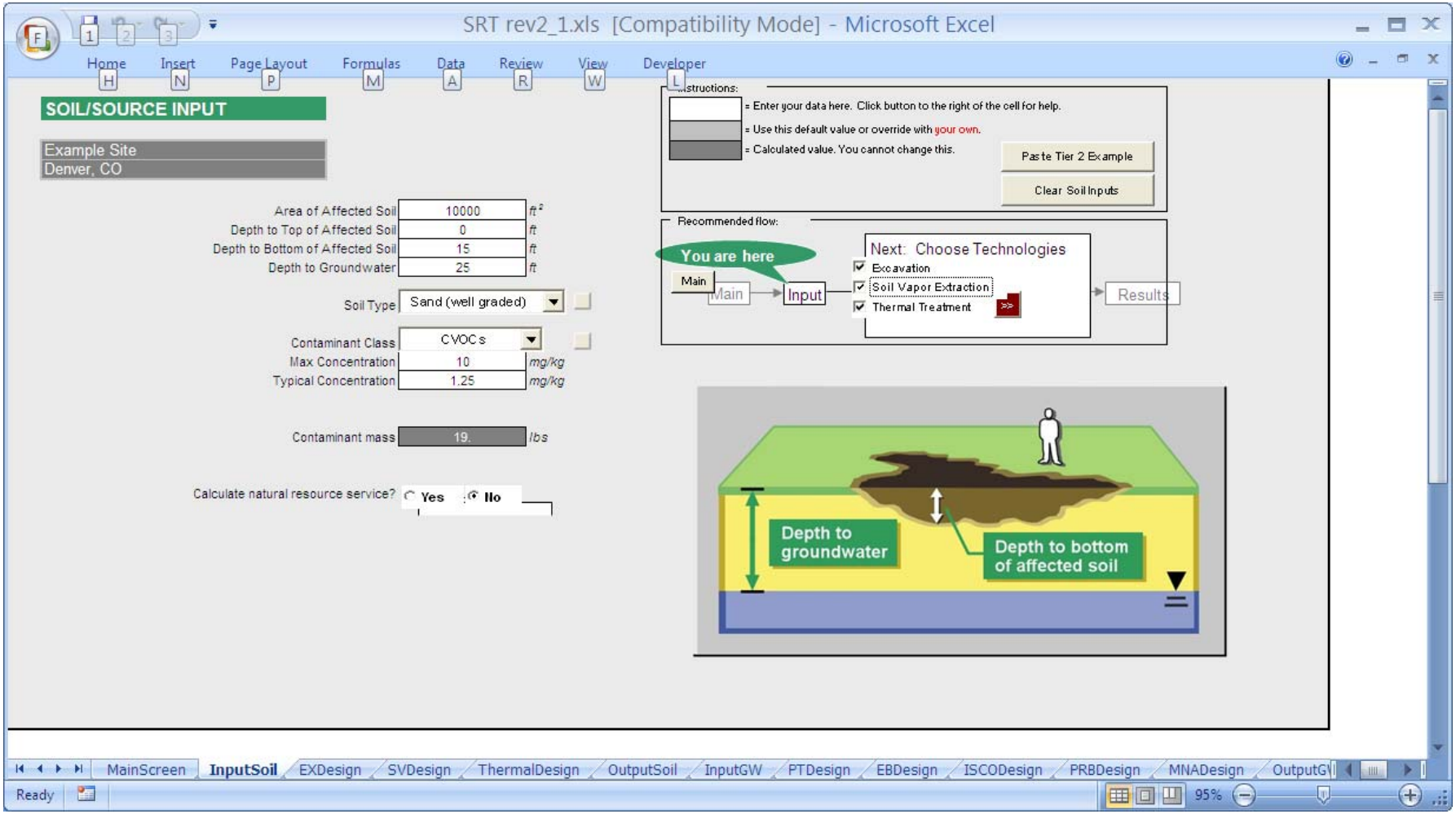
	Tier 1	Tier 2
Calculation Basis:	"Rules of Thumb"	User-entered detailed design
Time Required:	1 - 2 hrs	1 - 2 days

Tier 1 Advantages	Tier 2 Advantages
✓ Shorter execution than Tier 2 ✓ Extensive built-in defaults ✓ Simpler user inputs ✓ Most appropriate before a Feasibility Study (FS)	✓ More site-specific results ✓ More default user-overrides ✓ Most appropriate after an FS ✓ More appropriate for optimizing existing systems

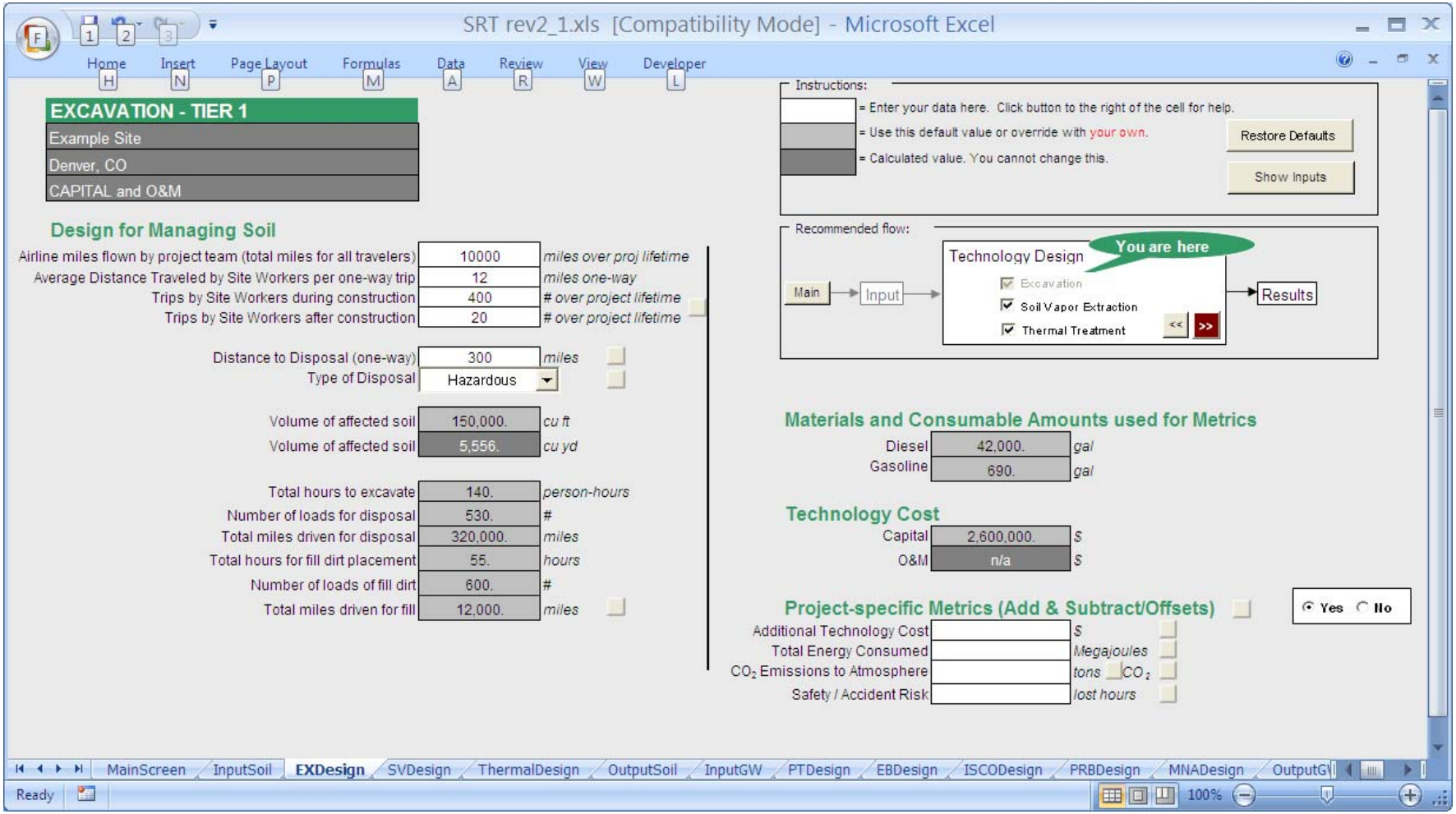
SRT General Inputs



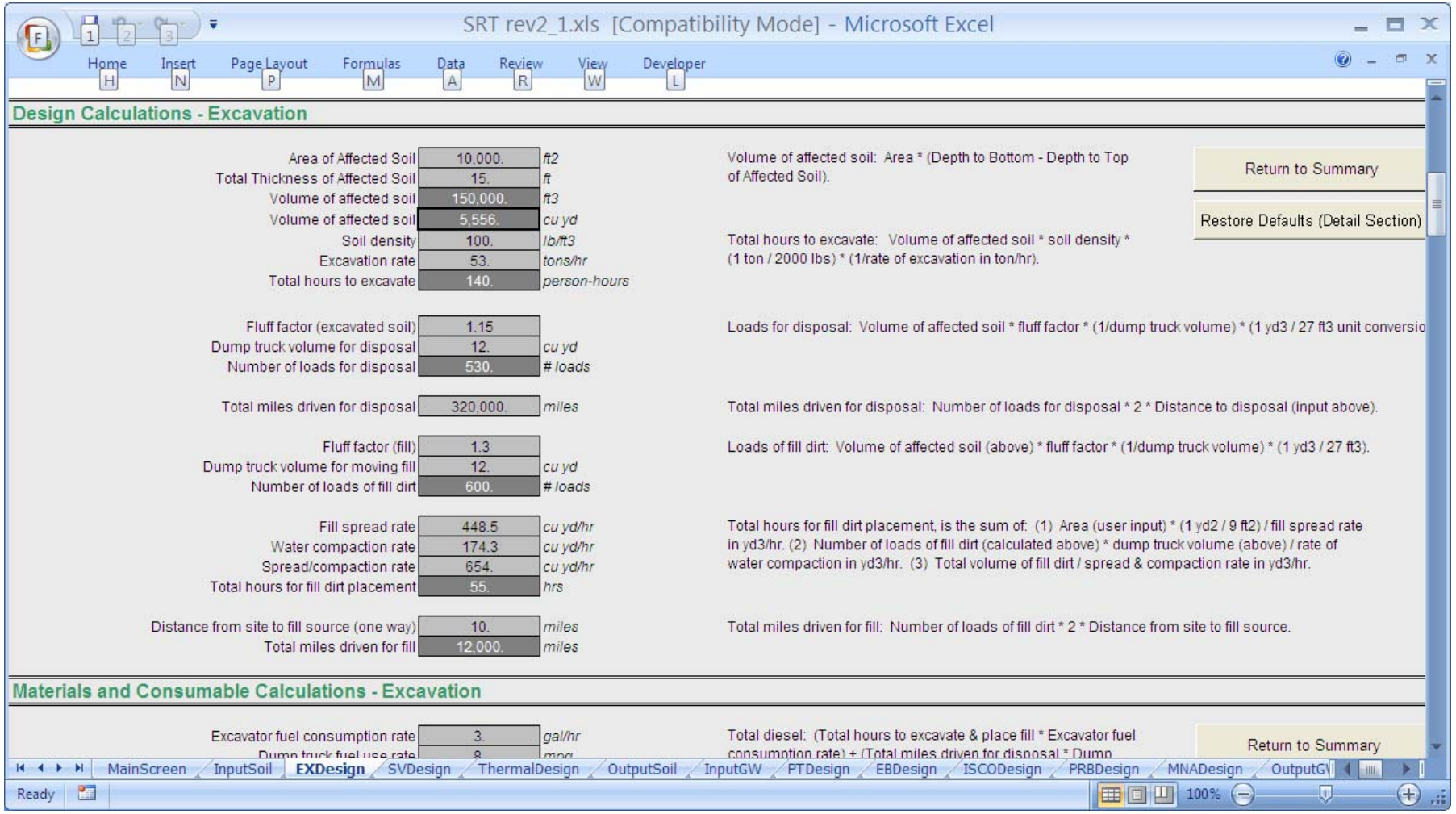
SRT Soil Inputs



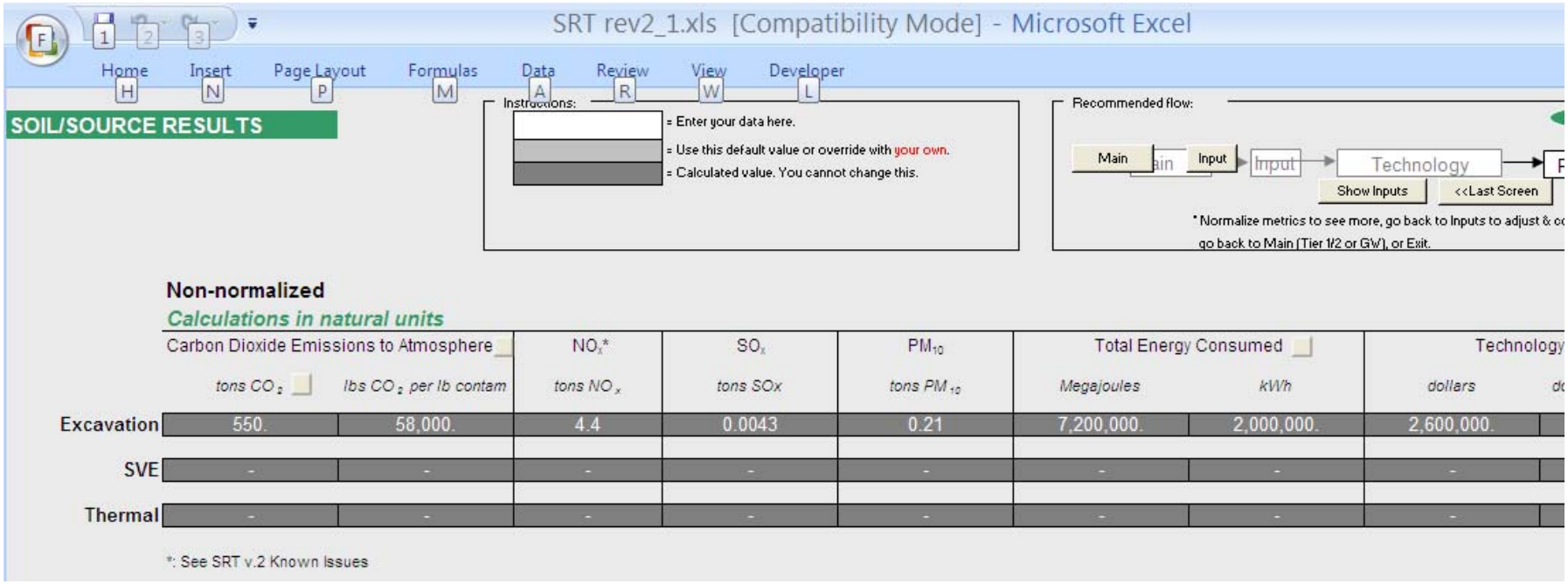
SRT Tier 1 - Excavation



SRT Tier 2 - Excavation



SRT Results Screen



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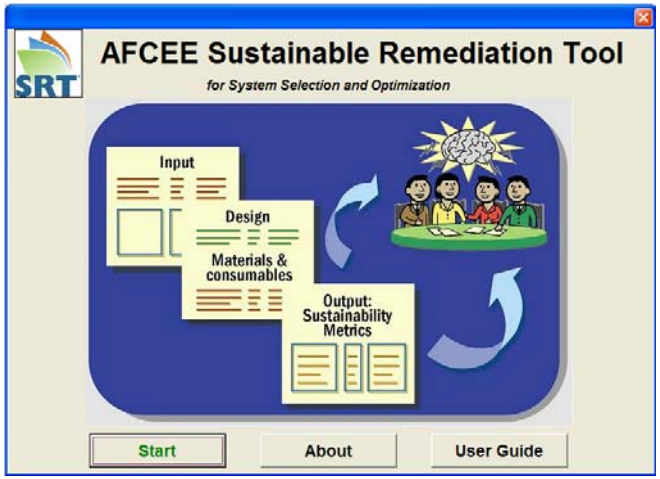


Optimization Scenario

Tier 2 Scenario – Soil Vapor Extraction

Inputs:

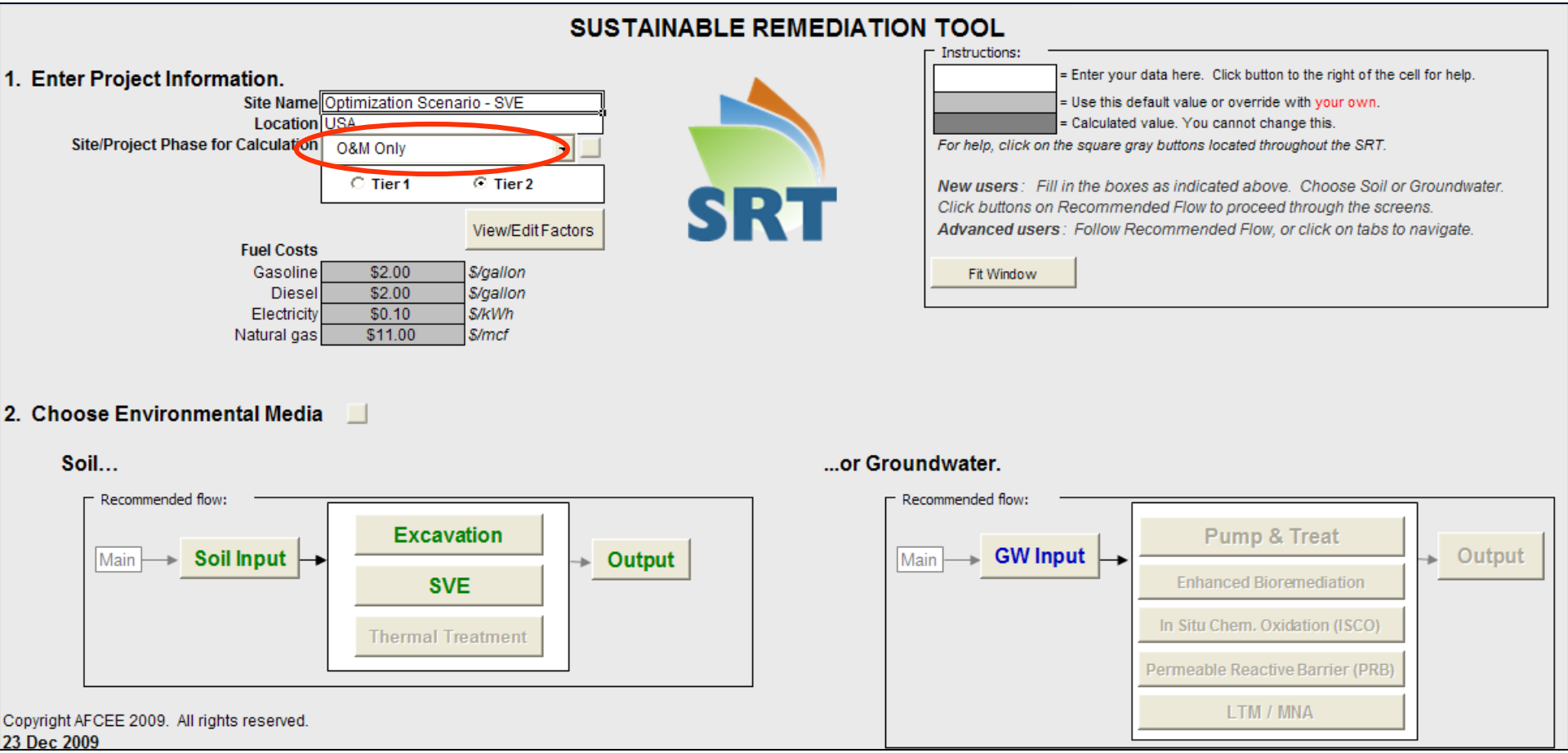
- Primary contaminant: trichloroethene (TCE)
- 300,000 ft^3 zone of contamination
- Typical concentration: 100 mg/kg; 3,000 lbs TCE
- Well-graded sand
- Average contaminated thickness: 12 ft
- 2-year duration
  - Year 1: Thermal Oxidizer
  - Year 2: Thermal Oxidizer or GAC?

Evaluation:

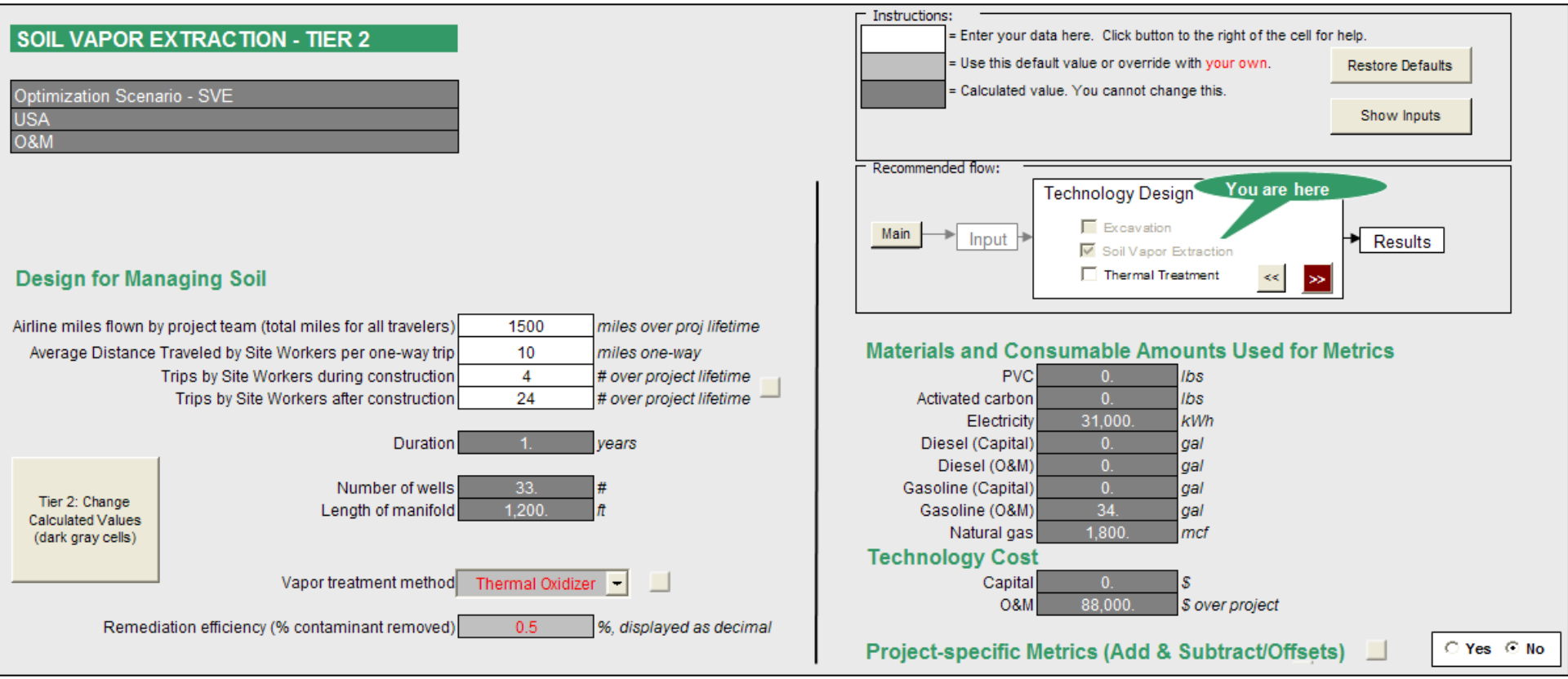
- Thermal Oxidizer (Year 2)
  compared with
- GAC (Year 2)

Key Question: What are the changes in sustainability metrics that would result from optimizing vapor treatment to GAC in Year 2?

Optimization Scenario



Optimization Scenario



SOIL VAPOR EXTRACTION - TIER 2

Optimization Scenario - SVE
USA
O&M

Instructions:
= Enter your data here. Click button to the right of the cell for help.
= Use this default value or override with your own.
= Calculated value. You cannot change this.
Restore Defaults
Show Inputs

Recommended flow:
Main → Input → Technology Design (You are here)
Excavation
Soil Vapor Extraction
Thermal Treatment
<< >>
→ Results

Design for Managing Soil

Airline miles flown by project team (total miles for all travelers)	1500	miles over proj lifetime
Average Distance Traveled by Site Workers per one-way trip	10	miles one-way
Trips by Site Workers during construction	4	# over project lifetime
Trips by Site Workers after construction	24	# over project lifetime
Duration	1.	years
Number of wells	33.	#
Length of manifold	1,200.	ft
Vapor treatment method	Thermal Oxidizer	
Remediation efficiency (% contaminant removed)	0.5	%, displayed as decimal

Tier 2: Change Calculated Values (dark gray cells)

Materials and Consumable Amounts Used for Metrics

PVC	0.	lbs
Activated carbon	0.	lbs
Electricity	31,000.	kWh
Diesel (Capital)	0.	gal
Diesel (O&M)	0.	gal
Gasoline (Capital)	0.	gal
Gasoline (O&M)	34.	gal
Natural gas	1,800.	mcf

Technology Cost

Capital	0.	$
O&M	88,000.	$ over project

Project-specific Metrics (Add & Subtract/Offsets)
Yes No

Optimization Scenario

Year 2 Thermal Oxidizer: "Non-normalized" Metrics

CO_2 Emissions……130 tons
lb CO_2 / lb contaminant……1,700 lb / lb

NO_x Emissions……0.3 tons
SO_x Emissions……0.24 tons
PM_{10} Emissions……0.047 tons

Energy Consumed……2,100,000 Megajoules

Cost……$88,000
Cost / lb contaminant……$300 / lb

Safety / Accident Risk……4×10^{-4} injury risk
Lost work-time……0.021 lost hours

Change in Resource Service
Economic……Net gain
Ecologic……Net gain

Optimization Scenario

Year 2 Thermal Oxidizer: "Normalized" Metrics

CO_2 Emissions	$260
Energy Consumed	$23,000
Cost (minus energy costs)	$65,000
Change in Resource Service	-$1,600
TOTAL	$87,000

Gains reduce the total cost

Converting metrics to dollars gives a common baseline.

Optimization Scenario

Year 2 GAC: "Non-normalized" Metrics

CO_2 Emissions……..27 tons
lb CO_2 / lb contaminant……..360 lb / lb

NO_x Emissions……..0.13 tons
SO_x Emissions……..0.24 tons
PM_{10} Emissions……..0.044 tons

Energy Consumed……370,000 Megajoules

Cost……$68,000
Cost / lb contaminant……$230 / lb

Safety / Accident Risk……5×10^{-4} injury risk
Lost work-time……0.025 lost hours

Change in Resource Service
Economic……Net gain
Ecologic……Net gain

Optimization Scenario

Year 2: GAC vs. Therm Ox: "Normalized" Metrics

	GAC	ThermOx
CO_2 Emissions	$54	$260
Energy Consumed	$3,400	$23,000
Cost (minus energy costs)	$65,000	$65,000
Change in Resource Service	-$1,600	-$1,600
TOTAL	$67,000	$87,000

Stakeholders can then decide which metrics are most important for the given site.

Optimization Scenario

Stakeholder Roundtable Feature: Reaching a Consensus

SOIL/SOURCE ROUND TABLE - WEIGH THE RESULTS

	Person 1	Person 2	Person 3	Person 4	Person 5
Carbon Dioxide Emissions to Atmosphere	High	Medium	Low	Don't Use	Medium
Total Energy Consumed	Medium	Low	Don't Use	High	Medium
Technology Cost	Low	Don't Use	High	Medium	Low
Change in Resource Service for Land	High	Medium	Low	Don't Use	High

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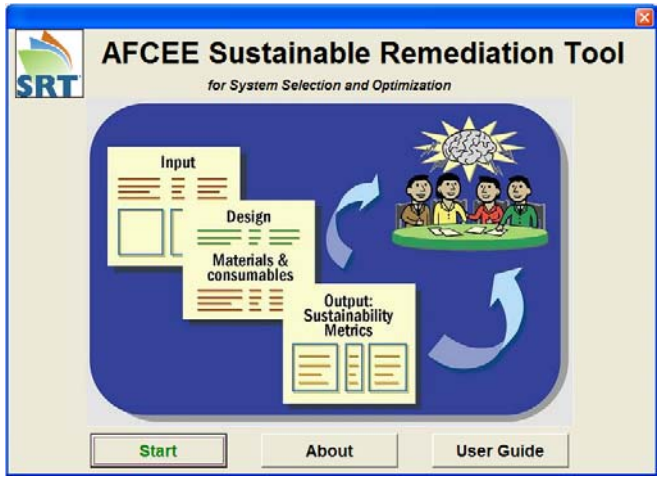


Conclusions

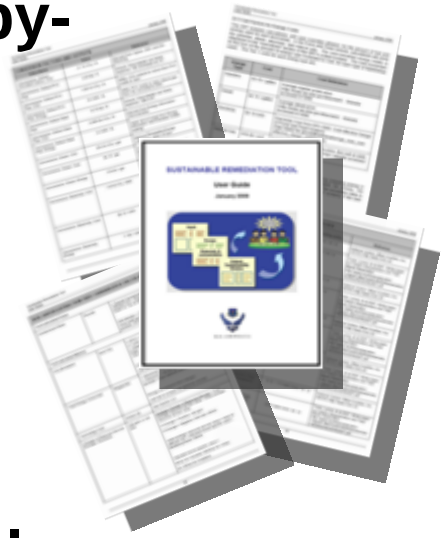
Sustainable Remediation Tool (SRT) Distribution

Available as free download from US Air Force (AFCEE)

www.afcee.af.mil/resources/technologytransfer/programsandinitiatives/sustainableremediation

Conclusions

- **SRT Strengths**
  - **Evaluates sustainability metrics**
  - **Screens / Compares technologies side-by-side**
    - **Up to 8 different technologies at once**
  - **Two tier options for user**
  - **Scenarios feature**
  - **Stakeholder roundtable feature**
  - **Capable of using inputs from design tools**
  - **Will have validated costing model (RACER™) interaction in next release**



Questions / Discussion