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TECHNICAL REPORT
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FINAL TECHNICAL REPORT FOR APPLICATION OF FLOW AND TRANSPORT OPTIMIZATION CODES TO GROUNDWATER PUMP AND TREAT SYSTEMS – VOLUME III

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FINAL TECHNICAL REPORT, VOLUME III

FOR

APPLICATION OF FLOW AND TRANSPORT OPTIMIZATION CODES TO GROUNDWATER PUMP AND TREAT SYSTEMS

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Phase 1 Demonstration Plan

Technology Demonstration Plan
for
Application of Flow and Transport Optimization Codes to Groundwater Pump and Treat Systems
Part 1: Pre-Optimization Screening

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ACROYNYMS AND ABBREVIATIONS

DOD	Department of Defense
EPA	Environmental Protection Agency
ESTCP	Environmental Security Technology Certification Program
FY	Fiscal year
gpm	Gallons per minute
H	High
L	Low
M	Medium
NPV	Net present value
O&M	Operating and maintenance
SVE	Soil vapor extraction

1. Introduction

1.1 Background

The 1998 DoD Inspector General report indicates that the cumulative operating and maintenance (O&M) costs for 75 pump and treat systems operating at DoD chlorinated solvent groundwater sites (a subset of over 200 DoD pump and treat sites) was $40 million in FY 1996, and these costs are projected to reach $1 billion in the year 2020. Recent studies completed by the EPA and the Navy indicate that the majority of pump and treat systems are not operating as designed, have unachievable or undefined goals, and have not been optimized since installation. Even under ideal circumstances, (i.e., when the initial pump and treat system has been appropriately designed with clearly-defined objectives), changes in contaminant distributions and aquifer stresses, alongside evolving regulatory climates result in the need for system optimization. Although it is recognized that many of these pump and treat systems are ineffective for cleanup, it must be realized that to comply with existing regulations, they will continue to operate until the “silver bullet” solution is developed. In the interim, the potential for tremendous cost savings exists with the application of simple screening tools and optimization-simulation modeling. The optimization-simulation models link mathematical optimization techniques with simulations of groundwater flow and/or solute transport, to determine the best combination of well locations and pumping rates.

1.2 Official DoD Requirement Statement(s)

Service	**Requirement #**	**Requirement Title**	**Priority (H,M,L)**
Army	A(1.5.o)	Development of Predictability Model for In-Situ Groundwater Treatment (Containment/Movement)	L
Air Force	2008	Methods and Remedial Techniques are Needed to More Effectively Treat Groundwater Contaminated with Chlorinated Solvents	M
Navy	1.I.1.e	Improved remediation of groundwater contaminated with non-chlorinated hydrocarbons	M
Navy	1.I.1.g	Improved remediation of groundwater contaminated with chlorinated hydrocarbons and other organics	H
Navy	1.II.1.a	Improved fate, effects and transport models for groundwater	M

This project addresses the optimization of pump and treat systems that have been installed to contain and/or remediate groundwater contamination by dissolved chemicals. Optimization will be performed by coupling optimization algorithmns to groundwater flow and transport models to select the best combination of well locations and pumping rates needed to achieve a particular pump and treat design objective. The application of mathematical optimization codes to optimize a pump and treat system can greatly reduce the total life cycle O&M costs for a pump and treat system while allowing remedial objectives to be accomplished more quickly. Finally, this mathematical approach to optimizing pump and treat systems requires up-to-date and accurate groundwater flow and transport models and will encourage their development.

1.3 Objectives of the Demonstration

The primary objective of the overall project is to demonstrate the cost benefit of applying transport optimization codes, which couple sophisticated optimization techniques (nonlinear programming) with simulations of groundwater solute transport. The effectiveness of the optimization codes will be evaluated by comparing the results to a *trial and error* optimization, which will be performed independently and in the same schedule.

The trial and error optimization, which will be performed by HSI GeoTrans, is anticipated to incorporate hydraulic optimization tools (MODMAN Version 4.0) to solve surrogate optimization problems that are based only on groundwater flow components. This independent analysis will allow the primary objective (to demonstrate the cost benefit of applying transport optimization codes) to be properly evaluated, because it specifically compares solutions obtained for the same problem and same transport model, but without the optimization techniques. These issues will be discussed more thoroughly in the forthcoming Technology Demonstration Plan, Part 2: Demonstration of Transport Optimization Codes.

A past project, sponsored by the US EPA (US EPA, 1999a,b), demonstrated potential savings of millions of dollars in O&M costs over the projected lifetime of the pump and treat system at two of three sites from the application of hydraulic optimization, which couples simpler optimization techniques (linear and mixed-integer programming) with simulations of groundwater flow (but not transport). Transport optimization techniques are potentially more powerful, because they not only look at optimization to accomplish hydraulic containment of the contaminant, but also optimization to reduce contaminant concentrations to reach a desired cleanup goal; however, transport optimization codes are also more complex than hydraulic optimization codes.

This Demonstration Plan (Part 1) pertains to the first phase of the overall project, which involves development and application of a screening methodology. The objective is to prioritize sites on the basis of optimization potential, in terms of potential cost savings likely to result from an optimization-simulation evaluation. Twelve existing pump and treat systems at DoD installations will be utilized for this effort. (The criteria used to select these twelve sites is discussed in Section 3.1.) The resulting screening methodology will be a valuable tool for determining the potential cost savings from hydraulic and/or transport optimization at other DoD facilities.

Based on the application of the screening methodology, three of the twelve sites will be selected for the next phase of work (i.e., demonstration of transport optimization codes), which will be described in a separate Demonstration Plan (i.e., Part 2).

1.4 Regulatory Issues

For the first phase of work, which involves site screening to evaluate optimization potential, there are no regulatory issues that will need to be directly addressed beyond those that have constrained the design and operation of the pump and treat systems being examined.

2. Technology Description

2.1 Background and Applications

This ESTCP Technology Demonstration Plan (i.e., Part 1) addresses the use of a screening process to evaluate pump and treat systems at twelve sites, and the selection of three of those sites for subsequent application of transport optimization codes. The screening tool that will be applied was initially developed for use on an earlier EPA hydraulic optimization demonstration study of groundwater pump and treat systems (US EPA, 1999a). The tool is in a spreadsheet format and encompasses the following components:

- annual O&M costs, both current and anticipated;

- the time horizon for each annual O&M item, both current and anticipated;

- costs of performing optimization analyses;

- costs of potential system modifications; and

- the discount rate to calculate the net present value (NPV) of future costs.

A sample of the screening spreadsheet developed for the EPA study is provided in Appendix B. Note that this spreadsheet will serve as a launching point for this screening effort, and that it will be tailored and refined during the evaluation of additional pump and treat sites for transport optimization potential. Examples of improvements include adding components that consider the tradeoff where higher annual costs are desired to achieve a quicker cleanup. As is the case for any design decision based on predictive simulations, it will not be possible in the short run to demonstrate actual reductions in product life cycle.

Annual O&M cost components for typical pump and treat systems include electricity, parts, chemicals/materials, labor, disposal, and analytical expenses. The transport optimization process assumes that the existing cleanup goals can be accomplished more quickly and/or more efficiently. It is based on the premise that some of the total life cycle O&M costs (i.e., annual O&M costs multiplied the anticipated duration of system operation) for a pump and treat system depend on the pumping locations and pumping rates (which in turn also determine the total pumping rate and/or estimated system duration). However, the extent to which the pumping locations and pumping rates impact system costs is site specific and should be determined in advance of conducting transport optimization -- hence, the role of the screening process.

The screening process includes the compilation of annual O&M costs for specific sites, plus calculations to estimate potential cost reductions that might result from realistic modifications to pumping rates and/or pumping locations at each site (e.g., what if system duration could be cut by 30% or what if total pumping rate could be cut by 30%. These issues will be addressed in the forthcoming Technology Demonstration Plan for Application of Flow and Transport Optimization Codes to Groundwater Pump and Treat

Systems, Part 2: Demonstration of Transport Optimization Codes). Capital costs associated with system modifications, including the costs of the mathematical optimization, are accounted for. If after accounting for the cost of the optimization analyses and system modifications, total life cycle O&M cost savings can be realized, then the site may benefit from a transport optimization analysis approach. Transport modeling can provide useful information, such as estimates of mass removal rates, for hydraulic containment remedies. However, designs for such remedies are typically based on hydraulic information provided by a groundwater flow model and typically do not require the development of a transport model.

Note that if cleanup (i.e. groundwater restoration to regulatory levels) is not considered a realistic objective at the site, yet there is potential to reduce annual O&M costs by system modifications, hydraulic optimization, rather than transport optimization, is the recommended approach. Thus, the end product of the fully developed screening tool will be to segregate sites that could benefit from a transport optimization analysis approach as the first tier, sites that could benefit from a hydraulic optimization analysis approach as a second tier, and sites that would not benefit from either approach as the third tier. Only sites that meet the first tier criteria will be considered as demonstration sites for this project.

The screening process will prioritize twelve candidate pump and treat systems by the quantity of potential cost savings from the application of transport optimization codes. A final aspect of the screening process is to evaluate qualitative factors, such as the willingness of the installation to implement (i.e., fund) system modifications based on results from an optimization effort. It will also consider if there is a favorable regulatory, community and political environment that will support such system modifications within the timeframe of the overall project.

Beyond the use of a screening process to select pump and treat sites for this project, this methodology has more general application to the selection of an appropriate optimization strategy for any given pump and treat system. This is discussed further in Section 2.2.

2.2 Advantages and Limitations of the Technology

Although a pump and treat system may be well designed based on existing data, changes in contaminant distribution (e.g. with the implementation of an aggressive source removal technology), changes in the regulatory climate or regulations, or the availability of new site data may necessitate or make favorable the consideration of pump and treat system modifications. Usually some decision-making process is involved with selecting a cost-effective approach to making these modifications.

The pre-optimization screening tool is a simple spreadsheet approach that allows the user to compare current operating and maintenance costs to the estimated costs of a modified system. By requiring the user to assemble the operating and maintenance costs of a current system, identifying the system objectives, and considering alternative pumping scenarios, the spreadsheets assist in prioritizing an optimization strategy for the site. The cost of conducting a screening analysis is expected to be minimal in comparison to the overall remediation costs at a site.

Typically there are several remediation strategies to consider for a given plume (e.g., containment only, containment plus aggressive mass removal, containment of a smaller region, etc.), and multiple potential design options for each(e.g., change in well locations, change in well rates, etc.). Total costs (NPV) are estimated for each alternative pumping scenario, and compared to the total cost of a baseline system (usually the existing system unless system modifications are already in progress). The screening analysis therefore determines which, if any, remediation alternatives are worth pursuing.

The results of the screening analysis also provide a basis for prioritizing subsequent design activities. For example:

• if the screening analysis indicates that system costs are driven by cleanup time and reduction in cleanup time is considered to be technically feasible, then additional design effort may be focused on reducing cleanup time (e.g., use of transport optimization to evaluating options for containment of source areas and aggressive pumping of dissolved plumes);
• if the screening analysis indicates that system costs are driven by total pumping rate, then additional design effort may be focused on minimizing total pumping rate (e.g., hydraulic optimization to minimize pumping required for containment);
• if the screening analysis indicates that system costs are driven by groundwater treatment and/or discharge costs, and alternate technologies are potentially feasible, then additional design effort may be focused on technology optimization (e.g., technology review, pilot testing, etc.).

(Note that the above is an example of the three-tier system mentioned in Section 2.1.)

Finally, this approach also helps to identify politically or socially unfavorable pumping scenarios from the outset. The ESTCP project team has not identified any similar screening tools that combine qualitative and quantitative aspects associated with pump and treat system improvement.

The success of the pre-optimization screening approach can be limited by the accuracy of O&M costs used in the screening analysis and the availability of data to verify the accuracy of the existing groundwater flow or transport model. These may result in an overestimate or underestimate of potential cost savings.

3. Pre-Demonstration Activities

3.1 Selecting Sites

Phone interviews were conducted by members of the project team to identify candidate pump and treat sites within the DoD for this project. Sites were first screened to meet the following set of criteria:

- Total pumping rate is at least 50 gpm;
- A flow model is documented, and is considered up-to-date and valid for design purposes by the Site and the regulators; and
- A transport model is documented, and is considered up-to-date and valid for design purposes by Site and the regulators (or it is considered realistic that the transport model can be completed, documented and considered valid for design purposes by Site and regulators within six months of selection for transport optimization).

For sites meeting these criteria, additional data are being collected. This is discussed further in Section 5.2. The following criteria will be applied to select 12 candidate sites for the pre-optimization screening.

- Annual O&M costs at least $100K/yr;
- Time horizon for pump and treat system operation is at least 5 years;
- Pump and treat system is operating
- Up-to-date plume maps for key contaminants exist; and
- Interest in participating on this project.

The criteria for minimum total pumping and minimum annual O&M cost remove sites with limited opportunity for significant cost savings using a transport optimization approach. The criteria pertaining to the existence of adequate flow and transport models eliminates sites for which a subsequent transport optimization analysis would not be possible within the time frame of this demonstration project. In addition, the selection of the twelve sites will incorporate the following preferences:

- simple to moderate complexity is preferred (e.g., more than 10 model layers, if actually required to provide adequate simulation, is probably too complex for this study)
- a single-phase, porous-media model simulating flow/transport in the saturated zone is preferred (i.e., multi-phase codes and/or saturated/unsaturated codes and/or specialized fracture-flow codes are more complex, subject to greater uncertainty, and generally require more simulation time than is appropriate for this demonstration project)

These preferences eliminate sites where excessive complexity would prevent the timely completion of the subsequent transport optimization simulations, and/or obscure the discussion of the case study in the final report.

The twelve pump and treat systems will be selected from among the list of sites provided in Table 3.1.

Table 3.1 Candidate Sites for Pre-Optimization Screening

Facility/Site	Flowrate (gpm)	Flow Model	Transport Model
Tooele Army Depot, UT	7000	✓	✓
Cornhusker Army Ammunition Plant, NE	600	✓	✓
Umatilla Army Depot, OR	1300	✓	✓
Twin Cities Army Ammunition Plant, MN	2000	?	?
Shaw Air Force Base, SC	250-300	✓	✓
McClellan Air Force Base, CA	1100-1200	✓	✓
Wurtsmith Air Force Base, MI	750	✓	?
George Air Force Base, CA	5-6 (upper aquifer) 100 (lower aquifer)	✓	
Wright-Patterson Air Force Base, OH	400-600	✓	?
Naval Air Engineering Station Lakehurst, NJ	500	✓	✓
Marine Corps Air Station Cherry Point, NC	90	✓	✓
Marine Corps Air Station Yuma, AZ	200	✓	?

3.2 Pre-Demonstration Sampling and Analysis

No groundwater sampling and analysis will be performed as part of this project. During the pre-optimization screening process, existing plume maps for key contaminants will be compiled and evaluated to understand the prevailing or "baseline" contamination scenario. This must be done to understand the remedial objectives. Confirmation will be requested from the installation to establish that the plume maps represent the most current understanding of contaminant distribution for the site.

A related issue is the extent to which the plume delineation may change during the extent of the overall project. At most facilities with operating pump and treat systems, groundwater monitoring is conducted on a regular basis. This updated groundwater concentration data can be used to recalibrate the groundwater models, further characterize source areas, and alter remedial objectives. For the first phase of the project (the focus of this Demonstration Plan) these issues are not a concern, because the time frame of the screening phase is limited to several months. However, the subsequent phases of this project (i.e., the transport optimization modeling) will occur over a longer time frame, and it will be necessary to establish a fixed set of plume maps and groundwater models to be used for the demonstration project. That issue will be addressed in Part 2 of the Demonstration Plan, to be submitted at a later date.

4. Site/Facility Descriptions

A table listing the twelve sites being evaluated in Phase 1 of this project was provided in Section 3. Basic information about these sites is included in that table. Detailed information regarding history and characteristics of these twelve sites (including maps and photographs) is not appropriate for Phase 1 of this project, which is the subject of this Demonstration Plan. This will be addressed in Part 2 of the Demonstration Plan, to be submitted at a later date, that will summarize the results of the pre-optimization screening and provide detailed site information for each of the three sites selected for the transport optimization modeling.

5. Demonstration Approach

5.1 Performance Objectives

There are two objectives for this pre-optimization screening effort (Phase 1 of the overall project). The first objective is to select three sites for the application of transport optimization codes. The second objective is to develop a robust screening tool that will enable remedial project managers to determine if mathematical optimization (i.e. transport or hydraulic optimization) could potentially reduce the O&M costs of their pump and treat systems. It is not feasible for the screening tool to provide a rigorous analysis of all variables. Rather, the screening tool will provide estimates and calculations based on site-specific data, and will provide a preliminary indication of the potential net benefit from optimization. Using the tool will help prioritize sites for the more detailed simulation-optimization evaluation.

The accuracy of this pre-optimization screening effort in selecting sites amenable to the transport optimization approach will be evaluated by comparing the anticipated cost savings (Phase 1 of the overall project) to the projected cost savings after application of the optimization codes (Phase 2 of the overall project). Any significant deviation (e.g. greater than 50%) between anticipated cost savings (before the optimization modeling) and projected cost savings (after the optimization modeling) will be examined and used to further refine the pre-optimization screening tool or will be adequately explained if it is determined that the result determined by the optimization modeling could not have been be reasonably predicted by a screening tool.

5.2 Demonstration Setup, Commencement, and Operation

For the pre-optimization screening effort (Phase 1 of the overall project), data will be compiled for each of the twelve sites. The data to be collected as well as some of the evaluations to be made for each site includes:

- hydrogeology
  - description of aquifers/aquitards
  - approximate depth to groundwater
  - maps indicating water levels and flow paths
  - conceptual model of groundwater flow
  - factors that make system transient (if any)

- contamination
  - list of key contaminants
  - current plume maps for key contaminants in each aquifer of concern
  - description and status of contaminant sources (e.g., known? removed?)
  - degree to which system can be evaluated on the basis of one key constituent
- remediation system
  - how long has it been operating
  - number of pumping/injection wells
  - typical pumping/injection rates at each well
  - treatment processes
  - statement of objectives and constraints for pump and treat system
  - anticipated system duration
  - assessment as to whether system constraints (e.g. containment) are being met
  - annual O&M costs by category (e.g., electric, materials, etc.)
- modeling
  - flow model (e.g., which code, when performed, how documented, etc.)
  - transport model (e.g., which code, when performed, how documented, etc.)

other factors
  - willingness of site and regulators to consider implementing recommendations
  - availability of leveraged funding for implementing recommendations

These data will be compiled by requesting appropriate Site documents, such as Design Reports, O&M Manuals, Monthly/Quarterly/Annual Reports, and Modeling Reports. Information pertinent to the screening that is not contained in these reports will be collected via phone interview, or if necessary by conducting a one-day site visit.

The data collected for each site will be summarized on an Information Form (to be developed). This will be based on the screening spreadsheet information collected for the EPA hydraulic optimization study in Appendix B, as well as a preliminary data collection form provided in Appendix C. The exact data fields to be included on the information form will be developed from a comprehensive assessment of the types of data that are necessary to screen sites for transport optimization potential.

For each of the three sites selected for complete optimization analysis, locations of monitoring wells and previously completed studies addressing increased/decreased pumping rates will be compiled and described in the final project report. Information regarding the original installation costs will be collected for each site to the extent that they add to the development of the problem formulations (objective functions and constraints.) However, a complete report of all past expenditures, or sunk costs, will not be required to develop and evaluate potential system modifications.

5.3 Technical Performance Criteria

5.3.1 Contaminants. The overall project will apply to any contaminants for which fate and transport in the saturated zone can be adequately simulated by a numerical transport model. One limitation is that numerical transport models operate most efficiently when a single constituent is simulated (in some cases, this single constituent can represent a composite of multiple actual constituents). For the transport optimization phase of this project, it is assumed that the transport optimization will involve one consituent, to simplify the demonstration (although the general methodology is not limited by this issue). For this reason, the degree to which the performance of the remedial system can be evaluated on the basis of one key constituent will be evaluated as part of the site screening phase.

5.3.2 Process Waste. Not applicable. No process wastes will be generated for the work specifically being performed by this computer-modeling project. The volumes and related costs of process waste for the actual remediation systems will be included in the evaluation of the baseline system and potential alternative systems (including potential changes in volumes/costs for a revised system).

5.3.3 Factors Affecting Technology Performance. For the pre-optimization screening effort (Phase 1 of the overall project), the actual calculations associated with the screening methodology are expected to be both simple and robust. Factors that could impact the successful implementation of the screening methodology include:

- Unwillingness of site to provide detailed cost data
- Unavailability of modeling reports to adequately assess previous modeling efforts
- Ongoing modifications to pump and treat system or groundwater model(s)
- Inability of site to clearly state remediation objectives
- Uncertainty in estimating system duration for current system and potential revised systems

5.3.4 Reliability. For the pre-optimization screening effort (Phase 1 of the overall project), there are no issues regarding potential breakdowns of the equipment and sensitivity to environmental conditions. However, the reliability of the results (i.e., estimates of potential cost savings) will be impacted by the accuracy of the data collected (e.g., costs, estimated system duration, etc.) for the current system, and the accuracy of estimates regarding potential cost savings that might result from an optimization analysis (e.g., how much annual costs would be reduced by a lower pumping rate, or how much of a reduction in system duration might be achieved as a result of transport optimization).

5.3.5 Ease of Use. For the pre-optimization screening effort (Phase 1 of the overall project), the goal is to create a logical and user-friendly tool that can be used by geologists or engineers that have elementary knowledge of hydrogeology, contaminant transport and the design of their pump and treat system. The ability to use a spreadsheet is assumed. No special training is anticipated.

5.3.6 Versatility. For the pre-optimization screening effort (Phase 1 of the overall project), the goal is to create an approach that is valid for all pump and treat systems. The screening approach will not be designed specifically to assess optimization potential for other types of remedial systems (e.g., SVE, passive barrier walls, etc). However, applying the screening method at a site may instigate the consideration of beneficial system modifications other than those associated with a subsequent pumpage optimization (e.g., alternate treatment technologies, revised remediation goals or constraints, alternate materials, etc.). Therefore, the benefits of applying the screening method may extend beyond the evaluation of optimization potential related to pumping rates and pumping locations.

5.3.7 Off-the-Shelf Procurement. For the pre-optimization screening effort (Phase 1 of the overall project), commercially available spreadsheet software will likely be utilized. This is not expected to limit the application of the screening techniques by interested parties.

5.3.8 Maintenance. Refer to Section 6.2.

5.3.9 Scaleup Issues. Not applicable.

5.4 Sampling Plan. Not applicable; no sampling will be conducted specifically for the ESTCP optimization effort.

6. Data Collection, Storage, and Archiving Procedures

6.1 Data Format

The results of the Part 1 pre-optimization screening will be documented in a Word file. The pre-screening optimization tool generated will be in the form of a commercially available spreadsheet (e.g., Excel).

6.2 Data Storage and Archiving Procedures

The Part 1 pre-optimization screening results and the pre-screening optimization tool will be electronically stored by the Navy and the EPA. Both will be submitted to ESTCP in paper and electronic formats for archiving. Additionally, at least one website (maintained by either the Navy or EPA) will be created where completed and approved documents and tools generated during the project will be accessible to users.

7. Cost Performance Criteria

Although all ESTCP project costs will be tracked, this section is not applicable to the Part 1 pre-optimization screening process, which is being conducted to select demonstration sites for the Part 2 effort and to develop a technology transfer tool that can be used by remedial project managers to determine the applicability of mathematical optimization to their pump and treat systems.

8. Regulatory Issues

There are no regulatory issues to be addressed in conducting this Part 1 Pre-optimization screening effort.

9. Quality Assurance Plan

No samples will be collected for this Part 1 effort; therefore, a Quality Assurance Plan is not needed.

10. Health and Safety Plan

No fieldwork will be conducted for this Part 1 effort; therefore a Health and Safety Plan is not required.

11. References

1. USEPA, 1999a. *Hydraulic Optimization Demonstration for Groundwater Pump and Treat Systems, Volume I: Pre-Optimization Screening (Method and Demonstration).* EPA/542/R-99/011A, December 1999.

2. USEPA, 1999a. *Hydraulic Optimization Demonstration for Groundwater Pump and Treat Systems, Volume II: Application of Hydraulic Optimization.* EPA/542/R-99/011B, December 1999.

12. Dated Signature of Project Lead

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Appendix B
Format of the screening spreadsheet used in the EPA Study

(US EPA, 1999a)

This is an example of the format for the screening spreadsheet. To perform the screening analysis, a spreadsheet in this format is filled out for the current system, and additional spreadsheets are filled out for potential optimization scenarios (e.g., assume pumping rate is cut by 33% as a result of system optimization, estimate resulting O&M cost components and required capital costs for system modification, and calculate total costs). The total costs for each scenario are compared to the total costs for the current system to assess the likely net benefits of performing a detailed optimization analysis in an attempt to achieve the assumed pumping rate reduction.

Site: Acme
Scenario: Sample

Discount Rate: 0.05

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs (NPV)	Total Costs (NPV)
O&M Costs					
-Electric	$0	$160,000	20	$2,093,651	$2,093,651
-Materials (pH adjustment)	$0	$67,000	20	$876,716	$876,716
-Maintenance	$0	$50,000	20	$654,266	$654,266
-Discharge Fees	$0	$0	20	$0	$0
-Monitoring	$0	$250,000	20	$3,271,330	$3,271,330
-Analytical	$0	$0	20	$0	$0
-Steam	$0	$800,000	20	$10,468,257	$10,468,257
-Labor	$0	$0	$0	$0	$0
-Waste Disposal	$0	$0	$0	$0	$0
-Administrative Expenses for Monitoring	$0	$0	$0	$0	$0
-Other 2	$0	$0	20	$0	$0
-Other 3	$0	$0	20	$0	$0
Costs of Analysis					
-Flow Modeling	$25,000	$0		$0	$25,000
-Transport Modeling	$0	$0		$0	$0
-Optimization	$15,000	$0		$0	$15,000
-Other 1	$0	$0		$0	$0
System Modification Costs					
-Engineering Design	$40,000	$0		$0	$40,000
-Regulatory Process	$25,000	$0		$0	$25,000
-New wells/pipes/equipment	$0	$0		$0	$0
-New Monitoring	$0	$0		$0	$0
-Other 1	$0	$0		$0	$0
-Other 2	$0	$0		$0	$0
-Other 3	$0	$0		$0	$0
Total Costs	**$105,000**	**$1,327,000**		**$17,364,221**	**$17,469,221**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the Net Present Value (NPV). The PV function in Microsoft Excel is utilized to calculate NPV, with payments applied at the beginning of each year.

<u>Assumptions</u>
None

Appendix C
Preliminary Data Collection Form

(Completed for pump and treat sites meeting the initial criteria)

Note: Only brief (one word/one sentence) answers are required.

Site Background

Location of site?

DoD agency?

DoD point(s) of contact?

Regulatory agencies and points of contact?

Name of plume?

Hydrogeology and Contamination Overview

Is hydrogeology relatively simple or relatively complicated?

Factors present that make hydrogeology complex (e.g., fractures, karst, etc., nearby pumping)?

How many aquifers are affected by contamination?

Approximate depth to groundwater?

Types of contaminants requiring remediation (e.g., VOC's, metals, PCB's, etc.)?

How many contaminants require remediation (many or a few)?

Approximate plume extent (length/width) in each aquifer of concern?

Is source of contamination known?

Is there a continuing source of dissolved contamination (e.g., NAPLs in the saturated and/or unsaturated zone)?

Existing/Planned Remediation System

Is there an existing (i.e., operating) pump-and-treat system?

How long has it been operating?

Other technologies employed along with pump-and-treat?

Objectives of current system (cleanup versus containment)?

What must be accomplished to shut off the system?

Anticipated remediation time frame?

How many wells?

Total pumping rate?

Are pumping rates relatively constant over time (and if not, why)?

How is pumped water treated and discharged?

Annual O&M costs (ballpark lumpsum number is fine)?

What aspects cost the most?

Approximate costs of a new extraction well?

Are revised objectives being considered?

Any key limitations to remediation system (treatment plant capacity, drawdown limits, etc.)?

Is site willing to implement modifications based on optimization results?

Modeling

Does a flow model exist?

Code for flow model (e.g., MODFLOW, etc)?

When was flow modeling performed?

Was flow modeling documented in a report?

How many layers/rows/columns for flow model?

Is flow model considered up-to-date and useable for design purposes?

Does a transport model exist?

Code for transport model (e.g., MT3D, etc)?

When was transport modeling performed?

Was transport modeling documented in a report?

How many layers/rows/columns for transport model?

Is transport model considered up-to-date and useable for design purposes?

Other Factors

Any issues (political/social) that make this site attractive or unattractive for demonstration project?

Name of Person Completing Form:____

Phone #:_____________________________________E-mail address:________________________

Pre-Optimization Screening Draft Report

Environmental Security Technology Certification Program

Application of Flow and Transport Optimization Codes to Groundwater Pump and Treat Systems

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Screening Methodology for Determining Optimization Potential

DRAFT

APRIL 2001

PREPARED BY GEOTRANS, INC

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1. Introduction

1.1 Overall Project

The ESTCP transport optimization project addresses the optimization of pump-and-treat systems that have been installed to contain and/or remediate groundwater contamination by dissolved chemicals. Optimization will be performed by coupling optimization algorithms to groundwater flow and transport models to select the best combination of well locations and pumping rates needed to achieve a particular pump-and-treat design objective. The application of mathematical optimization codes to optimize a pump-and-treat system can greatly reduce the total life cycle O&M costs for a pump-and-treat system while allowing remedial objectives to be accomplished more quickly.

The primary objective of the overall project is to demonstrate the cost benefit of applying transport optimization codes, which couple sophisticated optimization techniques (nonlinear programming) with simulations of groundwater solute transport. This demonstration project is divided into two phases. Phase I is pre-optimization site screening and Phase II is the demonstration of transport optimization codes to three selected sites.

This report will discuss the development and application of pre-optimization screening methodology.

1.2 Purpose of Performing A Screening Analysis

The screening methodology is designed to help a site manager and/or regulator determine if a pump-and-treat site is likely to benefit from the application of transport optimization and/or hydraulic optimization. It prioritizes sites on the basis of optimization potential, in terms of potential cost savings likely to result from an optimization-simulation evaluation. Reasons for altering a pump-and-treat system design might include any or all of the following:

- Potential to reduce the total cost;
- Potential to speed cleanup;
- Revised contaminant distribution; and
- Revised regulations and/or regulatory climate

Design aspects to be considered for alternation might include:

- Total pumping rate;
- Locations of wells;
- Number of wells;
- Projected cleanup time;
- Treatment technology employed;
- Remediation goal (cleanup versus containment); and
- The target containment zone.

The screening analysis is two-step procedure. First, a general screening (three questions) suggests whether or not the site is likely to benefit from hydraulic and/or transport optimization. Then, if the user is interested in quantifying the potential cost savings from hydraulic and/or transport optimization, the second step allows quick and inexpensive cost comparison of competing alternatives. Total costs (NPV) are estimated for each alternative, and compared to the total cost of a baseline system (typically the existing system). The methodology is intended to classify sites into tiers as follows:

$ **Tier 1** applies to those sites that are likely to benefit from transport optimization.

$ **Tier 2** applies to those sites that are likely to benefit from hydraulic optimization.

$ **Tier 3** applies to those sites that are likely to benefit from neither.

A site may be classified as both Tier 1 and Tier 2 if it will potentially benefit from either optimization technology.

Advantages of this screening approach are:

$ It is easy to understand and apply;
$ It is based on estimates of cost factors (which can be as simple as "ballpark estimates"), and therefore can be applied very quickly and at little cost;
$ It provides a simple and consistent framework for organizing cost data for pump-and-treat systems; and
$ It instigates the consideration of alternatives to existing pump-and-treat designs.

1.3 Case Study Examples

Eleven sites with existing pump-and-treat systems were evaluated in this study:

$ Umatilla Army Depot, Hermiston, Oregon (hereafter called "Umatilla")
$ Tooele Army Depot, Tooele, Utah
$ George Air Force Base, Victorville, California
$ Wurtsmith Air Force Base, Oscoda, Michigan
$ Wright-Patterson Air Force Base, Ohio
$ McClellan Air Force Base, Sacramento, California
$ Shaw Air Force Base, Sumner, South Carolina
$ Cornhusker Army Ammunition Plant, Grand Island, Nebraska
$ Naval Air Engineering Station, Lakehurst, New Jersey
$ Marine Corps Air Station, Cherry Point, North Carolina
$ Marine Corps Air Station, Yuma, Arizona

This report will highlight the application to Umatilla. The screening for the other 10 sites is included in Appendix A.

1.4 Structure of This Report

This report is structured as follows:

- $ Section 2: Overview of Spreadsheet Screening Approach
- $ Section 3: Case Study: Umatilla
- $ Section 4: Discussion and Conclusions
- $ Section 5: References

2. Overview of Spreadsheet Screening Approach

2.1 Introduction to the Screening Methodology

The screening analysis is two-stage procedure:

- $ first, a general screening (three questions) suggests whether or not the site is likely to benefit from hydraulic and/or transport optimization

- $ then, if the user is interested in quantifying the potential cost savings from hydraulic and/or transport optimization, the second stage allows quick and inexpensive cost comparison of competing alternatives

The first stage is intended to quickly remove sites from consideration if they are not likely to benefit from either hydraulic or transport optimization. The user answers three questions regarding system annual O&M costs, system flow rate, and estimated cleanup time:

- $ Are O&M costs > $100K/year?
- $ Is the system flowrate > 50gpm?
- $ Is the estimated cleanup time > 5 years?

If the answer to all three questions are "Yes", a potential benefit from hydraulic and/or transport optimization is suggested, and the second stage (i.e., quantitative potential cost saving evaluation) is recommended.

In the second stage, the potential cost savings are calculated based on site-specific values estimated by the user. Then classification of sites into the three tiers is primarily based on potential cost savings calculated for specific scenarios. Information provided by the user includes:

- $ basic information regarding the current pump-and-treat system (e.g., objectives, costs, pumping rate, number of wells, status of modeling efforts, etc.)

- $ estimated cost changes for specific scenarios associated with modified pumping rates and/or modified number of wells

Potential cost savings are quantified for the following scenarios:

Table 2.1. Hydraulic Optimization Scenarios

	Pumping Rate	Number of New Wells	Reduction in Cleanup Time
Baseline	No change	No change	no change
Scenario 1*	- 33%	No change	no change
Scenario 2	- 33%	+ 33%	no change

**maximum potential cost savings for hydraulic optimization expected from this scenario*

Table 2.2. Transport Optimization Scenarios (Initial Screening)

	Pumping Rate	Number of New Wells	Reduction in Cleanup Time
Baseline	no change	no change	no change
Scenario 1	- 33%	no change	no change
Scenario 2	- 33%	+ 33%	no change
Scenario 2a	- 33%	+ 33%	-10%
Scenario 2b	- 33%	+ 33%	-20%
Scenario 2c*	- 33%	+ 33%	-30%

**maximum potential cost savings for transport optimization expected from this scenario*

The results from these scenarios are used to classify the sites into the Tiers described in Section 1.2, based on the calculated values of potential cost savings. For sites that are categorized as Tier 1 (i.e., likely to benefit from a transport optimization analysis), additional quantification can optionally be performed to determine if other potential scenarios merit consideration within the context of a transport optimization analysis:

Table 2.3. Additional (Optional) Transport Optimization Scenarios

	Pumping Rate	Number of Wells	Reduction in Cleanup Time
Scenario 3	no change	+ 33%	0 to -30%
Scenario 4	+ 33%	no change	0 to -30%
Scenario 5	+ 33%	+ 33%	0 to -30%

2.2 Steps in the Screening Process

The screening process is implemented in twelve Excel worksheets (although user input is only required in one of the worksheets, with optional user input in two other worksheets).

The first worksheet (*"Readme"*) gives a brief overview of the inputs required by the user. The screening steps are listed below (associated worksheet names are listed in italics):

- **Step 1:** enter information into a spreadsheet (*"General_Screening"*). If the answer to all 3 questions are "Yes", this site is more likely than not to benefit from hydraulic and/or transport optimization

The following steps are optional, and are recommended if the answer to all 3 questions in Step 1 are "Yes", and the user is interested in quantifying potential cost savings that might result from hydraulic and/or transport optimization.

- **Step 2:** enter information into a spreadsheet (*"Infosheet (1)"*)
  - **Step 2a:** Enter background information for the current system including the best current estimate for system duration
  - **Step 2b:** Enter annual costs for the current system
  - **Step 2c:** Enter estimated up-front and annual costs for modified systems (Scenarios 1 and 2)

- **Step 3:** based on the information input in Step 2a, the spreadsheet automatically estimates the up-front costs of hydraulic and transport optimization analyses, including any potential model development. (*"Modeling Costs"*)

- **Step 4:** based on the costs input in Step 2b, the spreadsheet automatically calculates the current system costs in net present value (NPV). (*"Current"*)

- **Step 5:** based on the estimated costs input in Step 2c, the spreadsheet automatically calculates estimated life-cycle costs (NPV) for Scenarios 1 and 2 assuming hydraulic optimization. (*"HOS #1", "HOS #2"*)

- **Step 6:** based on the estimated costs input in Step 2c, the spreadsheet automatic ally calculates the life-cycle costs (NPV) associated with Scenarios 1 and 2 assuming transport optimization. (*ATOS"*)

- **Step 7:** based on information from Steps 4, 5, and 6, the spreadsheet automatically calculates the difference in life-cycle cost (NPV) between the current system and Scenarios 1 and 2, for both hydraulic and transport optimization. (*"Cost_Comp"*)

- **Step 8:** based on the estimated cost differences and system objectives the spreadsheet automatically classifies the site as Tier 1, Tier 2, Tier 1 & 2, or Tier 3. (*"Classify")*

The remaining steps are also optional, and are only performed if the site is classified as Tier 1 (or Tier 1 and 2) and the user wants to evaluate additional transport optimization scenarios ...

- **Step 9:** enter cost information into the spreadsheet for Scenarios 3, 4 and 5 (*"Infosheet (2)")*

- **Step 10:** based on the estimated costs input in Step 9, the spreadsheet automatically calculates the life-cycle costs (NPV) Scenarios 3, 4, and 5 assuming transport optimization (*"TOS"*)

- **Step 11:** based on information from Step 10, the spreadsheet automatically calculates the difference in life-cycle cost (NPV) between the current system and Scenarios 3, 4, and 5, for both hydraulic and transport optimization. (*"Total_Analysis"*)

2.3 Screening Input Instructions

To screen a site for optimization, complete Step 1 ("General_Screening") using the following line instructions.

Item 1: Enter the name of the site or plume. This name will be used to identify the site throughout the screening process. The name should uniquely identify the site.

Item 2: Enter the date that this spreadsheet is completed.

Item 3: Enter your name. You will be the point of contact for this site during the screening process.

Item 4: Enter your affiliation (i.e., EPA, USACE, name of private contractor, etc.) and contact information.

Item 5a: Is the system annual O&M cost greater than $100K/yr? If lower than $100K/yr, this site is unlikely to benefit from hydraulic and/or transport optimization.

Item 5b: Is the flow rate lower than 50gpm? If less than 50gpm, this site is unlikely to benefit from hydraulic and/or transport optimization.

Item 5c: Is the cleanup expected within 5 years? If less than 5 years, it is unlikely to benefit from hydraulic and/or transport optimization.

The Step 2 ("Infosheet (1)") is optional. It is required only if the answers to Items 5a, 5b, and 5c are "Yes", and the user wants to evaluate potential cost savings from hydraulic and/or transport optimizations. To complete Step 2 uses the following line instructions.

Item 6a: Enter the primary objective of the remediation system. Choose one of the three responses: "cleanup", "containment", or "both". This response should be entered in the cell to the right of item 6a.

Item 6b: Enter the ease with which modifications (e.g., new wells, increased pumping rate, increased treatment capacity, etc.) can be made to the current remediation system. Choose one of the five responses: "easy", "relatively easy", "relatively difficult", "difficult", "impossible".

Item 6c: Is cleanup of the site a feasible goal within 50 years? If there are continuing sources or contaminated immobile zones, cleanup may not be a realistic objective.

Item 6d: Are there unknown or uncharacterized sources of contamination at the site? If there are, transport model simulations will likely yield unreliable results. Containing the current plume may be a more practical objective until these sources are characterized.

Item 6e: If the answer to 6d is "yes", can the site be divided into two regions, one with and one without uncharacterized sources? If the site can be divided into these two regions, transport optimization can potentially be used for the region with known and characterized sources.

Item 7: Enter information about the system in the cells to the right of list. This information will be used to estimate the life-cycle costs associated with modified systems according to Scenarios.

- $ Expected duration B estimated amount of time between present and site close-out
- $ Number of extraction wells
- $ Total pumping rate
- $ Total treatment capacity
- $ Discount rate B rate used by the government for discounting future costs (if not known, assume 5%).

Item 8a: Enter information regarding the site complexity (ranging from Level 1-- 4). This information is used to estimate the cost of modeling/optimization analyses. Costs increase with site complexity.

- $ Level 1 - a sufficient evaluation of remedies requires simulation of only one contaminant, and requires less than 5 model layers;
- $ Level 2 - a sufficient evaluation of remedies requires simulation of two contaminants, and/or requires 5-10 model layers;
- $ Level 3 - a sufficient evaluation of remedies requires simulation of more than two contaminants, and/or requires more than 10 model layers;
- $ Level 4 - transport model must rigorously simulate both unsaturated and saturated zones, and/or presence of NAPLs, and/or fractured bedrock. Transport optimization will not likely benefit a Level 4 site.

Item 8b: Enter information regarding the flow and transport models for the site. This information is used to estimate the cost of modeling that may be required to conduct an optimization analysis. If models exist but are not up-to-date, costs for updating them will be estimated.

Item 9a: Enter annual O&M costs of the current, and the estimated annual costs for modified systems associated with Scenarios 1 and 2.

Item 9b: Enter estimated up-front costs for modified systems associated with Scenarios 1 and 2.

The remaining items are optional, and are input on "Infosheet (2)" only if the site is classified as Tier 1 (or Tier 1 and 2) and the user wants to evaluate additional transport optimization scenarios ...

Item 10a: Enter estimated annual costs for modified systems associated with Scenarios 3, 4, and 5.

Item 10b: Enter estimated up-front costs for modified systems associated with Scenarios 3, 4, and 5.

2.4 Site Classification

The classification of a site into Tiers 1, 2 and 3 is calculated automatically in Step 8 (*"Classify"*). The site classification is based on the user input in Step 2 *("Infosheet (1))* and the estimated potential cost savings for hydraulic optimization Scenario 1 and transport optimization Scenario 2b in Step 7 (*"Cost_Comp"*). Figure 2.1 provides a flowchart that depicts the classification process, and Table 2.4 summarizes the criteria for classifying sites. If the user specifies that obstacles may make modifications to a system to difficult, the following warning is provided: *"***Note: Potential obstacles to implementing modifications should be considered as the cost of optimization is likely not warranted if modifications cannot be made."*

The user can refer to the individual spreadsheets to evaluate the details of the screening calculations. This may not only help clarify the site classification, but may also provide an initial direction for optimizing a particular site.

2.5 Rationale For Site Classification Criteria

Is containment the only objective of the system (i.e., not cleanup)?

Transport optimization incurs a higher cost than hydraulic optimization and both technologies provide similar solutions for containment problems; therefore, this screening methodology does not select transport optimization for containment-only sites.

Is the site complexity Level 4?

Simulation of the unsaturated zone or multiphase flow significantly increases model uncertainty, especially prediction of contaminant transport; therefore, this screening methodology does not select transport optimization for Level 4 sites.

Are there unknown or uncharacterized sources of contamination?

Unknown or uncharacterized sources of contamination render transport models unreliable when evaluating transport times and cleanup strategies; therefore this screening methodology does not select sites transport optimization for sites with unknown or uncharacterized sources of contamination, unless a substantial region of the site is unaffected by these uncertainties and can be considered separately for cleanup.

Is cleanup considered feasible within 50 years?

If cleanup is considered infeasible within 50 years based on the current system or a potentially modified pump-and-treat system, then containment is probably a more effective strategy than cleanup and hydraulic optimization is likely more appropriate than transport optimization; therefore, this screening methodology does not select transport optimization for those sites.

Is the potential cost savings from transport optimization Scenario 2b greater than $500,000?

Transport optimization Scenario 2b, which assumes a 33% reduction in pumping rate, the addition of new wells (by 33% relative to current number), and a reduction in cleanup time of 20%, is considered a very favorable transport optimization Scenario. To ensure a substantial return on the investment from a modeling and optimization analysis, this screening methodology does not select transport optimization if potential cost savings for transport optimization Scenario 2b is less than $500,000.

Is the potential cost saving from hydraulic optimization Scenario 1 greater than $300,000?

Hydraulic optimization Scenario 1, which assumes a 33% reduction in pumping rate without addition of new wells, is considered a very favorable hydraulic optimization Scenario. To ensure a substantial return on the investment from a modeling and optimization analysis, this screening methodology does not select hydraulic optimization if potential cost saving for hydraulic optimization Scenario 1 is less than $300,000.

Is the potential cost savings from transport optimization Scenario 2b more than 5 times greater than that from hydraulic optimization Scenario 1?

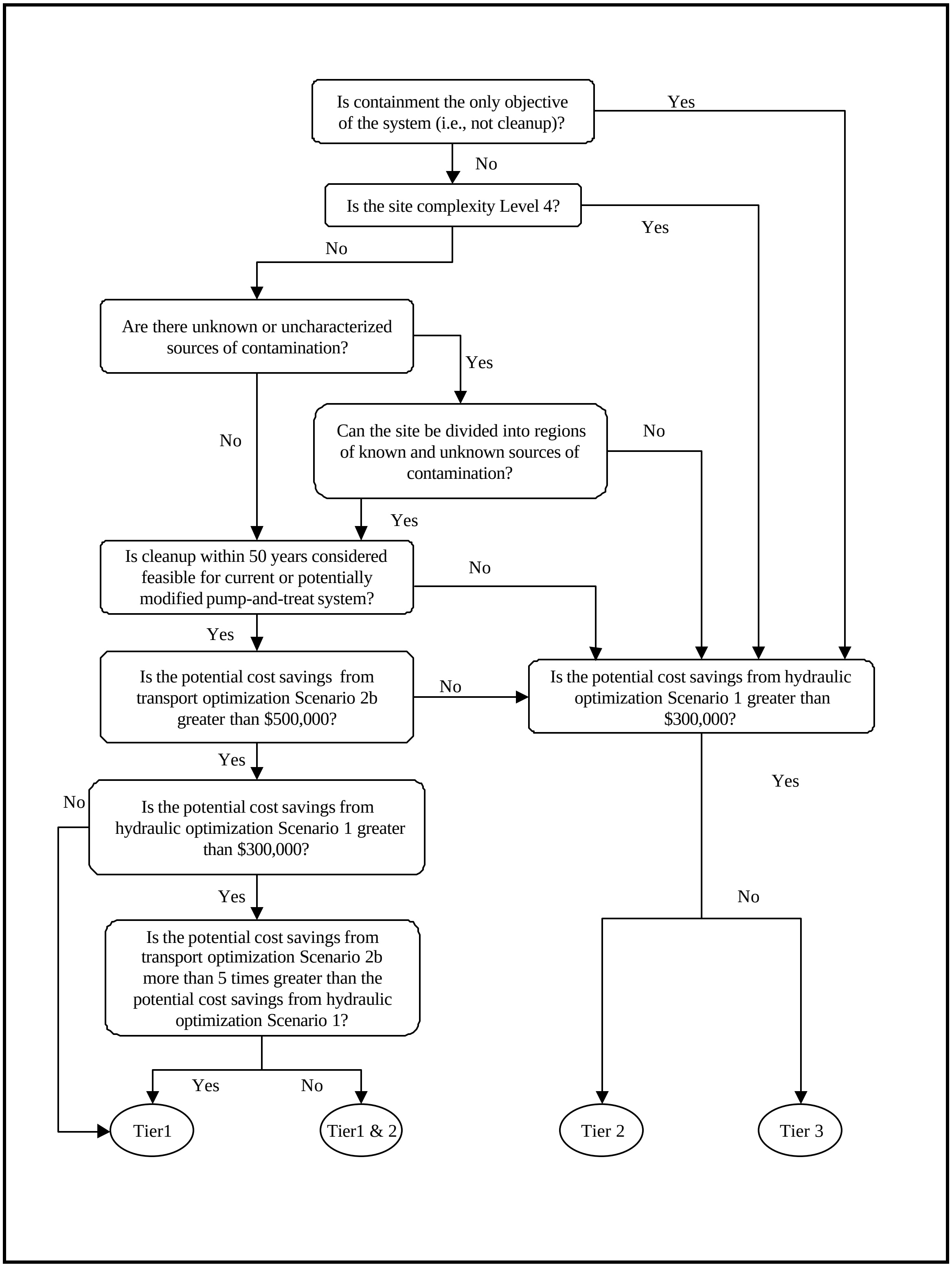
If substantially greater cost savings result from transport optimization compared with hydraulic optimization, then sites are classified as Tier 1 only (transport optimization). However, if potential cost savings from each of those scenarios are of sufficient magnitude to merit either optimization approach and are within a factor of 5, then sites are classified as both Tier 1 and 2.

Table 2.4. Summary of Criteria for Classifying Sites

Tier 1	Tier 1 and 2	Tier 2
G System objective is cleanup or cleanup/containment G Site complexity is not Level 4 G No unknown sources of contamination at the site ***OR*** the ability to divide the site into regions of known and unknown sources. G Cleanup within 50 years is considered feasible for current or potentially modified pump-and-treat system G The potential cost savings from transport optimization Scenario 2b is greater than $500,000 G The potential cost savings from hydraulic optimization Scenario 1 is less than $300,000 ***OR*** The ratio of the potential cost savings from transport optimization Scenario 2b to that from hydraulic optimization Scenario 1 is 5 or greater	G System objective is cleanup or cleanup/containment G Site complexity is not Level 4 G No unknown sources of contamination at the site ***OR*** the ability to divide the site into regions of known and unknown sources G Cleanup within 50 years is considered feasible for current or potentially modified pump-and-treat system G The potential cost savings from transport optimization Scenario 2b is greater than $500,000 G The potential cost savings from hydraulic optimization Scenario 1 is greater than $300,000 G The ratio of the potential cost savings from transport optimization Scenario 2b to that from hydraulic optimization Scenario 1 is less than 5	G System objective is containment only ***OR*** site complexity is Level 4 ***OR*** the majority of the site is affected by unknown sources of contamination ***OR*** cleanup within 50 years is considered infeasible for current or potentially modified pump-and-treat system ***OR*** the potential cost savings from transport optimization Scenario 2b is less than $500,000 G The potential cost savings from hydraulic optimization Scenario 1 is greater than $300,000

All of the criteria in a specified column must be met for a site to be classified in that Tier. All other sites are classified as Tier 3 (not likely to benefit from either transport or hydraulic optimization).

Figure 2-1 Flowchart Depicting Rationale for Site Classification



3. Case Study: Umatilla

3.1 Site Background

Umatilla Chemical Depot is a 19,728-acre military reservation established in 1941 as an ordnance depot for storage and handling of munitions. The facility is located in northeastern Oregon straddling the border of the Umatilla and Morrow counties, three miles south of the Columbia River and six miles west of Hermiston, Oregon (Figure 3.1). Originally Umatilla's mission included the storage, renovation and demilitarizing of conventional munitions and storage of chemical munitions. In 1994, as a result of the Base Realignment and Closure (BRAC) Act, the depot's mission was changed to storing chemical munitions until their destruction under the Chemical Stockpile Disposal Program and site remediation.

From the 1950s until 1965, the depot operated an onsite explosives washout plant. The plant processed munitions to remove and recover explosives using a pressurized hot water system. The wash water from the plant was disposed in two unlined lagoons, located northwest of the plant, where wash water infiltrated into the soil. During the 15 years of operation of the washout plant, an estimated 85 million gallons of wash water were discharged to the lagoons. Although lagoon sludge was removed regularly during operation of the plant, explosives contained in the wash water migrated into the soil and groundwater at the site. The groundwater table is encountered approximately 47 feet below the lagoons. Because of the soil and groundwater contamination of the lagoons, the site was placed on EPA’s National Priorities List (NPL) in 1984.

The Army initiated a Remedial Investigation (RI) of the lagoons in 1987. The RI was used to identify the types, quantities, and locations of contaminants and to develop ways of addressing contamination.

Following the environmental investigation studies, a Human Health Baseline Risk Assessment and a Feasibility Study (FS) were conducted. These evaluations were conducted to define remediation goals and criteria and to identify, evaluate, and provide the basis for selection of remediation alternatives for mitigating explosives contamination. The site was divided into Soils and Groundwater Operable Units, based on the independent methods for addressing those two avenues of public and worker exposure.

Upon review of the RI/FS, the US Army, US Environmental Protection Agency (EPA), and the Oregon Department of Environmental Quality selected a cleanup plan for the groundwater operable unit. As described in the Record of Decision (USACE 1994), Alternative 4B was selected. The major components of the alternative are:

- Pumping groundwater from extraction wells over an estimated 10 to 30 year period
- Treating extracted groundwater with granular activated carbon (GAC) to remove contaminants
- In-situ flushing of subsurface soils beneath the lagoons with all or part of the treated groundwater for an estimated period of one year
- Reinfiltration of the treated groundwater outside the contaminant plume

- Monitoring of groundwater contamination to determine the effectiveness of the remedial action and to determine when groundwater cleanup levels have been attained

- Institutional controls on the contaminated groundwater to prevent its use until cleanup levels are met

- Remediation of the groundwater is scheduled to continue until the concentration of explosives in the aquifer meets cleanup levels. The cleanup level for RDX is 2.1µg/l and TNT is 2.8 µg/l.

3.2 Existing Remediation System

A groundwater treatment system was designed to implement Remediation Alternative 4B. Design of the groundwater treatment system was based in part on the results of model studies described in the Final Remedial Design Submittal (USACE, 1996). The remedial design configuration is shown in Figure 3.2. Groundwater remediation at the site began with official plant startup on 15 January 1997. The system has operated since that time with the exception of an extended period of shutdown for treatment system adjustment during the first quarter of operation, intermittent power outages, and periodic treatment plant GAC replacement events.

Two of the most common contaminants, 2,4,6-Trinitrotoluene (TNT) and Hexahydro-1,3,5-trinitro-1,3,5-triazine (commonly referred to as Royal Demolition Explosive or RDX), are used as indicator parameters. Contaminants are removed by granular active carbon (GAC). Then treated water is discharged to the infiltration basins IF1, IF2, and IF3.

3.3 Groundwater Flow and Transport Models

Existing 3-dimensional, transient MODFLOW and MT3dMS models are calibrated and used for future predictions. There are 125 rows, 132 columns, and 5 layers. Based on modeling results, RDX cleanup in the alluvial aquifer is predicted to take 14 years and TNT cleanup in the alluvial aquifer is predicted to take approximate 23 years, based on system startup in 1997.

3.4 Screening Analysis

3.4.1 Current System

The current system has an annual O&M cost of approximately $429K/yr. Costs are summarized in Table 3.1, in the format of the screening spreadsheet. For this analysis, a remediation timeframe horizon of 20 years is specified. The total cost (NPV) of the current system, for a 20-yr time horizon, is estimated to be $5.6M (Table 3.1).

3.4.2 Hydraulic Optimization Potential

Because a modification in the system might significantly reduce annual O&M cost, additional groundwater modeling and/or optimization modeling may be considered to determine improved pumping scenarios. If the system is to be modified, costs associated with engineering design and the regulatory process can also be anticipated. If new wells are to be considered, the approximate cost including associated piping of new wells must be considered.

The estimated costs for hydraulic optimization Scenarios 1 and 2 are summarized in Tables 3.2 and 3.3, respectively. Scenario 1, i.e., 33% reduction in pumping rate and no change to number of extraction wells, has annual O&M cost of approximate $394K with the reduction in material cost. The total cost (NPV) for hydraulic optimization Scenario 1, for a 20-yr time horizon, is $5.2M, which includes up-front costs as follows:

Hydraulic optimization:	$22,500
Additional engineering design:	$10,000
Regulatory process:	$10,000

The O&M cost for hydraulic optimization Scenario 2, i.e., 33% reduction in pumping rate and 33% increase in number of wells, is approximate $398K/yr. The total cost (NPV), for a 20-yr time horizon, is estimated $5.3M, which includes up-front costs as follows:

Hydraulic optimization:	$22,500
Additional engineering design:	$15,000
Regulatory process:	$15,000
Additional wells:	$75,000

3.4.3 Transport Optimization Potential

A spreadsheet analysis for each transport optimization scenario is presented in Table 3.4 including additional alternatives Scenarios 3, 4, and 5. The following up-front costs are estimated for these alternative scenarios:

Transport optimization:	\$ 75,000
Additional wells:	\$ 75,000 (Scenarios 2, 3, and 5 only)
Increased treatment capacity:	\$150,000 (Scenarios 4, 5 only)
Additional engineering design:	\$ 10,000 for Scenario 1, \$ 15,000 for Scenario 2
Regulatory process:	\$ 10,000 for Scenario 1, \$ 15,000 for Scenario 2

By comparison to the current system, Table 3.5 summarizes the cost savings from hydraulic and transport optimizations. For transport optimization, a 10%, 20%, and 30% reduction in system operation duration are evaluated. The site is classified as Tier 1 and 2 (Table 3.6) by comparing the potential cost savings from hydraulic optimization Scenario 1 and transport optimization Scenario 2b.

Table 3.1. Umatilla Screening Analysis – Current System

Hydraulic Optimization Screening Analysis -- Current System

Site: Umatilla Army Depot, Hermiston, Oregon

pumping rate	1300
number of wells	3
Discount Rate:	5%

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$27,000	20	$353,304	$353,304
O&M labor	$0	$237,000	20	$3,101,221	$3,101,221
Materials	$0	$103,000	20	$1,347,788	$1,347,788
Maintenance	$0	$0	20	$0	$0
Discharge Fees	$0	$0	20	$0	$0
Analytical	$0	$62,000	20	$811,290	$811,290
Other #1	$0	$0	20	$0	$0
Other #2	$0	$0	20	$0	$0
Other #3	$0	$0	20	$0	$0
Costs of Analysis					
-Flow Modeling	$0			$0	$0
-Transport Modeling	$0			$0	$0
-Optimization	$0			$0	$0
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$0			$0	$0
-Regulatory Process	$0			$0	$0
-New wells/pipes/equipment	$0			$0	$0
-Increased monitoring	$0			$0	$0
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$0**	**$429,000**		**$5,613,603**	**$5,613,603**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Table 3.2. Umatilla Screening Analysis – Hydraulic Optimization Scenario 1

Hydraulic Optimization Screening Analysis -- Scenario #1

Site: Umatilla Army Depot, Hermiston, Oregon

pumping rate	871	(reduction of 33% from current system)
number of wells	3	(same as current system)
Discount Rate:	5%	

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$27,000	20	$353,304	$353,304
O&M labor	$0	$237,000	20	$3,101,221	$3,101,221
Materials	$0	$68,000	20	$889,802	$889,802
Maintenance	$0	$0	20	$0	$0
Discharge Fees	$0	$0	20	$0	$0
Analytical	$0	$62,000	20	$811,290	$811,290
Other #1	$0	$0	20	$0	$0
Other #2	$0	$0	20	$0	$0
Other #3	$0	$0	20	$0	$0
Costs of Analysis					
-Flow Modeling	$0			$0	$0
-Transport Modeling	$0			$0	$0
-Optimization	$22,500			$0	$22,500
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$10,000			$0	$10,000
-Regulatory Process	$10,000			$0	$10,000
-New wells/pipes/equipment	$0			$0	$0
-Increased monitoring	$0			$0	$0
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$42,500**	**$394,000**		**$5,155,616**	**$5,198,116**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Table 3.3. Umatilla Screening Analysis – Hydraulic Optimization Scenario 2

Hydraulic Optimization Screening Analysis -- Scenario #2

Site: Umatilla Army Depot, Hermiston, Oregon

pumping rate	871	(reduction of 33% from current system)
number of wells	4	(increase of 33% from current system)
Discount Rate:	5%	

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$30,900	20	$404,336	$404,336
O&M labor	$0	$237,000	20	$3,101,221	$3,101,221
Materials	$0	$68,000	20	$889,802	$889,802
Maintenance	$0	$0	20	$0	$0
Discharge Fees	$0	$0	20	$0	$0
Analytical	$0	$62,000	20	$811,290	$811,290
Other #1	$0	$0	20	$0	$0
Other #2	$0	$0	20	$0	$0
Other #3	$0	$0	20	$0	$0
Costs of Analysis					
-Flow Modeling	$0			$0	$0
-Transport Modeling	$0			$0	$0
-Optimization	$22,500			$0	$22,500
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$15,000			$0	$15,000
-Regulatory Process	$15,000			$0	$15,000
-New wells/pipes/equipment	$75,000			$0	$75,000
-Increased monitoring	$0			$0	$0
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$127,500**	**$397,900**		**$5,206,649**	**$5,334,149**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Table 3.4. Umatilla Screening Analysis – Transport Optimization

Transport Optimization Screening Analysis -- All Scenarios

Site: Umatilla Army Depot, Hermiston, Oregon

Discount Rate: 5%

Scenario 1: pumping rate decreased by 33%, no new wells
Scenario 2: pumping rate decreased by 33%, plus 33% additional wells (new)
Scenario 3: current pumping rate, plus 33% additional wells (new)
Scenario 4: pumping rate increased by 33%, no new wells
Scenario 5: pumping rate increased by 33%, plus 33% additional wells (new)

	Current	Scenario #1	Scenario #2	Scenario #3	Scenario #4	Scenario #5
pumping rate (gpm)	**1300**	**871**	**871**	**1300**	**1729**	**1729**
number of wells	**3**	**3**	**4**	**4**	**3**	**4**
	Annual	**Annual**	**Annual**	**Annual**	**Annual**	**Annual**
O&M Costs						
Electric	$27,000	$27,000	$30,900	$30,900	$27,000	$30,900
O&M labor	$237,000	$237,000	$237,000	$237,000	$237,000	$237,000
Materials	$103,000	$68,000	$68,000	$103,000	$137,000	$137,000
Maintenance	$0	$0	$0	$0	$0	$0
Discharge Fees	$0	$0	$0	$0	$0	$0
Analytical	$62,000	$62,000	$62,000	$62,000	$62,000	$62,000
Other #1	$0	$0	$0	$0	$0	$0
Other #2	$0	$0	$0	$0	$0	$0
Other #3	$0	$0	$0	$0	$0	$0
Annual Subtotal	$429,000	$394,000	$397,900	$432,900	$463,000	$466,900
	Upfront	**Upfront**	**Upfront**	**Upfront**	**Upfront**	**Upfront**
Costs of Analysis						
-Flow Modeling	$0	$0	$0	$0	$0	$0
-Transport Modeling	$0	$0	$0	$0	$0	$0
-Optimization	$0	$75,000	$75,000	$75,000	$75,000	$75,000
System Modification Costs						
-Engineering design	$0	$10,000	$15,000	$0	$0	$0
-Regulatory Process	$0	$10,000	$15,000	$0	$0	$0
-New wells/pipes/equipment	$0	$0	$75,000	$75,000	$0	$75,000
-Increased monitoring	$0	$0	$0	$0	$0	$0
-Increased treatment capacity	$0	$0	$0	$0	$150,000	$150,000
-Other #1	$0	$0	$0	$0	$0	$0
-Other #2	$0	$0	$0	$0	$0	$0
Upfront Subtotal	$0	$95,000	$180,000	$150,000	$225,000	$300,000
Life-cycle costs (NPV)	$5,613,603	$5,250,616	$5,386,649	$5,814,635	$6,283,504	$6,409,536

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Table 3.5. Umatilla Potential Cost Savings Summary

Hydraulic and Transport Optimization Potential Cost Savings Analysis

Site: Umatilla Army Depot, Hermiston, Oregon

Expected Duration:	20
Discount Rate:	5%
Current forecasted cost (NPV):	$5,613,603

	Reduction in time-to-close-out	Cost Savings by Scenario					
		Current	Scenario #1	Scenario #2	Scenario #3	Scenario #4	Scenario #5
Hydraulic Optimization	0%	$0	$415,486	$279,453	N/A	N/A	N/A
Transport Optimization	0%	$0	$362,986	$226,953	($201,033)	($669,901)	($795,934)
	10%	N/A	N/A	$549,752	$150,159	($294,290)	($417,159)
	20%	N/A	N/A	$905,637	$537,349	$119,821	$440
	30%	N/A	N/A	$1,298,000	$964,225	$576,378	$460,843

Hydraulic Optimization Summary

Maximum potential cost savings:	$415,486

Transport Optimization Summary

Maximum potential cost savings, no reduction in cleanup time:	$362,986
Maximum potential cost savings, 10% reduction in cleanup time:	$549,752
Maximum potential cost savings, 20% reduction in cleanup time:	$905,637
Maximum potential cost savings, 30% reduction in cleanup time:	$1,298,000

Table 3.6. Umatilla Site Classification Summary

Site Classification

Site: Umatilla Army Depot, Hermiston, Oregon

Basic Information:

The primary site objective is cleanup.
A feasible pump-and-treat cleanup solution with a time frame of less than 50 years exists.
There are no uncharacterized or unknown sources of contamination at the site.

Site Classification: Tier **1 and 2**

***Note: Please review the "**Cost_Comp**" worksheet for more detailed information regarding the potential cost savings associated with specific scenarios.

****We strongly suggest applying alternative transport optimization scenarios to this site. Please go to Infosheet (2) to enter additional cost information for Scenarios 3 through 5.***

Figure 3-1 Umatilla Facility and Site Location Map

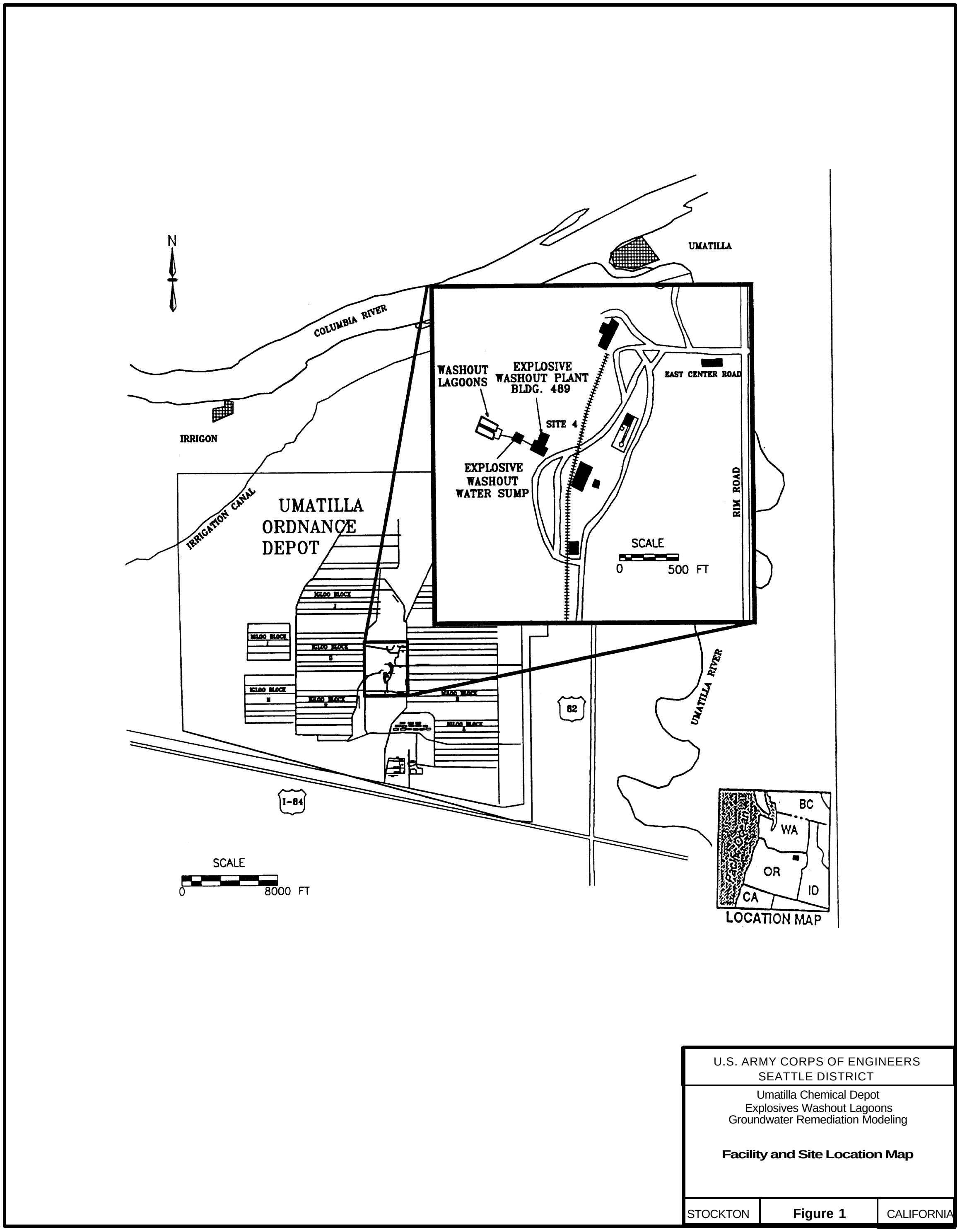
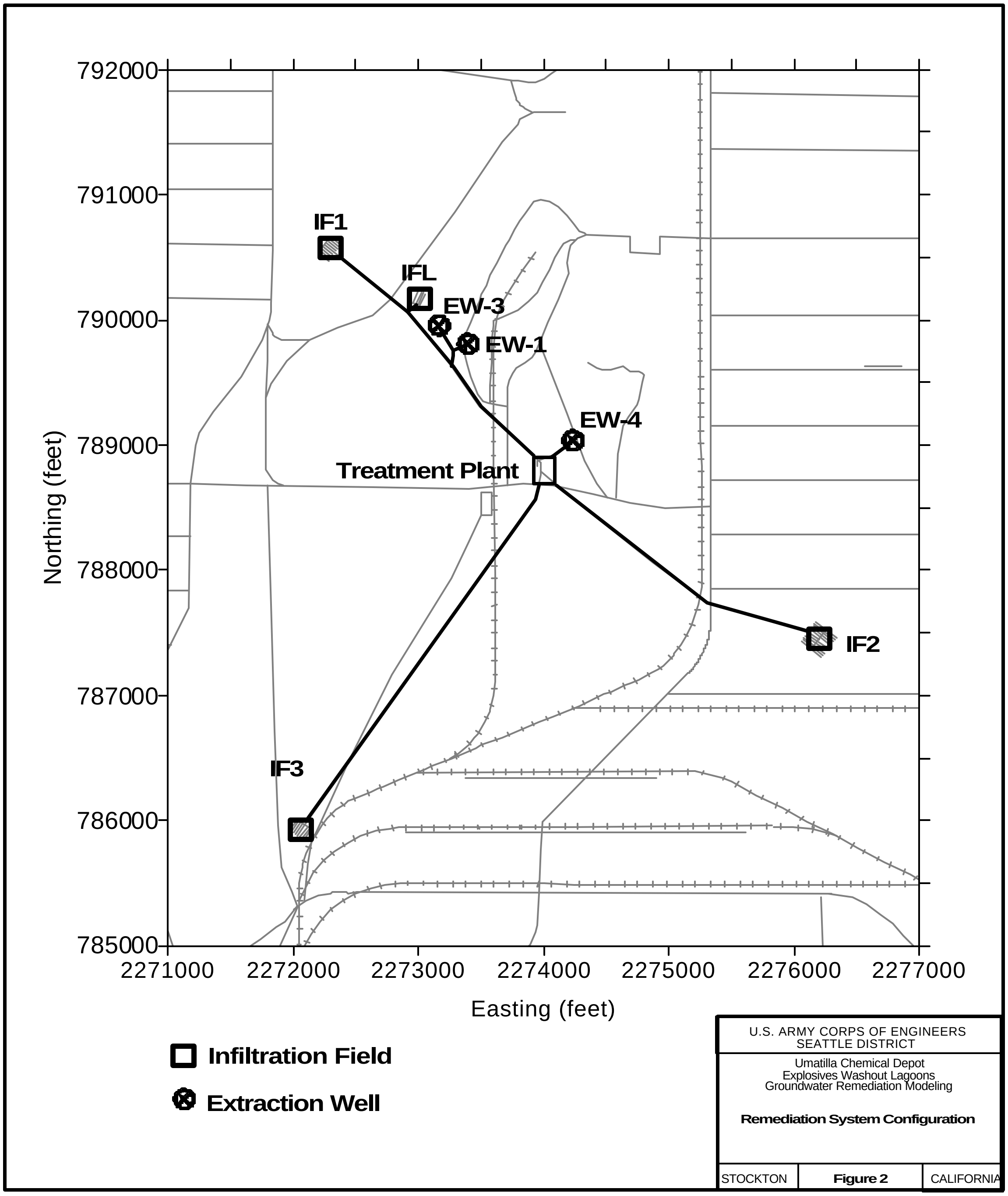


Figure 3-2 Umatilla Remediation System Configuration



4. Discussion and Conclusion

The screening analysis represented in this report can be used to quickly determine if the site will potential benefit from hydraulic and/or transport optimization, and if significant cost savings may be achieved by altering key aspects of an existing or planned pump-and-treat system. The spreadsheet-based screening analysis allows quick and inexpensive cost comparison of competing alternatives at a site, in terms of Net Present Value (NPV). Site-specific values input into the spreadsheet can be based on very detailed engineering calculations and modeling results, or may be based on "ballpark estimates".

The spreadsheet screening approach was demonstrated for 11 sites, including Umatilla, with existing pump-and-treat systems. The 11 sites can be summarized as follows, based on potential cost savings from hydraulic optimization Scenario 1 and transport optimization Scenario 2b. The screening spreadsheets for those sites are seen in Appendix.

Table 4.1. Summary of Potential Cost Savings for 11 Sites

Site	Total cost for Current System (NPV)	Potential Savings from Hydraulic Optimization (Scenario #1)	Potential Savings from Transport Optimization (Scenario #2b)	Site Classification
Umatilla	$5,613,603	$415,486	$905,637	Tiers 1 and 2
Tooele	$23,684,431	$3,379,423	$4,161,829	Tiers 1 and 2
George	$4,842,322	$272,821	$515,521	Tier 1
Wurtsmith	$1,439,710	$119,579	$108,195	Tier 3
Wright-Patterson	$3,906,140	$560,838	$480,244	Tier 2
McClellan	$168,801	($146,074)	($380,273)	Tier 3
Shaw	$2,461,514	$9,212	$47,398	Tier 3
Cornhusker	$6,939,077	$215,862	($110,853)	Tier 3
Lakehurst	$5,340,334	$167,973	($56,258)	Tier 3
Cherrypoint	$3,533,037	$155,391	($468,897)	Tier 3
Yuma	$292,857	$23,571	($19,382)	Tier 3

For Umatilla and Tooele, the screening analysis suggests that these two sites are classified as Tiers 1 and 2, i.e., they are more likely to benefit from both hydraulic and transport optimizations. George is Tier 1 classification based on the screening analysis, i.e., it is more likely to benefit from transport optimization, not hydraulic optimization. Wirght-Patterson is classified as Tier 2, so it has significant potential benefit from hydraulic optimization only. The other 7 sites, Wurtsmith, McClellan, Shaw, Cornhusker, Lakehurst, Cherrypoint, and Yuma, are classified as Tier 3. There will not be significant benefit from either hydraulic or transport optimization for those sites.

Appendix A:
Screening Tables for 11 Sites

Pre-Optimization Screening for Transport and Hydraulic Optimization

THIS WORKSHEET SUMMARIZES INPUT REQUIRED BY USER

Notes:

Users are only allowed to input information in "**General_Screening**", "**Infosheet (1)**", and "**Infosheet (2)**", other sheets are calculated automatically.

The fields that need to be filled out by users are highlighted in light-blue.

Instructions:

*Items 1 - 5c need to be entered in worksheet "**General_Screening**".*	
Item 1	Enter the name of the site or plume. This name will be used to identify the site throughout the screening process. The name should uniquely identify the site.
Item 2	Enter the date that this spreadsheet is completed.
Item 3	Enter your name. You will be the point of contact for this site during the pre-optimization screening process.
Item 4	Enter your affiliation (i.e., EPA, USACE, name of private contractor, etc.) and contact information.
Item 5a	Is the system annual O&M cost greater than $100K/yr? If lower than $100K/yr, this site is unlikely to benefit from hydraulic and/or transport optimization.
Item 5b	Is the flowrate lower than 50gpm? If less than 50 gpm, this site is unlikely to benefit from hydraulic and/or transport optimization.
Item 5c	Is site cleanup expected within 5 years? If less than 5 years, this site is unlikely to benefit from hydraulic and/or transport optimization.
*Only if the answers to Item 5a, 5b, and 5c are "Yes", and the user is insterested in quantifying potential cost savings by hydraulic and/or transport optimization, the following lines in worksheet "**Infosheet (1)**" need to be entered.*	
Item 6a	Enter the primary objective of the remediation system.
Item 6b	Enter the ease with which modifications (e.g., new wells, increased pumping rate, increased treatment capacity, etc.) can be made to the current remediation system.
Item 6c	Is cleanup of the site a feasible goal within 50 years based on the current system or a potentially modified pump-and-treat system? If there are continuing sources or contaminated immobile zones, cleanup may not be a realistic objective.
Item 6d	Are there unknown or uncharacterized sources of contamination at the site? If there are, transport model simulations will likely yield unreliable results. Containing the current plume may be a more practical objective until these sources are characterized.
Item 6e	If the answer to 5d is “yes”, can the site be divided into two regions, one with and one without uncharacterized sources? If the site can be divided into these two regions, transport optimization can be used potentially for the region with known and characterized sources.
Item 7	Enter the correct information about the system (number of wells, pumping rate, etc.) in the cells to the right of list. This information will be used to estimate the life-cycle costs associated with modified systems according to Scenarios.
Item 8a	Enter information regarding the site complexity (ranging from Level 1-- 4). This information is used to estimate the cost of the optimization analysis. Costs increase with site complexity.
Item 8b	Enter information regarding the flow and transport models for the site. This information is used to estimate the cost of the optimization analysis. If updated models are not available, costs for updating them will be included.
Item 9a	Enter the annual costs of the current O&M system and the estimated annual costs for Scenarios 1 and 2.
Item 9b	Enter the estimated up-front costs for Scenarios 1 and 2.
*Only if the site is classified as Tier 1 or Tier 1 and 2, and the user is insterested in other optimization alternatives, the following lines in worksheet "**Infosheet (2)**" need to be entered.*	
Item 10a	Enter the estimated annual costs for Scenarios 3, 4, and 5.
Item 10b	Enter the estimated up-front costs for Scenarios 3, 4, and 5.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Step 1: General Information

1) Name of Site/Plume:	Umatilla Army Depot, Hermiston, Oregon
2) Todays Date:	02/02/01
3) Your Name:	Yan Zhang
4a) Your Affiliation	GeoTrans, Inc.
4b) Your Contact Information	
Address	GeoTrans, Inc. 2 Paragon Way Freehold, NJ 07728
email	yzhang@geotransinc.com
Phone	(732) 409-0344
fax	(732) 409-3020

5) General Questions

5a) Are O&M costs > $100K/year (enter "y" or "n")?	**y**
5b) Is the system flowrate > 50gpm (enter "y" or "n")?	**y**
5c) Is the estimated cleanup time > 5 years (enter "y" or "n")?	**y**

***** Note: We strongly recommend applying quantitative screening to this site. Please fill in the required information on Infosheet (1).*

***** Note: If the anwer to all 3 questions above are "y", this site is more likely to potentially benefit from hydraulic and/or transport optimization. If the user is interested in quantifying potential cost savings that might result from hydraulic and/or transport optimzation simulation, please fill in the required information on "Infosheet(1)". Additionally, the user can goes to the FRTR optimization web site for information on hydraulic and transport optimization software.**

Click to go to -------> Infosheet (1)
Click to go to -------> FRTR Optimization Web site

Pre-Optimization Screening for Transport and Hydraulic Optimization

USER INPUT INTO THIS SHEET IS OPTIONAL
Fill in this sheet ONLY if the answer to all 3 questions in sheet "General_Screening" are "Yes" and you are interested in quantifying potential cost savings from hydraulic and/or transport optimization.

Site: Umatilla Army Depot, Hermiston, Oregon

Step 2a: Site Background and Information

6) Background Questions

6a) What is the current main objective for the remediation system? *Choose one (1, 2 or 3)* 1. Cleanup 2. Containment 3. Both	**1**
6b) If optimization were to recommend modifications that would result in a significant reduction in remediation system life-cycle costs, describe the ease of implementing these modifications. *Choose one (1, 2, 3, 4, or 5)* 1. Easy 2. Relatively easy 3. Relatively difficult 4. Difficult 5. Impossible	**2**
6c) Are there any continuing sources, immobile zones, or other factors that likely would prevent a feasible pump-and-treat solution in 50 years or less? *Choose one (1, 2, or 3)* 1. Yes 2. No 3. Don't know	**2**
6d) Are there unknown or uncharacterized sources of contamination at the site? *Choose one (1, 2, or 3)* 1. Yes 2. No 3. Don't know	**2**
6e) If the anwer to question 6d) is Yes, can the site be divided into different operable units in which the unknown sources are contained or addressed by an alternative solution and the remaining portion can be cleaned up by a pump and treat system? *Choose one (1, 2, or 3) (Leave it **blank** if the answer to question 6d) is "No".)* 1. Yes 2. No 3. Don't know	

7) System Information

Expected duration (years)	**20**
Number of extraction wells	**3**
Total pumping rate (gpm)	**1300**
Total treatment capacity (gpm)	**1300**
Discount rate	**5%**

Pre-Optimization Screening for Transport and Hydraulic Optimization

8) Model/Site Information

8a) How complex is the site? (Level 1 -- 4)	**2**
Choose one (1, 2, 3, or 4)	
Level 1: simulation of one contaminant sufficient for remedy evaluation, and less than 5 model layers	
Level 2: simulation of two contaminants sufficient for remedy evaluation, and/or 5-10 model layers	
Level 3: simulation of three or more contaminants required, and/or more than 10 model layers	
Level 4: rigorous simulation of both unsaturated and saturated zones, and/or multiple phases, and/or fractured bedrock in transport model	
8b) Model information *(Choose one, 1 or 2)*	
Is there an existing flow model?	**1**
1. Yes	
2. No	
Is the flow model up-to-date?	**1**
1. Yes	
2. No	
Is there an existing transport model?	**1**
1. Yes	
2. No	
Is the transport model up-to-date?	**1**
1. Yes	
2. No	

Step 2b: Current Costs		**Step 2c: Estimated Costs for Scenarios 1 & 2**	
		9a) Enter Annual Costs for Each Scenario	
Item	Current System	Scenario #1 no new extraction wells 33% less pumping	Scenario #2 new extraction wells (33% more) 33% less pumping
pumping rate (gpm)	1300	871	871
number of wells	3	3	4
Electric	$27,000	$27,000	$30,900
O&M labor	$237,000	$237,000	$237,000
Materials	$103,000	$68,000	$68,000
Maintenance			
Discharge Fees			
Analytical	$62,000	$62,000	$62,000
Other #1			
Other #2			
Other #3			
		9b) Enter Up-Front Costs for Each Scenario	
Item	Current System	Scenario #1 no new extraction wells 33% less pumping	Scenario #2 new extraction wells (33% more) 33% less pumping
Engineering design	$0	$10,000	$15,000
Regulatory Process	$0	$10,000	$15,000
New wells/pipes/equipment	$0		$75,000
Increased monitoring	$0		
Increased treatment capacity	$0		
Other #1	$0		
Other #2	$0		
Other #3	$0		

Check cost savings, go to ---------> Cost_Comp
Check site classification, go to ---------> Classify

Pre-Optimization Screening for Transport and Hydraulic Optimization

Costs of Modeling and Optimization Analyses

Site: Umatilla Army Depot, Hermiston, Oregon

Based on information input by user, this site is Level: 2

	Flow Modeling	Transport Modeling	Optimization	Total
Hydraulic Optimization	$0	$0	$22,500	$22,500
Transport Optimization	$0	$0	$75,000	$75,000

Assumed Costs for Level 1: one contaminant simulated and less than 5 model layers

1. Cost for creating a new flow model for Level 1 is $30,000
2. Cost for updating an existing flow model for Level 1 is $15,000
3. Cost for hydraulic optimization for Level 1 is $15,000
4. Cost for creating a new transport model for Level 1 is $30,000
5. Cost for updating an existing transport model for Level 1 is $15,000
6. Cost for tranport optimization for Level 1 is $50,000

Escalation Factors for Levels 2-4

Level 2: Level 1 * 1.5
Level 3: Level 1 * 2.0
Level 4: Level 1 * 2.5

Note:

Level 1: simulation of one contaminant sufficient for remedy evaluation, and less than 5 model layers
Level 2: simulation of two contaminants sufficient for remedy evaluation, and/or 5-10 model layers
Level 3: simulation of three or more contaminants required, and/or more than 10 model layers
Level 4: rigorous simulation of both unsaturated and saturated zones, and/or multiple phases, and/or fractured bedrock in transport model

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Current System

Site: Umatilla Army Depot, Hermiston, Oregon

pumping rate	1300
number of wells	3
Discount Rate:	5%

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$27,000	20	$353,304	$353,304
O&M labor	$0	$237,000	20	$3,101,221	$3,101,221
Materials	$0	$103,000	20	$1,347,788	$1,347,788
Maintenance	$0	$0	20	$0	$0
Discharge Fees	$0	$0	20	$0	$0
Analytical	$0	$62,000	20	$811,290	$811,290
Other #1	$0	$0	20	$0	$0
Other #2	$0	$0	20	$0	$0
Other #3	$0	$0	20	$0	$0
Costs of Analysis					
-Flow Modeling	$0			$0	$0
-Transport Modeling	$0			$0	$0
-Optimization	$0			$0	$0
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$0			$0	$0
-Regulatory Process	$0			$0	$0
-New wells/pipes/equipment	$0			$0	$0
-Increased monitoring	$0			$0	$0
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$0**	**$429,000**		**$5,613,603**	**$5,613,603**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Scenario #1

Site: Umatilla Army Depot, Hermiston, Oregon

pumping rate	871	(reduction of 33% from current system)
number of wells	3	(same as current system)
Discount Rate:	5%	

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$27,000	20	$353,304	$353,304
O&M labor	$0	$237,000	20	$3,101,221	$3,101,221
Materials	$0	$68,000	20	$889,802	$889,802
Maintenance	$0	$0	20	$0	$0
Discharge Fees	$0	$0	20	$0	$0
Analytical	$0	$62,000	20	$811,290	$811,290
Other #1	$0	$0	20	$0	$0
Other #2	$0	$0	20	$0	$0
Other #3	$0	$0	20	$0	$0
Costs of Analysis					
-Flow Modeling	$0			$0	$0
-Transport Modeling	$0			$0	$0
-Optimization	$22,500			$0	$22,500
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$10,000			$0	$10,000
-Regulatory Process	$10,000			$0	$10,000
-New wells/pipes/equipment	$0			$0	$0
-Increased monitoring	$0			$0	$0
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$42,500**	**$394,000**		**$5,155,616**	**$5,198,116**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Scenario #2

Site: Umatilla Army Depot, Hermiston, Oregon

pumping rate	871	(reduction of 33% from current system)
number of wells	4	(increase of 33% from current system)
Discount Rate:	5%	

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$30,900	20	$404,336	$404,336
O&M labor	$0	$237,000	20	$3,101,221	$3,101,221
Materials	$0	$68,000	20	$889,802	$889,802
Maintenance	$0	$0	20	$0	$0
Discharge Fees	$0	$0	20	$0	$0
Analytical	$0	$62,000	20	$811,290	$811,290
Other #1	$0	$0	20	$0	$0
Other #2	$0	$0	20	$0	$0
Other #3	$0	$0	20	$0	$0
Costs of Analysis					
-Flow Modeling	$0			$0	$0
-Transport Modeling	$0			$0	$0
-Optimization	$22,500			$0	$22,500
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$15,000			$0	$15,000
-Regulatory Process	$15,000			$0	$15,000
-New wells/pipes/equipment	$75,000			$0	$75,000
-Increased monitoring	$0			$0	$0
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$127,500**	**$397,900**		**$5,206,649**	**$5,334,149**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Transport Optimization Screening Analysis -- All Scenarios

Site: Umatilla Army Depot, Hermiston, Oregon

Discount Rate: 5%

Scenario 1: pumping rate decreased by 33%, no new wells
Scenario 2: pumping rate decreased by 33%, plus 33% additional wells (new)
Scenario 3: current pumping rate, plus 33% additional wells (new)
Scenario 4: pumping rate increased by 33%, no new wells
Scenario 5: pumping rate increased by 33%, plus 33% additional wells (new)

	Current	Scenario #1	Scenario #2	Scenario #3	Scenario #4	Scenario #5
pumping rate (gpm)	**1300**	**871**	**871**	**1300**	**1729**	**1729**
number of wells	**3**	**3**	**4**	**4**	**3**	**4**
	Annual	**Annual**	**Annual**	**Annual**	**Annual**	**Annual**
O&M Costs						
Electric	$27,000	$27,000	$30,900	$30,900	$27,000	$30,900
O&M labor	$237,000	$237,000	$237,000	$237,000	$237,000	$237,000
Materials	$103,000	$68,000	$68,000	$103,000	$137,000	$137,000
Maintenance	$0	$0	$0	$0	$0	$0
Discharge Fees	$0	$0	$0	$0	$0	$0
Analytical	$62,000	$62,000	$62,000	$62,000	$62,000	$62,000
Other #1	$0	$0	$0	$0	$0	$0
Other #2	$0	$0	$0	$0	$0	$0
Other #3	$0	$0	$0	$0	$0	$0
Annual Subtotal	$429,000	$394,000	$397,900	$432,900	$463,000	$466,900
	Upfront	**Upfront**	**Upfront**	**Upfront**	**Upfront**	**Upfront**
Costs of Analysis						
-Flow Modeling	$0	$0	$0	$0	$0	$0
-Transport Modeling	$0	$0	$0	$0	$0	$0
-Optimization	$0	$75,000	$75,000	$75,000	$75,000	$75,000
System Modification Costs						
-Engineering design	$0	$10,000	$15,000	$0	$0	$0
-Regulatory Process	$0	$10,000	$15,000	$0	$0	$0
-New wells/pipes/equipment	$0	$0	$75,000	$75,000	$0	$75,000
-Increased monitoring	$0	$0	$0	$0	$0	$0
-Increased treatment capacity	$0	$0	$0	$0	$150,000	$150,000
-Other #1	$0	$0	$0	$0	$0	$0
-Other #2	$0	$0	$0	$0	$0	$0
Upfront Subtotal	$0	$95,000	$180,000	$150,000	$225,000	$300,000
Life-cycle costs (NPV)	$5,613,603	$5,250,616	$5,386,649	$5,814,635	$6,283,504	$6,409,536

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic and Transport Optimization Potential Cost Savings Analysis

Site: Umatilla Army Depot, Hermiston, Oregon

Expected Duration:	20
Discount Rate:	5%
Current forecasted cost (NPV):	$5,613,603

	Assumed Reduction in Time-to-Close-Out	**Cost Savings by Scenario**		
		Current	Scenario #1	Scenario #2
Hydraulic Optimization	0%	$0	$415,486	$279,453
Transport Optimization	0%	$0	$362,986	$226,953
	10%	N/A	N/A	$549,752
	20%	N/A	N/A	$905,637
	30%	N/A	N/A	$1,298,000

Pre-Optimization Screening for Transport and Hydraulic Optimization

Site Classification

Site: Umatilla Army Depot, Hermiston, Oregon

Basic Information:

The primary site objective is cleanup.
A feasible pump-and-treat cleanup solution with a time frame of less than 50 years exists.
There are no uncharacterized or unknown sources of contamination at the site.

Site Classification: Tier **1 and 2**

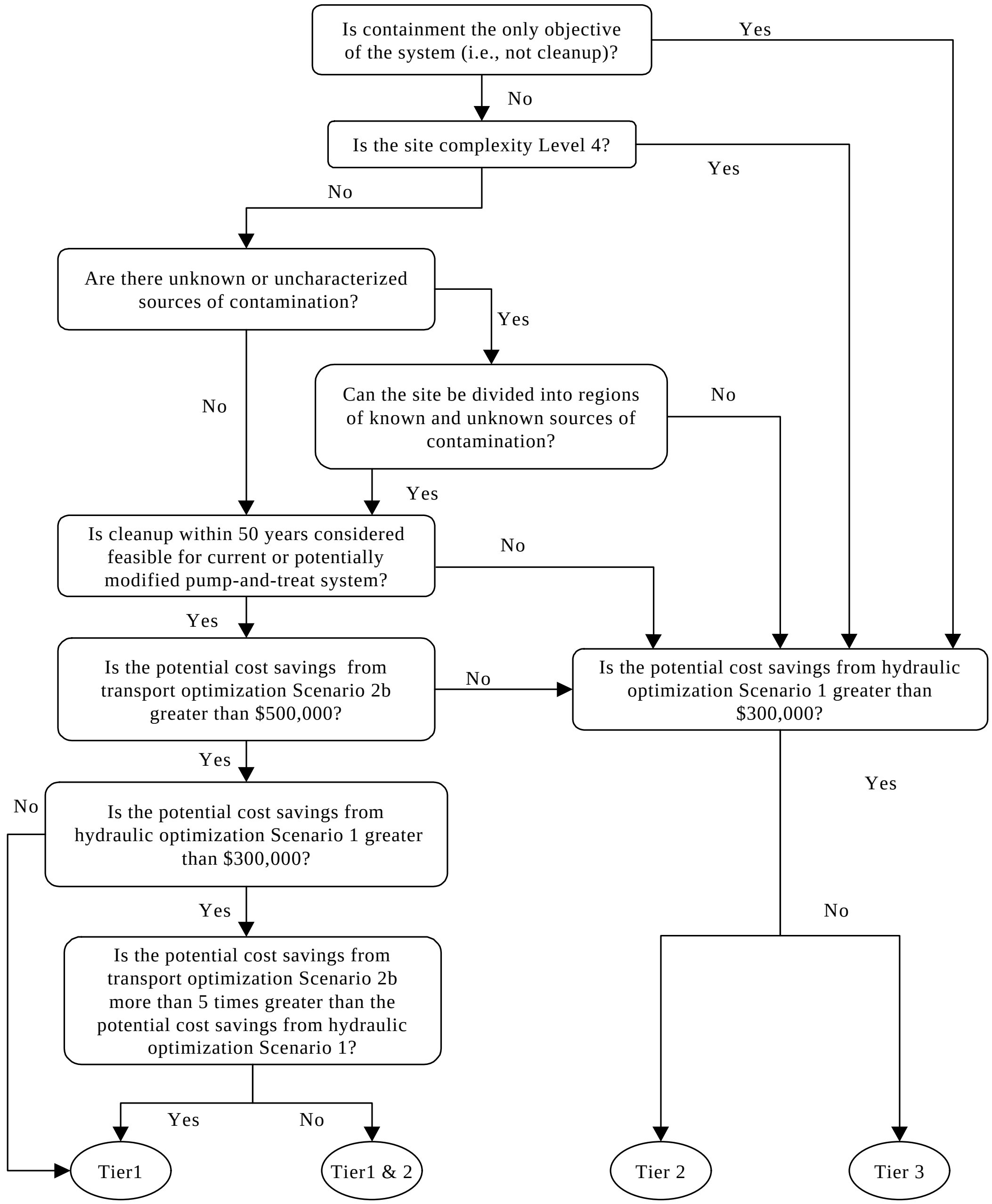
****Note: Please review the "**Cost_Comp**" worksheet for more detailed information regarding the potential cost savings associated with specific scenarios.*

******We strongly suggest applying alternative transport optimization scenarios to this site. Please go to Infosheet (2) to enter additional cost information for Scenarios 3 through 5.***

For additonal scenarios, go to ----------> Infosheet (2)

Pre-Optimization Screening for Transport and Hydraulic Optimization

Rationale for Classifying Sites into Tiers



File: GeneralScr_Draft 042701.xls, Sheet:Classify

Pre-Optimization Screening for Transport and Hydraulic Optimization

USER INPUT INTO THIS SHEET IS OPTIONAL
Fill out this table ONLY if the site is classified as Tier 1 (or Tier 1 and 2), and if you are interested in evaluating additional transport optimization alternatives.

Site: Umatilla Army Depot, Hermiston, Oregon

Estimated Costs for Transport Optimization Scenarios

10a) Enter Annual Costs for Each Scenario

Item	Scenario #3 new extraction wells (33% more) no change to pumping	Scenario #4 no new extraction wells 33% more pumping	Scenario #5 new extraction wells (33% more) 33% more pumping
pumping rate (gpm)	1300	1729	1729
number of wells	4	3	4
Electric	$30,900	$27,000	$30,900
O&M labor	$237,000	$237,000	$237,000
Materials	$103,000	$137,000	$137,000
Maintenance			
Discharge Fees			
Analytical	$62,000	$62,000	$62,000
Other #1			
Other #2			
Other #3			

****Warning: Total pumping rates exceed the current treatment capacity in Scenarios 4 & 5. Thus, the treatment capacity needs to be increased. Please enter capital costs for 'increased treatment capacity' in the table below.*

10b) Enter Up-Front Costs for Each Scenario

Item	Scenario #3 new extraction wells (33% more) no change to pumping	Scenario #4 no new extraction wells 33% more pumping	Scenario #5 new extraction wells (33% more) 33% more pumping
Engineering design			
Regulatory Process			
New wells/pipes/equipment	$75,000		$75,000
Increased monitoring			
Increased treatment capacity		$150,000	$150,000
Other #1			
Other #2			
Other #3			

Check for cost savings analysis, go to -------> Total_Analysis

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic and Transport Optimization Potential Cost Savings Analysis

Site: Umatilla Army Depot, Hermiston, Oregon

Expected Duration: 20
Discount Rate: 5%
Current forecasted cost (NPV): $5,613,603

	Reduction in time-to-close-out	Cost Savings by Scenario					
		Current	Scenario #1	Scenario #2	Scenario #3	Scenario #4	Scenario #5
Hydraulic Optimization	0%	$0	$415,486	$279,453	N/A	N/A	N/A
Transport Optimization	0%	$0	$362,986	$226,953	($201,033)	($669,901)	($795,934)
	10%	N/A	N/A	$549,752	$150,159	($294,290)	($417,159)
	20%	N/A	N/A	$905,637	$537,349	$119,821	$440
	30%	N/A	N/A	$1,298,000	$964,225	$576,378	$460,843

Hydraulic Optimization Summary

Maximum potential cost savings: $415,486

Transport Optimization Summary

Maximum potential cost savings, no reduction in cleanup time: $362,986
Maximum potential cost savings, 10% reduction in cleanup time: $549,752
Maximum potential cost savings, 20% reduction in cleanup time: $905,637
Maximum potential cost savings, 30% reduction in cleanup time: $1,298,000

Pre-Optimization Screening for Transport and Hydraulic Optimization

THIS WORKSHEET SUMMARIZES INPUT REQUIRED BY USER

Notes:

Users are only allowed to input information in "**General_Screening**", "**Infosheet (1)**", and "**Infosheet (2)**", other sheets are calculated automatically.

The fields that need to be filled out by users are highlighted in light-blue.

Instructions:

*Items 1 - 5c need to be entered in worksheet "**General_Screening**".*	
Item 1	Enter the name of the site or plume. This name will be used to identify the site throughout the screening process. The name should uniquely identify the site.
Item 2	Enter the date that this spreadsheet is completed.
Item 3	Enter your name. You will be the point of contact for this site during the pre-optimization screening process.
Item 4	Enter your affiliation (i.e., EPA, USACE, name of private contractor, etc.) and contact information.
Item 5a	Is the system annual O&M cost greater than $100K/yr? If lower than $100K/yr, this site is unlikely to benefit from hydraulic and/or transport optimization.
Item 5b	Is the flowrate lower than 50gpm? If less than 50 gpm, this site is unlikely to benefit from hydraulic and/or transport optimization.
Item 5c	Is site cleanup expected within 5 years? If less than 5 years, this site is unlikely to benefit from hydraulic and/or transport optimization.
*Only if the answers to Item 5a, 5b, and 5c are "Yes", and the user is insterested in quantifying potential cost savings by hydraulic and/or transport optimization, the following lines in worksheet "**Infosheet (1)**" need to be entered.*	
Item 6a	Enter the primary objective of the remediation system.
Item 6b	Enter the ease with which modifications (e.g., new wells, increased pumping rate, increased treatment capacity, etc.) can be made to the current remediation system.
Item 6c	Is cleanup of the site a feasible goal within 50 years based on the current system or a potentially modified pump-and-treat system? If there are continuing sources or contaminated immobile zones, cleanup may not be a realistic objective.
Item 6d	Are there unknown or uncharacterized sources of contamination at the site? If there are, transport model simulations will likely yield unreliable results. Containing the current plume may be a more practical objective until these sources are characterized.
Item 6e	If the answer to 5d is “yes”, can the site be divided into two regions, one with and one without uncharacterized sources? If the site can be divided into these two regions, transport optimization can be used potentially for the region with known and characterized sources.
Item 7	Enter the correct information about the system (number of wells, pumping rate, etc.) in the cells to the right of list. This information will be used to estimate the life-cycle costs associated with modified systems according to Scenarios.
Item 8a	Enter information regarding the site complexity (ranging from Level 1-- 4). This information is used to estimate the cost of the optimization analysis. Costs increase with site complexity.
Item 8b	Enter information regarding the flow and transport models for the site. This information is used to estimate the cost of the optimization analysis. If updated models are not available, costs for updating them will be included.
Item 9a	Enter the annual costs of the current O&M system and the estimated annual costs for Scenarios 1 and 2.
Item 9b	Enter the estimated up-front costs for Scenarios 1 and 2.
*Only if the site is classified as Tier 1 or Tier 1 and 2, and the user is interested in other optimization alternatives, the following lines in worksheet "**Infosheet (2)**" need to be entered.*	
Item 10a	Enter the estimated annual costs for Scenarios 3, 4, and 5.
Item 10b	Enter the estimated up-front costs for Scenarios 3, 4, and 5.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Step 1: General Information

1) Name of Site/Plume:	Tooele Army Depot, Tooele, Utah
2) Todays Date:	04/26/01
3) Your Name:	Yan Zhang
4a) Your Affiliation	GeoTrans, Inc.
4b) Your Contact Information	
Address	GeoTrans, Inc. 2 Paragon Way Freehold, NJ 07728
email	yzhang@geotransinc.com
Phone	(732) 409-0344
fax	(732) 409-3020

5) General Questions

5a) Are O&M costs > $100K/year (enter "y" or "n")?	**y**
5b) Is the system flowrate > 50gpm (enter "y" or "n")?	**y**
5c) Is the estimated cleanup time > 5 years (enter "y" or "n")?	**y**

**** Note: We strongly recommend applying quantitative screening to this site. Please fill in the required information on Infosheet (1).*

***** Note: If the anwer to all 3 questions above are "y", this site is more likely to potentially benefit from hydraulic and/or transport optimization. If the user is interested in quantifying potential cost savings that might result from hydraulic and/or transport optimzation simulation, please fill in the required information on "Infosheet(1)". Additionally, the user can goes to the FRTR optimization web site for information on hydraulic and transport optimization software.**

Click to go to -------> Infosheet (1)
Click to go to -------> FRTR Optimization Web site

Pre-Optimization Screening for Transport and Hydraulic Optimization

USER INPUT INTO THIS SHEET IS OPTIONAL
Fill in this sheet ONLY if the answer to all 3 questions in sheet "General_Screening" are "Yes" and you are interested in quantifying potential cost savings from hydraulic and/or transport optimization.

Site: Tooele Army Depot, Tooele, Utah

Step 2a: Site Background and Information

6) Background Questions

6a) What is the current main objective for the remediation system? *Choose one (1, 2 or 3)* 1. Cleanup 2. Containment 3. Both	**1**
6b) If optimization were to recommend modifications that would result in a significant reduction in remediation system life-cycle costs, describe the ease of implementing these modifications. *Choose one (1, 2, 3, 4, or 5)* 1. Easy 2. Relatively easy 3. Relatively difficult 4. Difficult 5. Impossible	**2**
6c) Are there any continuing sources, immobile zones, or other factors that likely would prevent a feasible pump-and-treat solution in 50 years or less? *Choose one (1, 2, or 3)* 1. Yes 2. No 3. Don't know	**2**
6d) Are there unknown or uncharacterized sources of contamination at the site? *Choose one (1, 2, or 3)* 1. Yes 2. No 3. Don't know	**2**
6e) If the anwer to question 6d) is Yes, can the site be divided into different operable units in which the unknown sources are contained or addressed by an alternative solution and the remaining portion can be cleaned up by a pump and treat system? *Choose one (1, 2, or 3) (Leave it* ***blank*** *if the answer to question 6d) is "No".)* 1. Yes 2. No 3. Don't know	

7) System Information

Expected duration (years)	**20**
Number of extraction wells	**16**
Total pumping rate (gpm)	**7500**
Total treatment capacity (gpm)	**7500**
Discount rate	**5%**

Pre-Optimization Screening for Transport and Hydraulic Optimization

8) Model/Site Information	
8a) How complex is the site? (Level 1 -- 4)	**1**
Choose one (1, 2, 3, or 4)	
Level 1: simulation of one contaminant sufficient for remedy evaluation, and less than 5 model layers	
Level 2: simulation of two contaminants sufficient for remedy evaluation, and/or 5-10 model layers	
Level 3: simulation of three or more contaminants required, and/or more than 10 model layers	
Level 4: rigorous simulation of both unsaturated and saturated zones, and/or multiple phases, and/or fractured bedrock in transport model	
8b) Model information *(Choose one, 1 or 2)*	
Is there an existing flow model?	**1**
1. Yes	
2. No	
Is the flow model up-to-date?	**2**
1. Yes	
2. No	
Is there an existing transport model?	**1**
1. Yes	
2. No	
Is the transport model up-to-date?	**2**
1. Yes	
2. No	

Step 2b: Current Costs		**Step 2c: Estimated Costs for Scenarios 1 & 2**	
		9a) Enter Annual Costs for Each Scenario	
Item	Current System	Scenario #1 no new extraction wells 33% less pumping	Scenario #2 new extraction wells (33% more) 33% less pumping
pumping rate (gpm)	7500	5025	5025
number of wells	16	16	22
Electric	$1,000,000	$800,000	$800,000
O&M labor	$500,000	$500,000	$500,000
Materials	$200,000	$133,333	$133,333
Maintenance	$30,000	$30,000	$30,000
Discharge Fees			
Analytical	$80,000	$80,000	$80,000
Other #1			
Other #2			
Other #3			
		9b) Enter Up-Front Costs for Each Scenario	
Item	Current System	Scenario #1 no new extraction wells 33% less pumping	Scenario #2 new extraction wells (33% more) 33% less pumping
Engineering design	$0	$40,000	$40,000
Regulatory Process	$0	$40,000	$40,000
New wells/pipes/equipment	$0		$1,800,000
Increased monitoring	$0		
Increased treatment capacity	$0		
Other #1	$0		
Other #2	$0		
Other #3	$0		

Check cost savings, go to ---------> Cost_Comp
Check site classification, go to ---------> Classify

Pre-Optimization Screening for Transport and Hydraulic Optimization

Costs of Modeling and Optimization Analyses

Site: Tooele Army Depot, Tooele, Utah

Based on information input by user, this site is Level: 1

	Flow Modeling	Transport Modeling	Optimization	Total
Hydraulic Optimization	$15,000	$0	$15,000	$30,000
Transport Optimization	$15,000	$15,000	$50,000	$80,000

Assumed Costs for Level 1: one contaminant simulated and less than 5 model layers

1. Cost for creating a new flow model for Level 1 is $30,000
2. Cost for updating an existing flow model for Level 1 is $15,000
3. Cost for hydraulic optimization for Level 1 is $15,000
4. Cost for creating a new transport model for Level 1 is $30,000
5. Cost for updating an existing transport model for Level 1 is $15,000
6. Cost for tranport optimization for Level 1 is $50,000

Escalation Factors for Levels 2-4

Level 2: Level 1 * 1.5
Level 3: Level 1 * 2.0
Level 4: Level 1 * 2.5

Note:

Level 1: simulation of one contaminant sufficient for remedy evaluation, and less than 5 model layers
Level 2: simulation of two contaminants sufficient for remedy evaluation, and/or 5-10 model layers
Level 3: simulation of three or more contaminants required, and/or more than 10 model layers
Level 4: rigorous simulation of both unsaturated and saturated zones, and/or multiple phases, and/or fractured bedrock in transport model

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Current System

Site: Tooele Army Depot, Tooele, Utah

pumping rate	7500
number of wells	16
Discount Rate:	5%

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$1,000,000	20	$13,085,321	$13,085,321
O&M labor	$0	$500,000	20	$6,542,660	$6,542,660
Materials	$0	$200,000	20	$2,617,064	$2,617,064
Maintenance	$0	$30,000	20	$392,560	$392,560
Discharge Fees	$0	$0	20	$0	$0
Analytical	$0	$80,000	20	$1,046,826	$1,046,826
Other #1	$0	$0	20	$0	$0
Other #2	$0	$0	20	$0	$0
Other #3	$0	$0	20	$0	$0
Costs of Analysis					
-Flow Modeling	$0			$0	$0
-Transport Modeling	$0			$0	$0
-Optimization	$0			$0	$0
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$0			$0	$0
-Regulatory Process	$0			$0	$0
-New wells/pipes/equipment	$0			$0	$0
-Increased monitoring	$0			$0	$0
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$0**	**$1,810,000**		**$23,684,431**	**$23,684,431**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Scenario #1

Site: Tooele Army Depot, Tooele, Utah

pumping rate	5025	(reduction of 33% from current system)
number of wells	16	(same as current system)
Discount Rate:	5%	

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$800,000	20	$10,468,257	$10,468,257
O&M labor	$0	$500,000	20	$6,542,660	$6,542,660
Materials	$0	$133,333	20	$1,744,705	$1,744,705
Maintenance	$0	$30,000	20	$392,560	$392,560
Discharge Fees	$0	$0	20	$0	$0
Analytical	$0	$80,000	20	$1,046,826	$1,046,826
Other #1	$0	$0	20	$0	$0
Other #2	$0	$0	20	$0	$0
Other #3	$0	$0	20	$0	$0
Costs of Analysis					
-Flow Modeling	$15,000			$0	$15,000
-Transport Modeling	$0			$0	$0
-Optimization	$15,000			$0	$15,000
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$40,000			$0	$40,000
-Regulatory Process	$40,000			$0	$40,000
-New wells/pipes/equipment	$0			$0	$0
-Increased monitoring	$0			$0	$0
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$110,000**	**$1,543,333**		**$20,195,007**	**$20,305,007**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Scenario #2

Site: Tooele Army Depot, Tooele, Utah

pumping rate	5025	(reduction of 33% from current system)
number of wells	22	(increase of 33% from current system)
Discount Rate:	5%	

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$800,000	20	$10,468,257	$10,468,257
O&M labor	$0	$500,000	20	$6,542,660	$6,542,660
Materials	$0	$133,333	20	$1,744,705	$1,744,705
Maintenance	$0	$30,000	20	$392,560	$392,560
Discharge Fees	$0	$0	20	$0	$0
Analytical	$0	$80,000	20	$1,046,826	$1,046,826
Other #1	$0	$0	20	$0	$0
Other #2	$0	$0	20	$0	$0
Other #3	$0	$0	20	$0	$0
Costs of Analysis					
-Flow Modeling	$15,000			$0	$15,000
-Transport Modeling	$0			$0	$0
-Optimization	$15,000			$0	$15,000
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$40,000			$0	$40,000
-Regulatory Process	$40,000			$0	$40,000
-New wells/pipes/equipment	$1,800,000			$0	$1,800,000
-Increased monitoring	$0			$0	$0
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$1,910,000**	**$1,543,333**		**$20,195,007**	**$22,105,007**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Transport Optimization Screening Analysis -- All Scenarios

Site: Tooele Army Depot, Tooele, Utah

Discount Rate: 5%

Scenario 1: pumping rate decreased by 33%, no new wells
Scenario 2: pumping rate decreased by 33%, plus 33% additional wells (new)
Scenario 3: current pumping rate, plus 33% additional wells (new)
Scenario 4: pumping rate increased by 33%, no new wells
Scenario 5: pumping rate increased by 33%, plus 33% additional wells (new)

	Current	Scenario #1	Scenario #2	Scenario #3	Scenario #4	Scenario #5
pumping rate (gpm)	**7500**	**5025**	**5025**	**7500**	**9975**	**9975**
number of wells	**16**	**16**	**22**	**22**	**16**	**22**
	Annual	**Annual**	**Annual**	**Annual**	**Annual**	**Annual**
O&M Costs						
Electric	$1,000,000	$800,000	$800,000	$0	$0	$0
O&M labor	$500,000	$500,000	$500,000	$0	$0	$0
Materials	$200,000	$133,333	$133,333	$0	$0	$0
Maintenance	$30,000	$30,000	$30,000	$0	$0	$0
Discharge Fees	$0	$0	$0	$0	$0	$0
Analytical	$80,000	$80,000	$80,000	$0	$0	$0
Other #1	$0	$0	$0	$0	$0	$0
Other #2	$0	$0	$0	$0	$0	$0
Other #3	$0	$0	$0	$0	$0	$0
Annual Subtotal	$1,810,000	$1,543,333	$1,543,333	$0	$0	$0
	Upfront	**Upfront**	**Upfront**	**Upfront**	**Upfront**	**Upfront**
Costs of Analysis						
-Flow Modeling	$0	$15,000	$15,000	$0	$0	$0
-Transport Modeling	$0	$15,000	$15,000	$0	$0	$0
-Optimization	$0	$50,000	$50,000	$0	$0	$0
System Modification Costs						
-Engineering design	$0	$40,000	$40,000	$0	$0	$0
-Regulatory Process	$0	$40,000	$40,000	$0	$0	$0
-New wells/pipes/equipment	$0	$0	$1,800,000	$0	$0	$0
-Increased monitoring	$0	$0	$0	$0	$0	$0
-Increased treatment capacity	$0	$0	$0	$0	$0	$0
-Other #1	$0	$0	$0	$0	$0	$0
-Other #2	$0	$0	$0	$0	$0	$0
Upfront Subtotal	$0	$160,000	$1,960,000	$0	$0	$0
Life-cycle costs (NPV)	$23,684,431	$20,355,007	$22,155,007	$0	$0	$0

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic and Transport Optimization Potential Cost Savings Analysis

Site: Tooele Army Depot, Tooele, Utah

Expected Duration:	20
Discount Rate:	5%
Current forecasted cost (NPV):	$23,684,431

	Assumed Reduction in Time-to-Close-Out	Cost Savings by Scenario		
		Current	Scenario #1	Scenario #2
Hydraulic Optimization	0%	$0	$3,379,423	$1,579,423
Transport Optimization	0%	$0	$3,329,423	$1,529,423
	10%	N/A	N/A	$2,781,459
	20%	N/A	N/A	$4,161,829
	30%	N/A	N/A	$5,683,687

Pre-Optimization Screening for Transport and Hydraulic Optimization

Site Classification

Site: Tooele Army Depot, Tooele, Utah

Basic Information:

The primary site objective is cleanup.
A feasible pump-and-treat cleanup solution with a time frame of less than 50 years exists.
There are no uncharacterized or unknown sources of contamination at the site.

Site Classification: Tier **1 and 2**

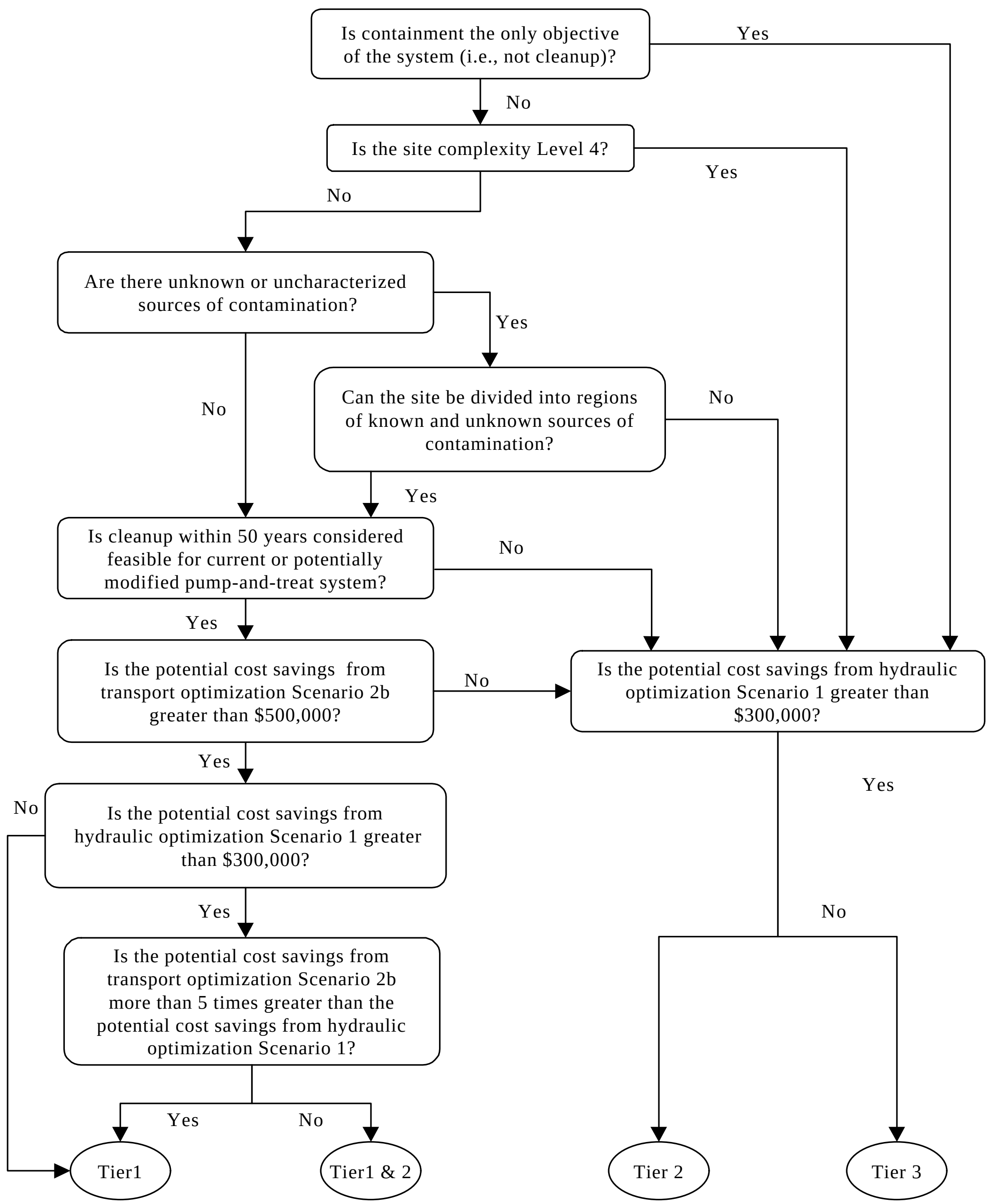
****Note: Please review the "**Cost_Comp**" worksheet for more detailed information regarding the potential cost savings associated with specific scenarios.*

******We strongly suggest applying alternative transport optimization scenarios to this site. Please go to Infosheet (2) to enter additional cost information for Scenarios 3 through 5.***

For additonal scenarios, go to ----------> Infosheet (2)

Pre-Optimization Screening for Transport and Hydraulic Optimization

Rationale for Classifying Sites into Tiers



Pre-Optimization Screening for Transport and Hydraulic Optimization

USER INPUT INTO THIS SHEET IS OPTIONAL
Fill out this table ONLY if the site is classified as Tier 1 (or Tier 1 and 2), and if you are interested in evaluating additional transport optimization alternatives.

Site: Tooele Army Depot, Tooele, Utah

Estimated Costs for Transport Optimization Scenarios

10a) Enter Annual Costs for Each Scenario

Item	Scenario #3 new extraction wells (33% more) no change to pumping	Scenario #4 no new extraction wells 33% more pumping	Scenario #5 new extraction wells (33% more) 33% more pumping
pumping rate (gpm)	7500	9975	9975
number of wells	22	16	22
Electric			
O&M labor			
Materials			
Maintenance			
Discharge Fees			
Analytical			
Other #1			
Other #2			
Other #3			

****Warning: Total pumping rates exceed the current treatment capacity in Scenarios 4 & 5. Thus, the treatment capacity needs to be increased. Please enter capital costs for 'increased treatment capacity' in the table below.*

10b) Enter Up-Front Costs for Each Scenario

Item	Scenario #3 new extraction wells (33% more) no change to pumping	Scenario #4 no new extraction wells 33% more pumping	Scenario #5 new extraction wells (33% more) 33% more pumping
Engineering design			
Regulatory Process			
New wells/pipes/equipment			
Increased monitoring			
Increased treatment capacity			
Other #1			
Other #2			
Other #3			

Check for cost savings analysis, go to -------> Total_Analysis

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic and Transport Optimization Potential Cost Savings Analysis

Site: Tooele Army Depot, Tooele, Utah

Expected Duration:	20
Discount Rate:	5%
Current forecasted cost (NPV):	$23,684,431

	Reduction in time-to-close-out	Cost Savings by Scenario					
		Current	Scenario #1	Scenario #2	Scenario #3	Scenario #4	Scenario #5
Hydraulic Optimization	0%	$0	$3,379,423	$1,579,423	N/A	N/A	N/A
Transport Optimization	0%	$0	$3,329,423	$1,529,423			
	10%	N/A	N/A	$2,781,459			
	20%	N/A	N/A	$4,161,829			
	30%	N/A	N/A	$5,683,687			

Hydraulic Optimization Summary

Maximum potential cost savings:	$3,379,423

Transport Optimization Summary

Maximum potential cost savings, no reduction in cleanup time:	$3,329,423
Maximum potential cost savings, 10% reduction in cleanup time:	$2,781,459
Maximum potential cost savings, 20% reduction in cleanup time:	$4,161,829
Maximum potential cost savings, 30% reduction in cleanup time:	$5,683,687

Pre-Optimization Screening for Transport and Hydraulic Optimization

THIS WORKSHEET SUMMARIZES INPUT REQUIRED BY USER

Notes:

Users are only allowed to input information in "**General_Screening**", "**Infosheet (1)**", and "**Infosheet (2)**", other sheets are calculated automatically.

The fields that need to be filled out by users are highlighted in light-blue.

Instructions:

*Items 1 - 5c need to be entered in worksheet "**General_Screening**".*	
Item 1	Enter the name of the site or plume. This name will be used to identify the site throughout the screening process. The name should uniquely identify the site.
Item 2	Enter the date that this spreadsheet is completed.
Item 3	Enter your name. You will be the point of contact for this site during the pre-optimization screening process.
Item 4	Enter your affiliation (i.e., EPA, USACE, name of private contractor, etc.) and contact information.
Item 5a	Is the system annual O&M cost greater than $100K/yr? If lower than $100K/yr, this site is unlikely to benefit from hydraulic and/or transport optimization.
Item 5b	Is the flowrate lower than 50gpm? If less than 50 gpm, this site is unlikely to benefit from hydraulic and/or transport optimization.
Item 5c	Is site cleanup expected within 5 years? If less than 5 years, this site is unlikely to benefit from hydraulic and/or transport optimization.
*Only if the answers to Item 5a, 5b, and 5c are "Yes", and the user is insterested in quantifying potential cost savings by hydraulic and/or transport optimization, the following lines in worksheet "**Infosheet (1)**" need to be entered.*	
Item 6a	Enter the primary objective of the remediation system.
Item 6b	Enter the ease with which modifications (e.g., new wells, increased pumping rate, increased treatment capacity, etc.) can be made to the current remediation system.
Item 6c	Is cleanup of the site a feasible goal within 50 years based on the current system or a potentially modified pump-and-treat system? If there are continuing sources or contaminated immobile zones, cleanup may not be a realistic objective.
Item 6d	Are there unknown or uncharacterized sources of contamination at the site? If there are, transport model simulations will likely yield unreliable results. Containing the current plume may be a more practical objective until these sources are characterized.
Item 6e	If the answer to 5d is "yes", can the site be divided into two regions, one with and one without uncharacterized sources? If the site can be divided into these two regions, transport optimization can be used potentially for the region with known and characterized sources.
Item 7	Enter the correct information about the system (number of wells, pumping rate, etc.) in the cells to the right of list. This information will be used to estimate the life-cycle costs associated with modified systems according to Scenarios.
Item 8a	Enter information regarding the site complexity (ranging from Level 1-- 4). This information is used to estimate the cost of the optimization analysis. Costs increase with site complexity.
Item 8b	Enter information regarding the flow and transport models for the site. This information is used to estimate the cost of the optimization analysis. If updated models are not available, costs for updating them will be included.
Item 9a	Enter the annual costs of the current O&M system and the estimated annual costs for Scenarios 1 and 2.
Item 9b	Enter the estimated up-front costs for Scenarios 1 and 2.
*Only if the site is classified as Tier 1 or Tier 1 and 2, and the user is insterested in other optimization alternatives, the following lines in worksheet "**Infosheet (2)**" need to be entered.*	
Item 10a	Enter the estimated annual costs for Scenarios 3, 4, and 5.
Item 10b	Enter the estimated up-front costs for Scenarios 3, 4, and 5.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Step 1: General Information

1) Name of Site/Plume:	George Air Force Base, Victorville, CA
2) Todays Date:	04/26/01
3) Your Name:	Yan Zhang
4a) Your Affiliation	GeoTrans, Inc.
4b) Your Contact Information	
Address	GeoTrans, Inc. 2 Paragon Way Freehold, NJ 07728
email	yzhang@geotransinc.com
Phone	(732) 409-0344
fax	(732) 409-3020

5) General Questions

5a) Are O&M costs > $100K/year (enter "y" or "n")?	**y**
5b) Is the system flowrate > 50gpm (enter "y" or "n")?	**y**
5c) Is the estimated cleanup time > 5 years (enter "y" or "n")?	**y**

**** Note: We strongly recommend applying quantitative screening to this site. Please fill in the required information on Infosheet (1).*

***** Note: If the anwer to all 3 questions above are "y", this site is more likely to potentially benefit from hydraulic and/or transport optimization. If the user is interested in quantifying potential cost savings that might result from hydraulic and/or transport optimzation simulation, please fill in the required information on "Infosheet(1)". Additionally, the user can goes to the FRTR optimization web site for information on hydraulic and transport optimization software.**

Click to go to -------> Infosheet (1)
Click to go to -------> FRTR Optimization Web site

Pre-Optimization Screening for Transport and Hydraulic Optimization

USER INPUT INTO THIS SHEET IS OPTIONAL
Fill in this sheet ONLY if the answer to all 3 questions in sheet "General_Screening" are "Yes" and you are interested in quantifying potential cost savings from hydraulic and/or transport optimization.

Site:George Air Force Base, Victorville, CA

Step 2a: Site Background and Information

6) Background Questions

6a) What is the current main objective for the remediation system? *Choose one (1, 2 or 3)* 1. Cleanup 2. Containment 3. Both	**3**
6b) If optimization were to recommend modifications that would result in a significant reduction in remediation system life-cycle costs, describe the ease of implementing these modifications. *Choose one (1, 2, 3, 4, or 5)* 1. Easy 2. Relatively easy 3. Relatively difficult 4. Difficult 5. Impossible	**2**
6c) Are there any continuing sources, immobile zones, or other factors that likely would prevent a feasible pump-and-treat solution in 50 years or less? *Choose one (1, 2, or 3)* 1. Yes 2. No 3. Don't know	**3**
6d) Are there unknown or uncharacterized sources of contamination at the site? *Choose one (1, 2, or 3)* 1. Yes 2. No 3. Don't know	**3**
6e) If the anwer to question 6d) is Yes, can the site be divided into different operable units in which the unknown sources are contained or addressed by an alternative solution and the remaining portion can be cleaned up by a pump and treat system? *Choose one (1, 2, or 3) (Leave it **blank** if the answer to question 6d) is "No".)* 1. Yes 2. No 3. Don't know	

7) System Information

Expected duration (years)	**30**
Number of extraction wells	**12**
Total pumping rate (gpm)	**250**
Total treatment capacity (gpm)	**500**
Discount rate	**5%**

Pre-Optimization Screening for Transport and Hydraulic Optimization

8) Model/Site Information

8a) How complex is the site? (Level 1 -- 4)	**1**
Choose one (1, 2, 3, or 4)	
Level 1: simulation of one contaminant sufficient for remedy evaluation, and less than 5 model layers	
Level 2: simulation of two contaminants sufficient for remedy evaluation, and/or 5-10 model layers	
Level 3: simulation of three or more contaminants required, and/or more than 10 model layers	
Level 4: rigorous simulation of both unsaturated and saturated zones, and/or multiple phases, and/or fractured bedrock in transport model	
8b) Model information *(Choose one, 1 or 2)*	
Is there an existing flow model?	**1**
1. Yes	
2. No	
Is the flow model up-to-date?	**2**
1. Yes	
2. No	
Is there an existing transport model?	**1**
1. Yes	
2. No	
Is the transport model up-to-date?	**2**
1. Yes	
2. No	

Step 2b: Current Costs		**Step 2c: Estimated Costs for Scenarios 1 & 2**	
		9a) Enter Annual Costs for Each Scenario	
Item	Current System	Scenario #1 no new extraction wells 33% less pumping	Scenario #2 new extraction wells (33% more) 33% less pumping
pumping rate (gpm)	250	167.5	167.5
number of wells	12	12	16
Electric	$100,000	$80,000	$80,000
O&M labor	$150,000	$150,000	$150,000
Materials			
Maintenance	$50,000	$50,000	$50,000
Discharge Fees			
Analytical			
Other #1			
Other #2			
Other #3			
		9b) Enter Up-Front Costs for Each Scenario	
Item	Current System	Scenario #1 no new extraction wells 33% less pumping	Scenario #2 new extraction wells (33% more) 33% less pumping
Engineering design	$0	$10,000	$15,000
Regulatory Process	$0	$10,000	$15,000
New wells/pipes/equipment	$0		$160,000
Increased monitoring	$0		
Increased treatment capacity	$0		
Other #1	$0		
Other #2	$0		
Other #3	$0		

Check cost savings, go to ---------> Cost_Comp
Check site classification, go to ---------> Classify

Pre-Optimization Screening for Transport and Hydraulic Optimization

Costs of Modeling and Optimization Analyses

Site: George Air Force Base, Victorville, CA

Based on information input by user, this site is Level: 1

	Flow Modeling	Transport Modeling	Optimization	Total
Hydraulic Optimization	$15,000	$0	$15,000	$30,000
Transport Optimization	$15,000	$15,000	$50,000	$80,000

Assumed Costs for Level 1: one contaminant simulated and less than 5 model layers

1. Cost for creating a new flow model for Level 1 is $30,000
2. Cost for updating an existing flow model for Level 1 is $15,000
3. Cost for hydraulic optimization for Level 1 is $15,000
4. Cost for creating a new transport model for Level 1 is $30,000
5. Cost for updating an existing transport model for Level 1 is $15,000
6. Cost for tranport optimization for Level 1 is $50,000

Escalation Factors for Levels 2-4

Level 2: Level 1 * 1.5
Level 3: Level 1 * 2.0
Level 4: Level 1 * 2.5

Note:

Level 1: simulation of one contaminant sufficient for remedy evaluation, and less than 5 model layers
Level 2: simulation of two contaminants sufficient for remedy evaluation, and/or 5-10 model layers
Level 3: simulation of three or more contaminants required, and/or more than 10 model layers
Level 4: rigorous simulation of both unsaturated and saturated zones, and/or multiple phases, and/or fractured bedrock in transport model

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Current System

Site: George Air Force Base, Victorville, CA

pumping rate	250
number of wells	12
Discount Rate:	5%

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$100,000	30	$1,614,107	$1,614,107
O&M labor	$0	$150,000	30	$2,421,161	$2,421,161
Materials	$0	$0	30	$0	$0
Maintenance	$0	$50,000	30	$807,054	$807,054
Discharge Fees	$0	$0	30	$0	$0
Analytical	$0	$0	30	$0	$0
Other #1	$0	$0	30	$0	$0
Other #2	$0	$0	30	$0	$0
Other #3	$0	$0	30	$0	$0
Costs of Analysis					
-Flow Modeling	$0			$0	$0
-Transport Modeling	$0			$0	$0
-Optimization	$0			$0	$0
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$0			$0	$0
-Regulatory Process	$0			$0	$0
-New wells/pipes/equipment	$0			$0	$0
-Increased monitoring	$0			$0	$0
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$0**	**$300,000**		**$4,842,322**	**$4,842,322**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Scenario #1

Site: George Air Force Base, Victorville, CA

pumping rate	167.5	(reduction of 33% from current system)
number of wells	12	(same as current system)
Discount Rate:	5%	

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$80,000	30	$1,291,286	$1,291,286
O&M labor	$0	$150,000	30	$2,421,161	$2,421,161
Materials	$0	$0	30	$0	$0
Maintenance	$0	$50,000	30	$807,054	$807,054
Discharge Fees	$0	$0	30	$0	$0
Analytical	$0	$0	30	$0	$0
Other #1	$0	$0	30	$0	$0
Other #2	$0	$0	30	$0	$0
Other #3	$0	$0	30	$0	$0
Costs of Analysis					
-Flow Modeling	$15,000			$0	$15,000
-Transport Modeling	$0			$0	$0
-Optimization	$15,000			$0	$15,000
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$10,000			$0	$10,000
-Regulatory Process	$10,000			$0	$10,000
-New wells/pipes/equipment	$0			$0	$0
-Increased monitoring	$0			$0	$0
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$50,000**	**$280,000**		**$4,519,501**	**$4,569,501**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Scenario #2

Site: George Air Force Base, Victorville, CA

pumping rate	167.5	(reduction of 33% from current system)
number of wells	16	(increase of 33% from current system)
Discount Rate:	5%	

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$80,000	30	$1,291,286	$1,291,286
O&M labor	$0	$150,000	30	$2,421,161	$2,421,161
Materials	$0	$0	30	$0	$0
Maintenance	$0	$50,000	30	$807,054	$807,054
Discharge Fees	$0	$0	30	$0	$0
Analytical	$0	$0	30	$0	$0
Other #1	$0	$0	30	$0	$0
Other #2	$0	$0	30	$0	$0
Other #3	$0	$0	30	$0	$0
Costs of Analysis					
-Flow Modeling	$15,000			$0	$15,000
-Transport Modeling	$0			$0	$0
-Optimization	$15,000			$0	$15,000
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$15,000			$0	$15,000
-Regulatory Process	$15,000			$0	$15,000
-New wells/pipes/equipment	$160,000			$0	$160,000
-Increased monitoring	$0			$0	$0
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$220,000**	**$280,000**		**$4,519,501**	**$4,739,501**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Transport Optimization Screening Analysis -- All Scenarios

Site: George Air Force Base, Victorville, CA

Discount Rate: 5%

Scenario 1: pumping rate decreased by 33%, no new wells
Scenario 2: pumping rate decreased by 33%, plus 33% additional wells (new)
Scenario 3: current pumping rate, plus 33% additional wells (new)
Scenario 4: pumping rate increased by 33%, no new wells
Scenario 5: pumping rate increased by 33%, plus 33% additional wells (new)

	Current	Scenario #1	Scenario #2	Scenario #3	Scenario #4	Scenario #5
pumping rate (gpm)	**250**	**167.5**	**167.5**	**250**	**332.5**	**332.5**
number of wells	**12**	**12**	**16**	**16**	**12**	**16**
	Annual	**Annual**	**Annual**	**Annual**	**Annual**	**Annual**
O&M Costs						
Electric	$100,000	$80,000	$80,000	$0	$0	$0
O&M labor	$150,000	$150,000	$150,000	$0	$0	$0
Materials	$0	$0	$0	$0	$0	$0
Maintenance	$50,000	$50,000	$50,000	$0	$0	$0
Discharge Fees	$0	$0	$0	$0	$0	$0
Analytical	$0	$0	$0	$0	$0	$0
Other #1	$0	$0	$0	$0	$0	$0
Other #2	$0	$0	$0	$0	$0	$0
Other #3	$0	$0	$0	$0	$0	$0
Annual Subtotal	$300,000	$280,000	$280,000	$0	$0	$0
	Upfront	**Upfront**	**Upfront**	**Upfront**	**Upfront**	**Upfront**
Costs of Analysis						
-Flow Modeling	$0	$15,000	$15,000	$0	$0	$0
-Transport Modeling	$0	$15,000	$15,000	$0	$0	$0
-Optimization	$0	$50,000	$50,000	$0	$0	$0
System Modification Costs						
-Engineering design	$0	$10,000	$15,000	$0	$0	$0
-Regulatory Process	$0	$10,000	$15,000	$0	$0	$0
-New wells/pipes/equipment	$0	$0	$160,000	$0	$0	$0
-Increased monitoring	$0	$0	$0	$0	$0	$0
-Increased treatment capacity	$0	$0	$0	$0	$0	$0
-Other #1	$0	$0	$0	$0	$0	$0
-Other #2	$0	$0	$0	$0	$0	$0
Upfront Subtotal	$0	$100,000	$270,000	$0	$0	$0
Life-cycle costs (NPV)	$4,842,322	$4,619,501	$4,789,501	$0	$0	$0

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic and Transport Optimization Potential Cost Savings Analysis

Site: George Air Force Base, Victorville, CA

Expected Duration:	30
Discount Rate:	5%
Current forecasted cost (NPV):	$4,842,322

	Assumed Reduction in Time-to-Close-Out	**Cost Savings by Scenario**		
		Current	Scenario #1	Scenario #2
Hydraulic Optimization	0%	$0	$272,821	$102,821
Transport Optimization	0%	$0	$222,821	$52,821
	10%	N/A	N/A	$267,270
	20%	N/A	N/A	$515,521
	30%	N/A	N/A	$802,903

Pre-Optimization Screening for Transport and Hydraulic Optimization

Site Classification

Site: George Air Force Base, Victorville, CA

Basic Information:

Both cleanup and containment are site objectives.
The presence of a continuing source or immobile zones prevents a feasible pump-and-treat cleanup
There are unknown and uncharacterized sources of contamination at this site. Containment may be more appropriate.

Site Classification: Tier **1**

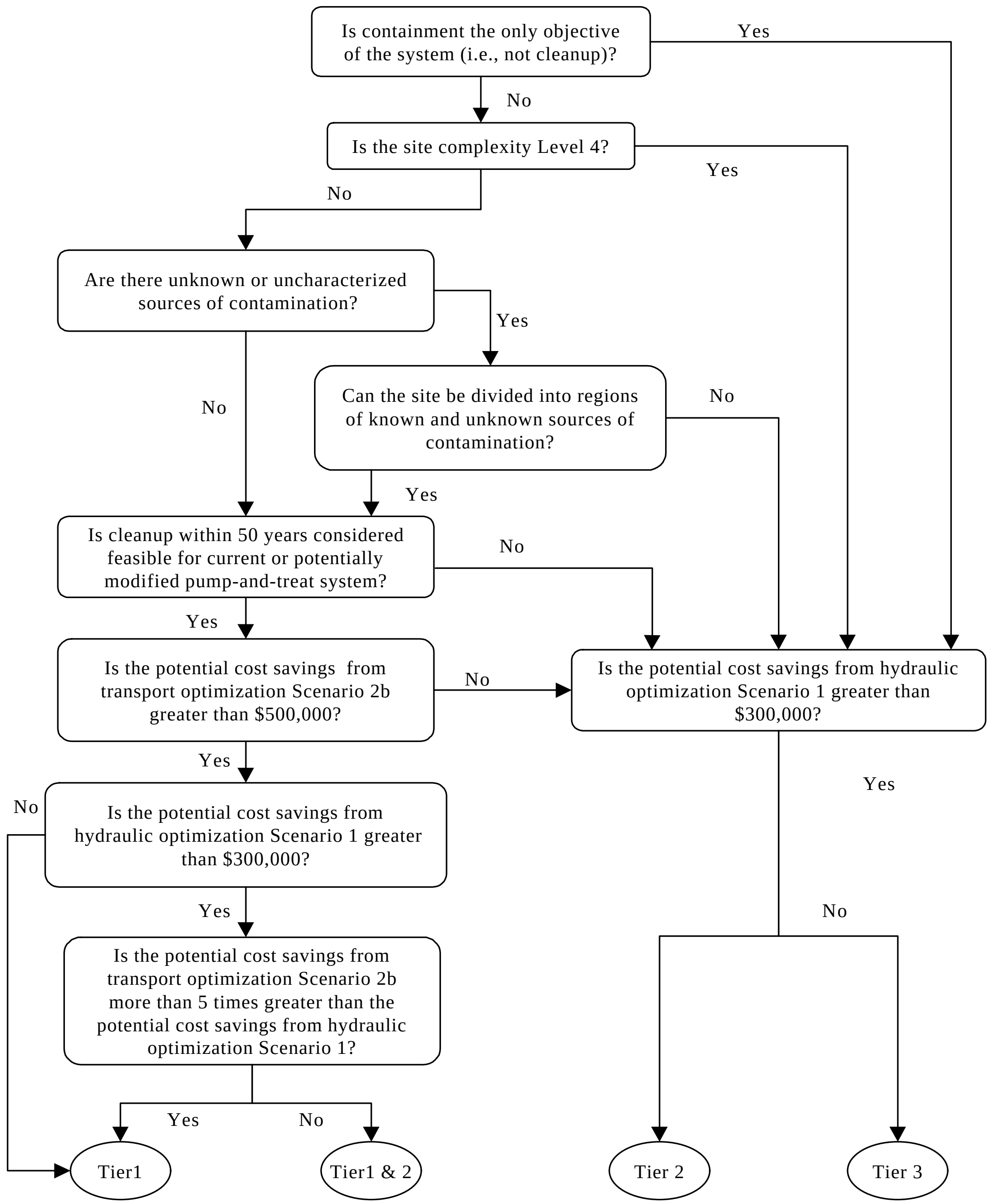
****Note: Please review the "**Cost_Comp**" worksheet for more detailed information regarding the potential cost savings associated with specific scenarios.*

******We strongly suggest applying alternative transport optimization scenarios to this site. Please go to Infosheet (2) to enter additional cost information for Scenarios 3 through 5.***

For additonal scenarios, go to ----------> Infosheet (2)

Pre-Optimization Screening for Transport and Hydraulic Optimization

Rationale for Classifying Sites into Tiers



File: GeorgeScr_Draft 042701.xls, Sheet:Classify

Pre-Optimization Screening for Transport and Hydraulic Optimization

USER INPUT INTO THIS SHEET IS OPTIONAL
Fill out this table ONLY if the site is classified as Tier 1 (or Tier 1 and 2), and if you are interested in evaluating additional transport optimization alternatives.

Site: George Air Force Base, Victorville, CA

Estimated Costs for Transport Optimization Scenarios

10a) Enter Annual Costs for Each Scenario

Item	Scenario #3 new extraction wells (33% more) no change to pumping	Scenario #4 no new extraction wells 33% more pumping	Scenario #5 new extraction wells (33% more) 33% more pumping
pumping rate (gpm)	250	332.5	332.5
number of wells	16	12	16
Electric			
O&M labor			
Materials			
Maintenance			
Discharge Fees			
Analytical			
Other #1			
Other #2			
Other #3			

10b) Enter Up-Front Costs for Each Scenario

Item	Scenario #3 new extraction wells (33% more) no change to pumping	Scenario #4 no new extraction wells 33% more pumping	Scenario #5 new extraction wells (33% more) 33% more pumping
Engineering design			
Regulatory Process			
New wells/pipes/equipment			
Increased monitoring			
Increased treatment capacity			
Other #1			
Other #2			
Other #3			

Check for cost savings analysis, go to -------> Total_Analysis

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic and Transport Optimization Potential Cost Savings Analysis

Site: George Air Force Base, Victorville, CA

Expected Duration:	30
Discount Rate:	5%
Current forecasted cost (NPV):	$4,842,322

	Reduction in time-to-close-out	Cost Savings by Scenario					
		Current	Scenario #1	Scenario #2	Scenario #3	Scenario #4	Scenario #5
Hydraulic Optimization	0%	$0	$272,821	$102,821	N/A	N/A	N/A
Transport Optimization	0%	$0	$222,821	$52,821			
	10%	N/A	N/A	$267,270			
	20%	N/A	N/A	$515,521			
	30%	N/A	N/A	$802,903			

<u>Hydraulic Optimization Summary</u>

Maximum potential cost savings:	$272,821

<u>Transport Optimization Summary</u>

Maximum potential cost savings, no reduction in cleanup time:	$222,821
Maximum potential cost savings, 10% reduction in cleanup time:	$267,270
Maximum potential cost savings, 20% reduction in cleanup time:	$515,521
Maximum potential cost savings, 30% reduction in cleanup time:	$802,903

Pre-Optimization Screening for Transport and Hydraulic Optimization

THIS WORKSHEET SUMMARIZES INPUT REQUIRED BY USER

Notes:

Users are only allowed to input information in "**General_Screening**", "**Infosheet (1)**", and "**Infosheet (2)**", other sheets are calculated automatically.

The fields that need to be filled out by users are highlighted in light-blue.

Instructions:

*Items 1 - 5c need to be entered in worksheet "**General_Screening**".*

Item 1	Enter the name of the site or plume. This name will be used to identify the site throughout the screening process. The name should uniquely identify the site.
Item 2	Enter the date that this spreadsheet is completed.
Item 3	Enter your name. You will be the point of contact for this site during the pre-optimization screening process.
Item 4	Enter your affiliation (i.e., EPA, USACE, name of private contractor, etc.) and contact information.
Item 5a	Is the system annual O&M cost greater than $100K/yr? If lower than $100K/yr, this site is unlikely to benefit from hydraulic and/or transport optimization.
Item 5b	Is the flowrate lower than 50gpm? If less than 50 gpm, this site is unlikely to benefit from hydraulic and/or transport optimization.
Item 5c	Is site cleanup expected within 5 years? If less than 5 years, this site is unlikely to benefit from hydraulic and/or transport optimization.

*Only if the answers to Item 5a, 5b, and 5c are "Yes", and the user is insterested in quantifying potential cost savings by hydraulic and/or transport optimization, the following lines in worksheet "**Infosheet (1)**" need to be entered.*

Item 6a	Enter the primary objective of the remediation system.
Item 6b	Enter the ease with which modifications (e.g., new wells, increased pumping rate, increased treatment capacity, etc.) can be made to the current remediation system.
Item 6c	Is cleanup of the site a feasible goal within 50 years based on the current system or a potentially modified pump-and-treat system? If there are continuing sources or contaminated immobile zones, cleanup may not be a realistic objective.
Item 6d	Are there unknown or uncharacterized sources of contamination at the site? If there are, transport model simulations will likely yield unreliable results. Containing the current plume may be a more practical objective until these sources are characterized.
Item 6e	If the answer to 5d is “yes”, can the site be divided into two regions, one with and one without uncharacterized sources? If the site can be divided into these two regions, transport optimization can be used potentially for the region with known and characterized sources.
Item 7	Enter the correct information about the system (number of wells, pumping rate, etc.) in the cells to the right of list. This information will be used to estimate the life-cycle costs associated with modified systems according to Scenarios.
Item 8a	Enter information regarding the site complexity (ranging from Level 1-- 4). This information is used to estimate the cost of the optimization analysis. Costs increase with site complexity.
Item 8b	Enter information regarding the flow and transport models for the site. This information is used to estimate the cost of the optimization analysis. If updated models are not available, costs for updating them will be included.
Item 9a	Enter the annual costs of the current O&M system and the estimated annual costs for Scenarios 1 and 2.
Item 9b	Enter the estimated up-front costs for Scenarios 1 and 2.

*Only if the site is classified as Tier 1 or Tier 1 and 2, and the user is insterested in other optimization alternatives, the following lines in worksheet "**Infosheet (2)**" need to be entered.*

Item 10a	Enter the estimated annual costs for Scenarios 3, 4, and 5.
Item 10b	Enter the estimated up-front costs for Scenarios 3, 4, and 5.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Step 1: General Information

1) Name of Site/Plume:	Wurtsmith AFB, Oscoda, Michigan
2) Todays Date:	02/21/01
3) Your Name:	Kathy Yager
4a) Your Affiliation	US EPA
4b) Your Contact Information	
Address	2890 Woodbridge Ave Edison, NJ 08837
email	yager.kathleen@epa.gov
Phone	732-321-6738
fax	732-321-4484

5) General Questions

5a) Are O&M costs > $100K/year (enter "y" or "n")?	**y**
5b) Is the system flowrate > 50gpm (enter "y" or "n")?	**y**
5c) Is the estimated cleanup time > 5 years (enter "y" or "n")?	**y**

**** Note: We strongly recommend applying quantitative screening to this site. Please fill in the required information on Infosheet (1).*

***** Note: If the anwer to all 3 questions above are "y", this site is more likely to potentially benefit from hydraulic and/or transport optimization. If the user is interested in quantifying potential cost savings that might result from hydraulic and/or transport optimzation simulation, please fill in the required information on "Infosheet(1)". Additionally, the user can goes to the FRTR optimization web site for information on hydraulic and transport optimization software.**

Click to go to -------> Infosheet (1)
Click to go to -------> FRTR Optimization Web site

Pre-Optimization Screening for Transport and Hydraulic Optimization

USER INPUT INTO THIS SHEET IS OPTIONAL
Fill in this sheet ONLY if the answer to all 3 questions in sheet "General_Screening" are "Yes" and you are interested in quantifying potential cost savings from hydraulic and/or transport optimization.

Site: Wurtsmith AFB, Oscoda, Michigan

Step 2a: Site Background and Information

6) Background Questions	
6a) What is the current main objective for the remediation system? *Choose one (1, 2 or 3)* 1. Cleanup 2. Containment 3. Both	**3**
6b) If optimization were to recommend modifications that would result in a significant reduction in remediation system life-cycle costs, describe the ease of implementing these modifications. *Choose one (1, 2, 3, 4, or 5)* 1. Easy 2. Relatively easy 3. Relatively difficult 4. Difficult 5. Impossible	**2**
6c) Are there any continuing sources, immobile zones, or other factors that likely would prevent a feasible pump-and-treat solution in 50 years or less? *Choose one (1, 2, or 3)* 1. Yes 2. No 3. Don't know	**3**
6d) Are there unknown or uncharacterized sources of contamination at the site? *Choose one (1, 2, or 3)* 1. Yes 2. No 3. Don't know	**1**
6e) If the anwer to question 6d) is Yes, can the site be divided into different operable units in which the unknown sources are contained or addressed by an alternative solution and the remaining portion can be cleaned up by a pump and treat system? *Choose one (1, 2, or 3) (Leave it **blank** if the answer to question 6d) is "No".)* 1. Yes 2. No 3. Don't know	**1**

7) System Information	
Expected duration (years)	**15**
Number of extraction wells	**4**
Total pumping rate (gpm)	**750**
Total treatment capacity (gpm)	**750**
Discount rate	**5%**

Pre-Optimization Screening for Transport and Hydraulic Optimization

8) Model/Site Information

8a) How complex is the site? (Level 1 -- 4)	**2**
Choose one (1, 2, 3, or 4)	
Level 1: simulation of one contaminant sufficient for remedy evaluation, and less than 5 model layers	
Level 2: simulation of two contaminants sufficient for remedy evaluation, and/or 5-10 model layers	
Level 3: simulation of three or more contaminants required, and/or more than 10 model layers	
Level 4: rigorous simulation of both unsaturated and saturated zones, and/or multiple phases, and/or fractured bedrock in transport model	
8b) Model information *(Choose one, 1 or 2)*	
Is there an existing flow model?	**1**
1. Yes	
2. No	
Is the flow model up-to-date?	**2**
1. Yes	
2. No	
Is there an existing transport model?	**1**
1. Yes	
2. No	
Is the transport model up-to-date?	**2**
1. Yes	
2. No	

Step 2b: Current Costs		**Step 2c: Estimated Costs for Scenarios 1 & 2**	
		9a) Enter Annual Costs for Each Scenario	
Item	Current System	Scenario #1 no new extraction wells 33% less pumping	Scenario #2 new extraction wells (33% more) 33% less pumping
pumping rate (gpm)	750	502.5	502.5
number of wells	4	4	6
Electric	$70,000	$52,500	$52,500
O&M labor	$25,000	$22,000	$25,000
Materials	$7,000	$4,600	$5,000
Maintenance	$30,000	$30,000	$32,000
Discharge Fees	$100	$100	$100
Analytical			
Other #1			
Other #2			
Other #3			
		9b) Enter Up-Front Costs for Each Scenario	
Item	Current System	Scenario #1 no new extraction wells 33% less pumping	Scenario #2 new extraction wells (33% more) 33% less pumping
Engineering design	$0	$50,000	$70,000
Regulatory Process	$0	$25,000	$25,000
New wells/pipes/equipment	$0		$40,000
Increased monitoring	$0	$10,000	$10,000
Increased treatment capacity	$0		
Other #1	$0		
Other #2	$0		
Other #3	$0		

Check cost savings, go to ---------> Cost_Comp
Check site classification, go to ---------> Classify

Pre-Optimization Screening for Transport and Hydraulic Optimization

Costs of Modeling and Optimization Analyses

Site: Wurtsmith AFB, Oscoda, Michigan

Based on information input by user, this site is Level: 2

	Flow Modeling	Transport Modeling	Optimization	Total
Hydraulic Optimization	$22,500	$0	$22,500	$45,000
Transport Optimization	$22,500	$22,500	$75,000	$120,000

Assumed Costs for Level 1: one contaminant simulated and less than 5 model layers
1. Cost for creating a new flow model for Level 1 is $30,000
2. Cost for updating an existing flow model for Level 1 is $15,000
3. Cost for hydraulic optimization for Level 1 is $15,000
4. Cost for creating a new transport model for Level 1 is $30,000
5. Cost for updating an existing transport model for Level 1 is $15,000
6. Cost for tranport optimization for Level 1 is $50,000

Escalation Factors for Levels 2-4
Level 2: Level 1 * 1.5
Level 3: Level 1 * 2.0
Level 4: Level 1 * 2.5

Note:
Level 1: simulation of one contaminant sufficient for remedy evaluation, and less than 5 model layers
Level 2: simulation of two contaminants sufficient for remedy evaluation, and/or 5-10 model layers
Level 3: simulation of three or more contaminants required, and/or more than 10 model layers
Level 4: rigorous simulation of both unsaturated and saturated zones, and/or multiple phases, and/or fractured bedrock in transport model

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Current System

Site: Wurtsmith AFB, Oscoda, Michigan

pumping rate	750
number of wells	4
Discount Rate:	5%

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$70,000	15	$762,905	$762,905
O&M labor	$0	$25,000	15	$272,466	$272,466
Materials	$0	$7,000	15	$76,290	$76,290
Maintenance	$0	$30,000	15	$326,959	$326,959
Discharge Fees	$0	$100	15	$1,090	$1,090
Analytical	$0	$0	15	$0	$0
Other #1	$0	$0	15	$0	$0
Other #2	$0	$0	15	$0	$0
Other #3	$0	$0	15	$0	$0
Costs of Analysis					
-Flow Modeling	$0			$0	$0
-Transport Modeling	$0			$0	$0
-Optimization	$0			$0	$0
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$0			$0	$0
-Regulatory Process	$0			$0	$0
-New wells/pipes/equipment	$0			$0	$0
-Increased monitoring	$0			$0	$0
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$0**	**$132,100**		**$1,439,710**	**$1,439,710**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Scenario #1

Site: Wurtsmith AFB, Oscoda, Michigan

pumping rate	502.5	(reduction of 33% from current system)
number of wells	4	(same as current system)
Discount Rate:	5%	

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$52,500	15	$572,179	$572,179
O&M labor	$0	$22,000	15	$239,770	$239,770
Materials	$0	$4,600	15	$50,134	$50,134
Maintenance	$0	$30,000	15	$326,959	$326,959
Discharge Fees	$0	$100	15	$1,090	$1,090
Analytical	$0	$0	15	$0	$0
Other #1	$0	$0	15	$0	$0
Other #2	$0	$0	15	$0	$0
Other #3	$0	$0	15	$0	$0
Costs of Analysis					
-Flow Modeling	$22,500			$0	$22,500
-Transport Modeling	$0			$0	$0
-Optimization	$22,500			$0	$22,500
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$50,000			$0	$50,000
-Regulatory Process	$25,000			$0	$25,000
-New wells/pipes/equipment	$0			$0	$0
-Increased monitoring	$10,000			$0	$10,000
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$130,000**	**$109,200**		**$1,190,132**	**$1,320,132**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Scenario #2

Site: Wurtsmith AFB, Oscoda, Michigan

pumping rate	502.5	(reduction of 33% from current system)
number of wells	6	(increase of 33% from current system)
Discount Rate:	5%	

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$52,500	15	$572,179	$572,179
O&M labor	$0	$25,000	15	$272,466	$272,466
Materials	$0	$5,000	15	$54,493	$54,493
Maintenance	$0	$32,000	15	$348,757	$348,757
Discharge Fees	$0	$100	15	$1,090	$1,090
Analytical	$0	$0	15	$0	$0
Other #1	$0	$0	15	$0	$0
Other #2	$0	$0	15	$0	$0
Other #3	$0	$0	15	$0	$0
Costs of Analysis					
-Flow Modeling	$22,500			$0	$22,500
-Transport Modeling	$0			$0	$0
-Optimization	$22,500			$0	$22,500
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$70,000			$0	$70,000
-Regulatory Process	$25,000			$0	$25,000
-New wells/pipes/equipment	$40,000			$0	$40,000
-Increased monitoring	$10,000			$0	$10,000
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$190,000**	**$114,600**		**$1,248,984**	**$1,438,984**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Transport Optimization Screening Analysis -- All Scenarios

Site: Wurtsmith AFB, Oscoda, Michigan

Discount Rate: 5%

Scenario 1: pumping rate decreased by 33%, no new wells
Scenario 2: pumping rate decreased by 33%, plus 33% additional wells (new)
Scenario 3: current pumping rate, plus 33% additional wells (new)
Scenario 4: pumping rate increased by 33%, no new wells
Scenario 5: pumping rate increased by 33%, plus 33% additional wells (new)

	Current	Scenario #1	Scenario #2	Scenario #3	Scenario #4	Scenario #5
pumping rate (gpm)	**750**	**502.5**	**502.5**	**750**	**997.5**	**997.5**
number of wells	**4**	**4**	**6**	**6**	**4**	**6**
	Annual	**Annual**	**Annual**	**Annual**	**Annual**	**Annual**
O&M Costs						
Electric	$70,000	$52,500	$52,500	$0	$0	$0
O&M labor	$25,000	$22,000	$25,000	$0	$0	$0
Materials	$7,000	$4,600	$5,000	$0	$0	$0
Maintenance	$30,000	$30,000	$32,000	$0	$0	$0
Discharge Fees	$100	$100	$100	$0	$0	$0
Analytical	$0	$0	$0	$0	$0	$0
Other #1	$0	$0	$0	$0	$0	$0
Other #2	$0	$0	$0	$0	$0	$0
Other #3	$0	$0	$0	$0	$0	$0
Annual Subtotal	$132,100	$109,200	$114,600	$0	$0	$0
	Upfront	**Upfront**	**Upfront**	**Upfront**	**Upfront**	**Upfront**
Costs of Analysis						
-Flow Modeling	$0	$22,500	$22,500	$0	$0	$0
-Transport Modeling	$0	$22,500	$22,500	$0	$0	$0
-Optimization	$0	$75,000	$75,000	$0	$0	$0
System Modification Costs						
-Engineering design	$0	$50,000	$70,000	$0	$0	$0
-Regulatory Process	$0	$25,000	$25,000	$0	$0	$0
-New wells/pipes/equipment	$0	$0	$40,000	$0	$0	$0
-Increased monitoring	$0	$10,000	$10,000	$0	$0	$0
-Increased treatment capacity	$0	$0	$0	$0	$0	$0
-Other #1	$0	$0	$0	$0	$0	$0
-Other #2	$0	$0	$0	$0	$0	$0
Upfront Subtotal	$0	$205,000	$265,000	$0	$0	$0
Life-cycle costs (NPV)	$1,439,710	$1,395,132	$1,513,984	$0	$0	$0

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic and Transport Optimization Potential Cost Savings Analysis

Site: Wurtsmith AFB, Oscoda, Michigan

Expected Duration: 15
Discount Rate: 5%
Current forecasted cost (NPV): $1,439,710

	Assumed Reduction in Time-to-Close-Out	Cost Savings by Scenario		
		Current	Scenario #1	Scenario #2
Hydraulic Optimization	0%	$0	$119,579	$726
Transport Optimization	0%	$0	$44,579	($74,274)
	10%	N/A	N/A	$13,624
	20%	N/A	N/A	$108,195
	30%	N/A	N/A	$209,948

Pre-Optimization Screening for Transport and Hydraulic Optimization

Site Classification

Site: Wurtsmith AFB, Oscoda, Michigan

Basic Information:

Both cleanup and containment are site objectives.
The presence of a continuing source or immobile zones prevents a feasible pump-and-treat cleanup
There are unknown sources of contamination at the site, but the site can be divided into regions with known and unknown sources.

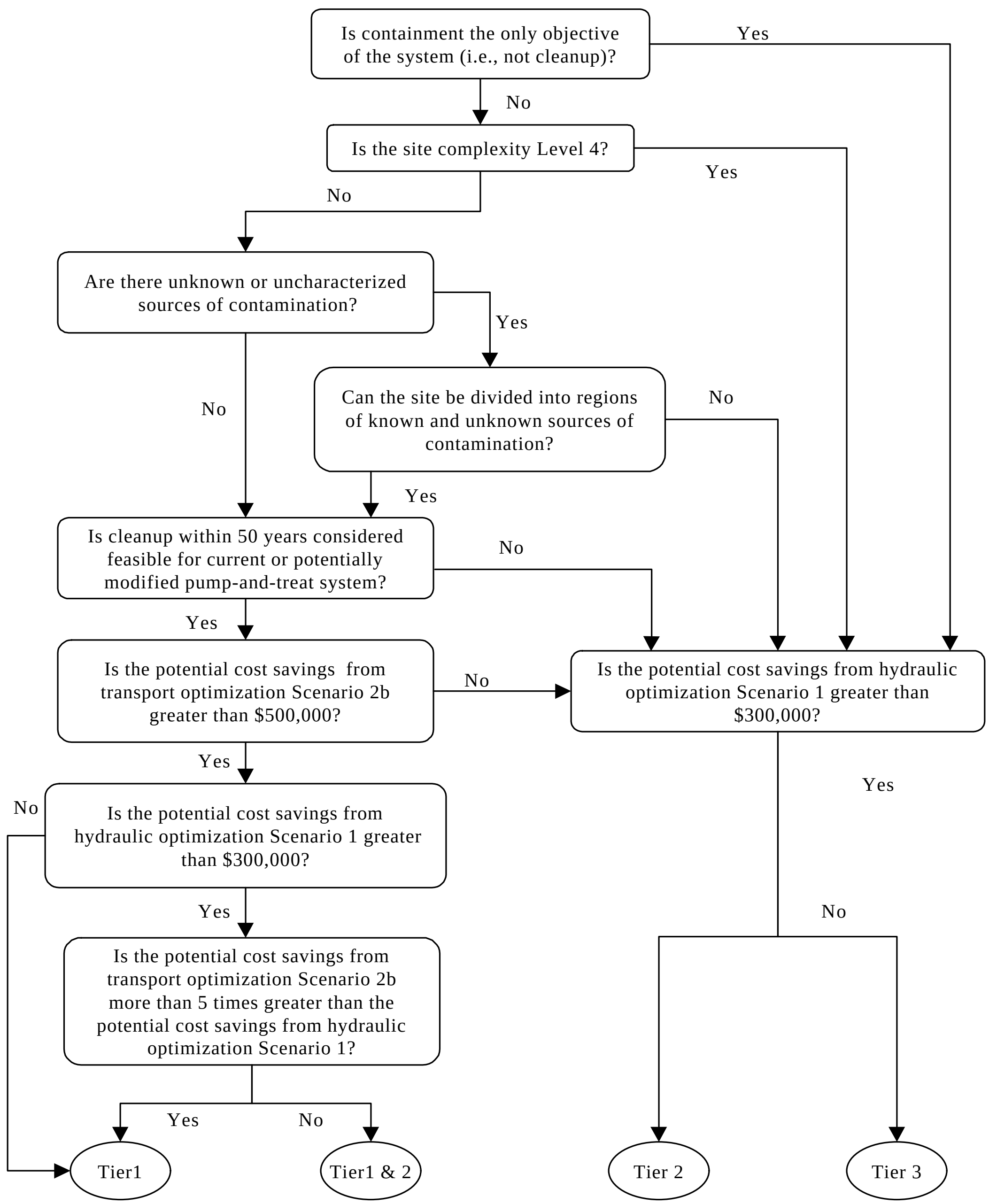
Site Classification: Tier **3**

***Note: Please review the "**Cost_Comp**" worksheet for more detailed information regarding the potential cost savings associated with specific scenarios.

For additonal scenarios, go to ----------> Infosheet (2)

Pre-Optimization Screening for Transport and Hydraulic Optimization

Rationale for Classifying Sites into Tiers



File: WursmithScr_Draft 042701.xls, Sheet:Classify

Pre-Optimization Screening for Transport and Hydraulic Optimization

USER INPUT INTO THIS SHEET IS OPTIONAL
Fill out this table ONLY if the site is classified as Tier 1 (or Tier 1 and 2), and if you are interested in evaluating additional transport optimization alternatives.

Site: Wurtsmith AFB, Oscoda, Michigan

Estimated Costs for Transport Optimization Scenarios

10a) Enter Annual Costs for Each Scenario

Item	Scenario #3 new extraction wells (33% more) no change to pumping	Scenario #4 no new extraction wells 33% more pumping	Scenario #5 new extraction wells (33% more) 33% more pumping
pumping rate (gpm)	750	997.5	997.5
number of wells	6	4	6
Electric			
O&M labor			
Materials			
Maintenance			
Discharge Fees			
Analytical			
Other #1			
Other #2			
Other #3			

****Warning: Total pumping rates exceed the current treatment capacity in Scenarios 4 & 5. Thus, the treatment capacity needs to be increased. Please enter capital costs for 'increased treatment capacity' in the table below.*

10b) Enter Up-Front Costs for Each Scenario

Item	Scenario #3 new extraction wells (33% more) no change to pumping	Scenario #4 no new extraction wells 33% more pumping	Scenario #5 new extraction wells (33% more) 33% more pumping
Engineering design			
Regulatory Process			
New wells/pipes/equipment			
Increased monitoring			
Increased treatment capacity			
Other #1			
Other #2			
Other #3			

Check for cost savings analysis, go to -------> Total_Analysis

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic and Transport Optimization Potential Cost Savings Analysis

Site: Wurtsmith AFB, Oscoda, Michigan

Expected Duration: 15
Discount Rate: 5%
Current forecasted cost (NPV): $1,439,710

	Reduction in time-to-close-out	Cost Savings by Scenario					
		Current	Scenario #1	Scenario #2	Scenario #3	Scenario #4	Scenario #5
Hydraulic Optimization	0%	$0	$119,579	$726	N/A	N/A	N/A
Transport Optimization	0%	$0	$44,579	($74,274)			
	10%	N/A	N/A	$13,624			
	20%	N/A	N/A	$108,195			
	30%	N/A	N/A	$209,948			

Hydraulic Optimization Summary
Maximum potential cost savings: $119,579

Transport Optimization Summary
Maximum potential cost savings, no reduction in cleanup time: $44,579
Maximum potential cost savings, 10% reduction in cleanup time: $13,624
Maximum potential cost savings, 20% reduction in cleanup time: $108,195
Maximum potential cost savings, 30% reduction in cleanup time: $209,948

Pre-Optimization Screening for Transport and Hydraulic Optimization

THIS WORKSHEET SUMMARIZES INPUT REQUIRED BY USER

Notes:

Users are only allowed to input information in "**General_Screening**", "**Infosheet (1)**", and "**Infosheet (2)**", other sheets are calculated automatically.

The fields that need to be filled out by users are highlighted in light-blue.

Instructions:

*Items 1 - 5c need to be entered in worksheet "**General_Screening**".*	
Item 1	Enter the name of the site or plume. This name will be used to identify the site throughout the screening process. The name should uniquely identify the site.
Item 2	Enter the date that this spreadsheet is completed.
Item 3	Enter your name. You will be the point of contact for this site during the pre-optimization screening process.
Item 4	Enter your affiliation (i.e., EPA, USACE, name of private contractor, etc.) and contact information.
Item 5a	Is the system annual O&M cost greater than $100K/yr? If lower than $100K/yr, this site is unlikely to benefit from hydraulic and/or transport optimization.
Item 5b	Is the flowrate lower than 50gpm? If less than 50 gpm, this site is unlikely to benefit from hydraulic and/or transport optimization.
Item 5c	Is site cleanup expected within 5 years? If less than 5 years, this site is unlikely to benefit from hydraulic and/or transport optimization.
*Only if the answers to Item 5a, 5b, and 5c are "Yes", and the user is insterested in quantifying potential cost savings by hydraulic and/or transport optimization, the following lines in worksheet "**Infosheet (1)**" need to be entered.*	
Item 6a	Enter the primary objective of the remediation system.
Item 6b	Enter the ease with which modifications (e.g., new wells, increased pumping rate, increased treatment capacity, etc.) can be made to the current remediation system.
Item 6c	Is cleanup of the site a feasible goal within 50 years based on the current system or a potentially modified pump-and-treat system? If there are continuing sources or contaminated immobile zones, cleanup may not be a realistic objective.
Item 6d	Are there unknown or uncharacterized sources of contamination at the site? If there are, transport model simulations will likely yield unreliable results. Containing the current plume may be a more practical objective until these sources are characterized.
Item 6e	If the answer to 5d is "yes", can the site be divided into two regions, one with and one without uncharacterized sources? If the site can be divided into these two regions, transport optimization can be used potentially for the region with known and characterized sources.
Item 7	Enter the correct information about the system (number of wells, pumping rate, etc.) in the cells to the right of list. This information will be used to estimate the life-cycle costs associated with modified systems according to Scenarios.
Item 8a	Enter information regarding the site complexity (ranging from Level 1-- 4). This information is used to estimate the cost of the optimization analysis. Costs increase with site complexity.
Item 8b	Enter information regarding the flow and transport models for the site. This information is used to estimate the cost of the optimization analysis. If updated models are not available, costs for updating them will be included.
Item 9a	Enter the annual costs of the current O&M system and the estimated annual costs for Scenarios 1 and 2.
Item 9b	Enter the estimated up-front costs for Scenarios 1 and 2.
*Only if the site is classified as Tier 1 or Tier 1 and 2, and the user is insterested in other optimization alternatives, the following lines in worksheet "**Infosheet (2)**" need to be entered.*	
Item 10a	Enter the estimated annual costs for Scenarios 3, 4, and 5.
Item 10b	Enter the estimated up-front costs for Scenarios 3, 4, and 5.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Step 1: General Information

1) Name of Site/Plume:	Wright-Patterson AFB, Ohio
2) Todays Date:	02/21/01
3) Your Name:	Kathy Yager
4a) Your Affiliation	US EPA
4b) Your Contact Information	
Address	2890 Woodbridge Ave Edison, NJ 08837
email	yager.kathleen@epa.gov
Phone	732-321-6738
fax	732-321-4484

5) General Questions

5a) Are O&M costs > $100K/year (enter "y" or "n")?	**y**
5b) Is the system flowrate > 50gpm (enter "y" or "n")?	**y**
5c) Is the estimated cleanup time > 5 years (enter "y" or "n")?	**y**

**** Note: We strongly recommend applying quantitative screening to this site. Please fill in the required information on Infosheet (1).*

***** Note: If the anwer to all 3 questions above are "y", this site is more likely to potentially benefit from hydraulic and/or transport optimization. If the user is interested in quantifying potential cost savings that might result from hydraulic and/or transport optimzation simulation, please fill in the required information on "Infosheet(1)". Additionally, the user can goes to the FRTR optimization web site for information on hydraulic and transport optimization software.**

Click to go to -------> Infosheet (1)
Click to go to -------> FRTR Optimization Web site

Pre-Optimization Screening for Transport and Hydraulic Optimization

USER INPUT INTO THIS SHEET IS OPTIONAL
Fill in this sheet ONLY if the answer to all 3 questions in sheet "General_Screening" are "Yes" and you are interested in quantifying potential cost savings from hydraulic and/or transport optimization.

Site: Wright-Patterson AFB, Ohio

Step 2a: Site Background and Information

6) Background Questions

6a) What is the current main objective for the remediation system? *Choose one (1, 2 or 3)* 1. Cleanup 2. Containment 3. Both	**3**
6b) If optimization were to recommend modifications that would result in a significant reduction in remediation system life-cycle costs, describe the ease of implementing these modifications. *Choose one (1, 2, 3, 4, or 5)* 1. Easy 2. Relatively easy 3. Relatively difficult 4. Difficult 5. Impossible	**2**
6c) Are there any continuing sources, immobile zones, or other factors that likely would prevent a feasible pump-and-treat solution in 50 years or less? *Choose one (1, 2, or 3)* 1. Yes 2. No 3. Don't know	**1**
6d) Are there unknown or uncharacterized sources of contamination at the site? *Choose one (1, 2, or 3)* 1. Yes 2. No 3. Don't know	**1**
6e) If the anwer to question 6d) is Yes, can the site be divided into different operable units in which the unknown sources are contained or addressed by an alternative solution and the remaining portion can be cleaned up by a pump and treat system? *Choose one (1, 2, or 3) (Leave it **blank** if the answer to question 6d) is "No".)* 1. Yes 2. No 3. Don't know	**1**

7) System Information

Expected duration (years)	**30**
Number of extraction wells	**1**
Total pumping rate (gpm)	**500**
Total treatment capacity (gpm)	**800**
Discount rate	**5%**

Pre-Optimization Screening for Transport and Hydraulic Optimization

8) Model/Site Information

8a) How complex is the site? (Level 1 -- 4)	**1**
Choose one (1, 2, 3, or 4)	
Level 1: simulation of one contaminant sufficient for remedy evaluation, and less than 5 model layers	
Level 2: simulation of two contaminants sufficient for remedy evaluation, and/or 5-10 model layers	
Level 3: simulation of three or more contaminants required, and/or more than 10 model layers	
Level 4: rigorous simulation of both unsaturated and saturated zones, and/or multiple phases, and/or fractured bedrock in transport model	
8b) Model information *(Choose one, 1 or 2)*	
Is there an existing flow model?	**1**
1. Yes	
2. No	
Is the flow model up-to-date?	**2**
1. Yes	
2. No	
Is there an existing transport model?	**1**
1. Yes	
2. No	
Is the transport model up-to-date?	**2**
1. Yes	
2. No	

Step 2b: Current Costs		Step 2c: Estimated Costs for Scenarios 1 & 2	
		9a) Enter Annual Costs for Each Scenario	
Item	Current System	Scenario #1 no new extraction wells 33% less pumping	Scenario #2 new extraction wells (33% more) 33% less pumping
pumping rate (gpm)	500	335	335
number of wells	1	1	2
Electric	$38,000	$26,600	$26,600
O&M labor	$71,000	$71,000	$71,000
Materials	$50,000	$34,500	$34,500
Maintenance	$80,000	$65,000	$85,000
Discharge Fees	$3,000	$2,100	$2,100
Analytical			
Other #1			
Other #2			
Other #3			
		9b) Enter Up-Front Costs for Each Scenario	
Item	Current System	Scenario #1 no new extraction wells 33% less pumping	Scenario #2 new extraction wells (33% more) 33% less pumping
Engineering design	$0	$40,000	$60,000
Regulatory Process	$0	$30,000	$30,000
New wells/pipes/equipment	$0		$50,000
Increased monitoring	$0	$30,000	$30,000
Increased treatment capacity	$0		
Other #1	$0		
Other #2	$0		
Other #3	$0		

Check cost savings, go to ---------> Cost_Comp
Check site classification, go to ---------> Classify

Pre-Optimization Screening for Transport and Hydraulic Optimization

Costs of Modeling and Optimization Analyses

Site: Wright-Patterson AFB, Ohio

Based on information input by user, this site is Level: 1

	Flow Modeling	**Transport Modeling**	**Optimization**	**Total**
Hydraulic Optimization	$15,000	$0	$15,000	$30,000
Transport Optimization	$15,000	$15,000	$50,000	$80,000

Assumed Costs for Level 1: one contaminant simulated and less than 5 model layers
1. Cost for creating a new flow model for Level 1 is $30,000
2. Cost for updating an existing flow model for Level 1 is $15,000
3. Cost for hydraulic optimization for Level 1 is $15,000
4. Cost for creating a new transport model for Level 1 is $30,000
5. Cost for updating an existing transport model for Level 1 is $15,000
6. Cost for tranport optimization for Level 1 is $50,000

Escalation Factors for Levels 2-4
Level 2: Level 1 * 1.5
Level 3: Level 1 * 2.0
Level 4: Level 1 * 2.5

Note:
Level 1: simulation of one contaminant sufficient for remedy evaluation, and less than 5 model layers
Level 2: simulation of two contaminants sufficient for remedy evaluation, and/or 5-10 model layers
Level 3: simulation of three or more contaminants required, and/or more than 10 model layers
Level 4: rigorous simulation of both unsaturated and saturated zones, and/or multiple phases, and/or fractured bedrock in transport model

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Current System

Site: Wright-Patterson AFB, Ohio

pumping rate 500
number of wells 1

Discount Rate: 5%

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$38,000	30	$613,361	$613,361
O&M labor	$0	$71,000	30	$1,146,016	$1,146,016
Materials	$0	$50,000	30	$807,054	$807,054
Maintenance	$0	$80,000	30	$1,291,286	$1,291,286
Discharge Fees	$0	$3,000	30	$48,423	$48,423
Analytical	$0	$0	30	$0	$0
Other #1	$0	$0	30	$0	$0
Other #2	$0	$0	30	$0	$0
Other #3	$0	$0	30	$0	$0
Costs of Analysis					
-Flow Modeling	$0			$0	$0
-Transport Modeling	$0			$0	$0
-Optimization	$0			$0	$0
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$0			$0	$0
-Regulatory Process	$0			$0	$0
-New wells/pipes/equipment	$0			$0	$0
-Increased monitoring	$0			$0	$0
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$0**	**$242,000**		**$3,906,140**	**$3,906,140**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Scenario #1

Site: Wright-Patterson AFB, Ohio

pumping rate	335	(reduction of 33% from current system)
number of wells	1	(same as current system)
Discount Rate:	5%	

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$26,600	30	$429,353	$429,353
O&M labor	$0	$71,000	30	$1,146,016	$1,146,016
Materials	$0	$34,500	30	$556,867	$556,867
Maintenance	$0	$65,000	30	$1,049,170	$1,049,170
Discharge Fees	$0	$2,100	30	$33,896	$33,896
Analytical	$0	$0	30	$0	$0
Other #1	$0	$0	30	$0	$0
Other #2	$0	$0	30	$0	$0
Other #3	$0	$0	30	$0	$0
Costs of Analysis					
-Flow Modeling	$15,000			$0	$15,000
-Transport Modeling	$0			$0	$0
-Optimization	$15,000			$0	$15,000
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$40,000			$0	$40,000
-Regulatory Process	$30,000			$0	$30,000
-New wells/pipes/equipment	$0			$0	$0
-Increased monitoring	$30,000			$0	$30,000
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$130,000**	**$199,200**		**$3,215,302**	**$3,345,302**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Scenario #2

Site: Wright-Patterson AFB, Ohio

pumping rate	335	(reduction of 33% from current system)
number of wells	2	(increase of 33% from current system)
Discount Rate:	5%	

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$26,600	30	$429,353	$429,353
O&M labor	$0	$71,000	30	$1,146,016	$1,146,016
Materials	$0	$34,500	30	$556,867	$556,867
Maintenance	$0	$85,000	30	$1,371,991	$1,371,991
Discharge Fees	$0	$2,100	30	$33,896	$33,896
Analytical	$0	$0	30	$0	$0
Other #1	$0	$0	30	$0	$0
Other #2	$0	$0	30	$0	$0
Other #3	$0	$0	30	$0	$0
Costs of Analysis					
-Flow Modeling	$15,000			$0	$15,000
-Transport Modeling	$0			$0	$0
-Optimization	$15,000			$0	$15,000
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$60,000			$0	$60,000
-Regulatory Process	$30,000			$0	$30,000
-New wells/pipes/equipment	$50,000			$0	$50,000
-Increased monitoring	$30,000			$0	$30,000
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$200,000**	**$219,200**		**$3,538,123**	**$3,738,123**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Transport Optimization Screening Analysis -- All Scenarios

Site: Wright-Patterson AFB, Ohio

Discount Rate: 5%

Scenario 1: pumping rate decreased by 33%, no new wells
Scenario 2: pumping rate decreased by 33%, plus 33% additional wells (new)
Scenario 3: current pumping rate, plus 33% additional wells (new)
Scenario 4: pumping rate increased by 33%, no new wells
Scenario 5: pumping rate increased by 33%, plus 33% additional wells (new)

	Current	Scenario #1	Scenario #2	Scenario #3	Scenario #4	Scenario #5
pumping rate (gpm)	**500**	**335**	**335**	**500**	**665**	**665**
number of wells	**1**	**1**	**2**	**2**	**1**	**2**
	Annual	**Annual**	**Annual**	**Annual**	**Annual**	**Annual**
O&M Costs						
Electric	$38,000	$26,600	$26,600	$0	$0	$0
O&M labor	$71,000	$71,000	$71,000	$0	$0	$0
Materials	$50,000	$34,500	$34,500	$0	$0	$0
Maintenance	$80,000	$65,000	$85,000	$0	$0	$0
Discharge Fees	$3,000	$2,100	$2,100	$0	$0	$0
Analytical	$0	$0	$0	$0	$0	$0
Other #1	$0	$0	$0	$0	$0	$0
Other #2	$0	$0	$0	$0	$0	$0
Other #3	$0	$0	$0	$0	$0	$0
Annual Subtotal	$242,000	$199,200	$219,200	$0	$0	$0
	Upfront	**Upfront**	**Upfront**	**Upfront**	**Upfront**	**Upfront**
Costs of Analysis						
-Flow Modeling	$0	$15,000	$15,000	$0	$0	$0
-Transport Modeling	$0	$15,000	$15,000	$0	$0	$0
-Optimization	$0	$50,000	$50,000	$0	$0	$0
System Modification Costs						
-Engineering design	$0	$40,000	$60,000	$0	$0	$0
-Regulatory Process	$0	$30,000	$30,000	$0	$0	$0
-New wells/pipes/equipment	$0	$0	$50,000	$0	$0	$0
-Increased monitoring	$0	$30,000	$30,000	$0	$0	$0
-Increased treatment capacity	$0	$0	$0	$0	$0	$0
-Other #1	$0	$0	$0	$0	$0	$0
-Other #2	$0	$0	$0	$0	$0	$0
Upfront Subtotal	$0	$180,000	$250,000	$0	$0	$0
Life-cycle costs (NPV)	$3,906,140	$3,395,302	$3,788,123	$0	$0	$0

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic and Transport Optimization Potential Cost Savings Analysis

Site: Wright-Patterson AFB, Ohio

Expected Duration: 30
Discount Rate: 5%
Current forecasted cost (NPV): $3,906,140

	Assumed Reduction in Time-to-Close-Out	Cost Savings by Scenario		
		Current	Scenario #1	Scenario #2
Hydraulic Optimization	0%	$0	$560,838	$168,016
Transport Optimization	0%	$0	$510,838	$118,016
	10%	N/A	N/A	$285,899
	20%	N/A	N/A	$480,244
	30%	N/A	N/A	$705,223

Pre-Optimization Screening for Transport and Hydraulic Optimization

Site Classification

Site: Wright-Patterson AFB, Ohio

Basic Information:

Both cleanup and containment are site objectives.
The presence of a continuing source or immobile zones prevents a feasible pump-and-treat cleanup
There are unknown sources of contamination at the site, but the site can be divided into regions with known and unknown sources.

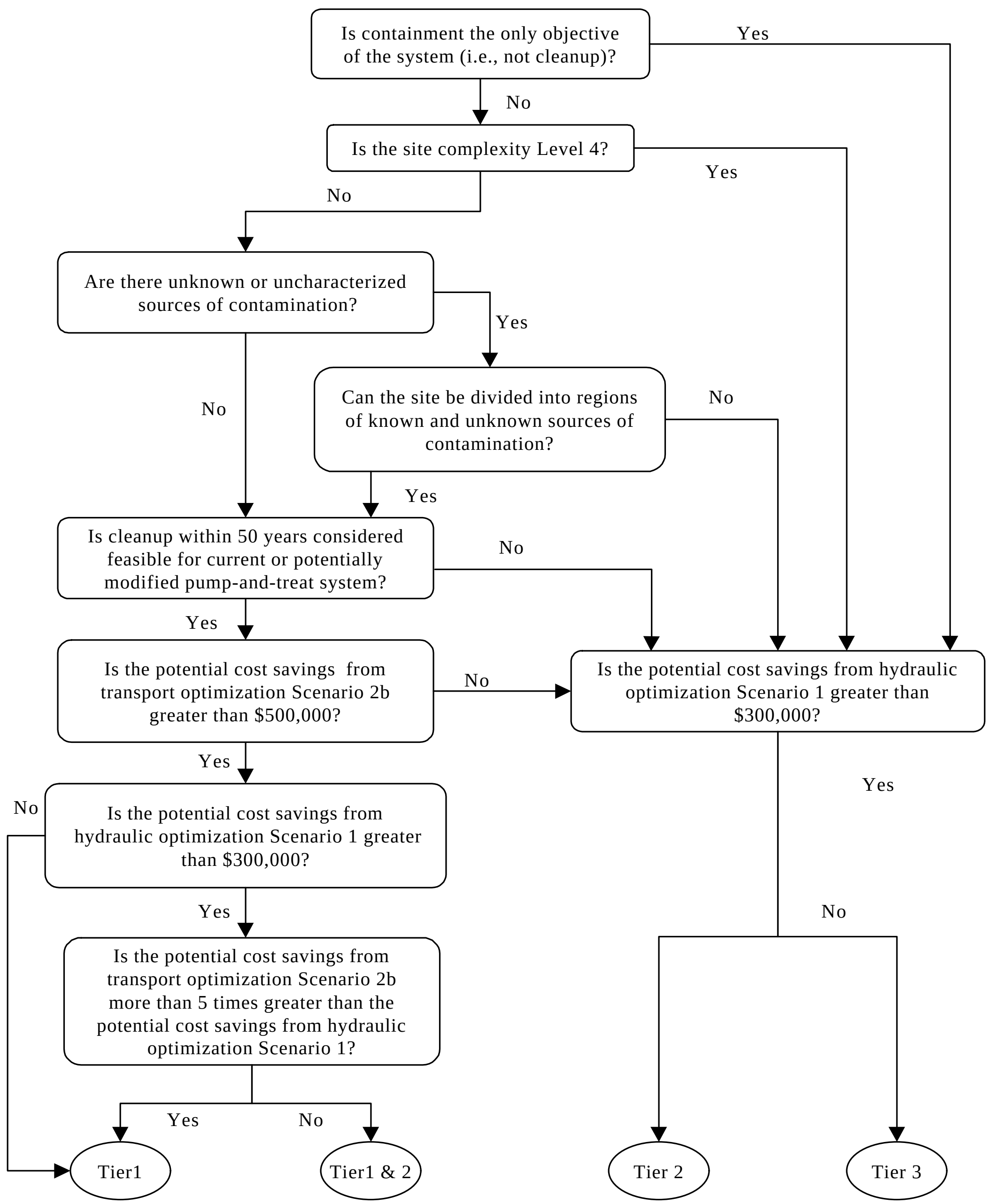
Site Classification: Tier **2**

****Note: Please review the "**Cost_Comp**" worksheet for more detailed information regarding the potential cost savings associated with specific scenarios.*

For additonal scenarios, go to ----------> Infosheet (2)

Pre-Optimization Screening for Transport and Hydraulic Optimization

Rationale for Classifying Sites into Tiers



Pre-Optimization Screening for Transport and Hydraulic Optimization

USER INPUT INTO THIS SHEET IS OPTIONAL
Fill out this table ONLY if the site is classified as Tier 1 (or Tier 1 and 2), and if you are interested in evaluating additional transport optimization alternatives.

Site: Wright-Patterson AFB, Ohio

Estimated Costs for Transport Optimization Scenarios

10a) Enter Annual Costs for Each Scenario

Item	Scenario #3 new extraction wells (33% more) no change to pumping	Scenario #4 no new extraction wells 33% more pumping	Scenario #5 new extraction wells (33% more) 33% more pumping
pumping rate (gpm)	500	665	665
number of wells	2	1	2
Electric			
O&M labor			
Materials			
Maintenance			
Discharge Fees			
Analytical			
Other #1			
Other #2			
Other #3			

10b) Enter Up-Front Costs for Each Scenario

Item	Scenario #3 new extraction wells (33% more) no change to pumping	Scenario #4 no new extraction wells 33% more pumping	Scenario #5 new extraction wells (33% more) 33% more pumping
Engineering design			
Regulatory Process			
New wells/pipes/equipment			
Increased monitoring			
Increased treatment capacity			
Other #1			
Other #2			
Other #3			

Check for cost savings analysis, go to -------> Total_Analysis

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic and Transport Optimization Potential Cost Savings Analysis

Site: Wright-Patterson AFB, Ohio

Expected Duration: 30
Discount Rate: 5%
Current forecasted cost (NPV): $3,906,140

	Reduction in time-to-close-out	Cost Savings by Scenario					
		Current	Scenario #1	Scenario #2	Scenario #3	Scenario #4	Scenario #5
Hydraulic Optimization	0%	$0	$560,838	$168,016	N/A	N/A	N/A
Transport Optimization	0%	$0	$510,838	$118,016			
	10%	N/A	N/A	$285,899			
	20%	N/A	N/A	$480,244			
	30%	N/A	N/A	$705,223			

Hydraulic Optimization Summary

Maximum potential cost savings: $560,838

Transport Optimization Summary

Maximum potential cost savings, no reduction in cleanup time: $510,838
Maximum potential cost savings, 10% reduction in cleanup time: $285,899
Maximum potential cost savings, 20% reduction in cleanup time: $480,244
Maximum potential cost savings, 30% reduction in cleanup time: $705,223

Pre-Optimization Screening for Transport and Hydraulic Optimization

THIS WORKSHEET SUMMARIZES INPUT REQUIRED BY USER

Notes:

Users are only allowed to input information in "**General_Screening**", "**Infosheet (1)**", and "**Infosheet (2)**", other sheets are calculated automatically.

The fields that need to be filled out by users are highlighted in light-blue.

Instructions:

*Items 1 - 5c need to be entered in worksheet "**General_Screening**".*

Item 1	Enter the name of the site or plume. This name will be used to identify the site throughout the screening process. The name should uniquely identify the site.
Item 2	Enter the date that this spreadsheet is completed.
Item 3	Enter your name. You will be the point of contact for this site during the pre-optimization screening process.
Item 4	Enter your affiliation (i.e., EPA, USACE, name of private contractor, etc.) and contact information.
Item 5a	Is the system annual O&M cost greater than $100K/yr? If lower than $100K/yr, this site is unlikely to benefit from hydraulic and/or transport optimization.
Item 5b	Is the flowrate lower than 50gpm? If less than 50 gpm, this site is unlikely to benefit from hydraulic and/or transport optimization.
Item 5c	Is site cleanup expected within 5 years? If less than 5 years, this site is unlikely to benefit from hydraulic and/or transport optimization.

*Only if the answers to Item 5a, 5b, and 5c are "Yes", and the user is insterested in quantifying potential cost savings by hydraulic and/or transport optimization, the following lines in worksheet "**Infosheet (1)**" need to be entered.*

Item 6a	Enter the primary objective of the remediation system.
Item 6b	Enter the ease with which modifications (e.g., new wells, increased pumping rate, increased treatment capacity, etc.) can be made to the current remediation system.
Item 6c	Is cleanup of the site a feasible goal within 50 years based on the current system or a potentially modified pump-and-treat system? If there are continuing sources or contaminated immobile zones, cleanup may not be a realistic objective.
Item 6d	Are there unknown or uncharacterized sources of contamination at the site? If there are, transport model simulations will likely yield unreliable results. Containing the current plume may be a more practical objective until these sources are characterized.
Item 6e	If the answer to 5d is “yes”, can the site be divided into two regions, one with and one without uncharacterized sources? If the site can be divided into these two regions, transport optimization can be used potentially for the region with known and characterized sources.
Item 7	Enter the correct information about the system (number of wells, pumping rate, etc.) in the cells to the right of list. This information will be used to estimate the life-cycle costs associated with modified systems according to Scenarios.
Item 8a	Enter information regarding the site complexity (ranging from Level 1-- 4). This information is used to estimate the cost of the optimization analysis. Costs increase with site complexity.
Item 8b	Enter information regarding the flow and transport models for the site. This information is used to estimate the cost of the optimization analysis. If updated models are not available, costs for updating them will be included.
Item 9a	Enter the annual costs of the current O&M system and the estimated annual costs for Scenarios 1 and 2.
Item 9b	Enter the estimated up-front costs for Scenarios 1 and 2.

*Only if the site is classified as Tier 1 or Tier 1 and 2, and the user is insterested in other optimization alternatives, the following lines in worksheet "**Infosheet (2)**" need to be entered.*

Item 10a	Enter the estimated annual costs for Scenarios 3, 4, and 5.
Item 10b	Enter the estimated up-front costs for Scenarios 3, 4, and 5.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Step 1: General Information

1) Name of Site/Plume:	McClellan AFB, Sacramento, CA
2) Todays Date:	02/21/01
3) Your Name:	Kathy Yager
4a) Your Affiliation	US EPA
4b) Your Contact Information	
Address	2890 Woodbridge Ave Edison, NJ 08837
email	yager.kathleen@epa.gov
Phone	732-321-6738
fax	732-321-4484

5) General Questions

5a) Are O&M costs > $100K/year (enter "y" or "n")?	**n**
5b) Is the system flowrate > 50gpm (enter "y" or "n")?	**y**
5c) Is the estimated cleanup time > 5 years (enter "y" or "n")?	**y**

**** Note: Quantitative screening analysis is not recommended for this site.*

***** Note: If the anwer to all 3 questions above are "y", this site is more likely to potentially benefit from hydraulic and/or transport optimization. If the user is interested in quantifying potential cost savings that might result from hydraulic and/or transport optimzation simulation, please fill in the required information on "Infosheet(1)". Additionally, the user can goes to the FRTR optimization web site for information on hydraulic and transport optimization software.**

Click to go to -------> Infosheet (1)
Click to go to -------> FRTR Optimization Web site

**** Note: Annual O&M costs are low, so that it is less likely to benefit from hydraulic optimization and/or transport optimization.*

Pre-Optimization Screening for Transport and Hydraulic Optimization

USER INPUT INTO THIS SHEET IS OPTIONAL
Fill in this sheet ONLY if the answer to all 3 questions in sheet "General_Screening" are "Yes" and you are interested in quantifying potential cost savings from hydraulic and/or transport optimization.

Site: McClellan AFB, Sacramento, CA

Step 2a: Site Background and Information

6) Background Questions

6a) What is the current main objective for the remediation system? *Choose one (1, 2 or 3)* 1. Cleanup 2. Containment 3. Both	**3**
6b) If optimization were to recommend modifications that would result in a significant reduction in remediation system life-cycle costs, describe the ease of implementing these modifications. *Choose one (1, 2, 3, 4, or 5)* 1. Easy 2. Relatively easy 3. Relatively difficult 4. Difficult 5. Impossible	**2**
6c) Are there any continuing sources, immobile zones, or other factors that likely would prevent a feasible pump-and-treat solution in 50 years or less? *Choose one (1, 2, or 3)* 1. Yes 2. No 3. Don't know	**3**
6d) Are there unknown or uncharacterized sources of contamination at the site? *Choose one (1, 2, or 3)* 1. Yes 2. No 3. Don't know	**1**
6e) If the anwer to question 6d) is Yes, can the site be divided into different operable units in which the unknown sources are contained or addressed by an alternative solution and the remaining portion can be cleaned up by a pump and treat system? *Choose one (1, 2, or 3) (Leave it **blank** if the answer to question 6d) is "No".)* 1. Yes 2. No 3. Don't know	**1**

7) System Information

Expected duration (years)	**20**
Number of extraction wells	**2**
Total pumping rate (gpm)	**20**
Total treatment capacity (gpm)	**1500**
Discount rate	**5%**

Pre-Optimization Screening for Transport and Hydraulic Optimization

8) Model/Site Information

8a) How complex is the site? (Level 1 -- 4)	**2**
Choose one (1, 2, 3, or 4)	
Level 1: simulation of one contaminant sufficient for remedy evaluation, and less than 5 model layers	
Level 2: simulation of two contaminants sufficient for remedy evaluation, and/or 5-10 model layers	
Level 3: simulation of three or more contaminants required, and/or more than 10 model layers	
Level 4: rigorous simulation of both unsaturated and saturated zones, and/or multiple phases, and/or fractured bedrock in transport model	
8b) Model information *(Choose one, 1 or 2)*	
Is there an existing flow model?	**1**
1. Yes	
2. No	
Is the flow model up-to-date?	**2**
1. Yes	
2. No	
Is there an existing transport model?	**1**
1. Yes	
2. No	
Is the transport model up-to-date?	**2**
1. Yes	
2. No	

Step 2b: Current Costs		**Step 2c: Estimated Costs for Scenarios 1 & 2**	
		9a) Enter Annual Costs for Each Scenario	
Item	Current System	Scenario #1 no new extraction wells 33% less pumping	Scenario #2 new extraction wells (33% more) 33% less pumping
pumping rate (gpm)	20	13.4	13.4
number of wells	2	2	3
Electric	$1,000	$1,000	$800
O&M labor	$5,000	$5,000	$5,000
Materials	$1,000	$700	$700
Maintenance	$4,000	$4,000	$4,000
Discharge Fees	$100	$100	$100
Analytical	$1,800	$1,800	$2,500
Other #1			
Other #2			
Other #3			
		9b) Enter Up-Front Costs for Each Scenario	
Item	Current System	Scenario #1 no new extraction wells 33% less pumping	Scenario #2 new extraction wells (33% more) 33% less pumping
Engineering design	$0	$50,000	$75,000
Regulatory Process	$0	$25,000	$25,000
New wells/pipes/equipment	$0		$150,000
Increased monitoring	$0	$30,000	$30,000
Increased treatment capacity	$0		
Other #1	$0		
Other #2	$0		
Other #3	$0		

Check cost savings, go to ---------> Cost_Comp
Check site classification, go to ---------> Classify

Pre-Optimization Screening for Transport and Hydraulic Optimization

Costs of Modeling and Optimization Analyses

Site: McClellan AFB, Sacramento, CA

Based on information input by user, this site is Level: 2

	Flow Modeling	Transport Modeling	Optimization	Total
Hydraulic Optimization	$22,500	$0	$22,500	$45,000
Transport Optimization	$22,500	$22,500	$75,000	$120,000

Assumed Costs for Level 1: one contaminant simulated and less than 5 model layers
1. Cost for creating a new flow model for Level 1 is $30,000
2. Cost for updating an existing flow model for Level 1 is $15,000
3. Cost for hydraulic optimization for Level 1 is $15,000
4. Cost for creating a new transport model for Level 1 is $30,000
5. Cost for updating an existing transport model for Level 1 is $15,000
6. Cost for tranport optimization for Level 1 is $50,000

Escalation Factors for Levels 2-4
Level 2: Level 1 * 1.5
Level 3: Level 1 * 2.0
Level 4: Level 1 * 2.5

Note:
Level 1: simulation of one contaminant sufficient for remedy evaluation, and less than 5 model layers
Level 2: simulation of two contaminants sufficient for remedy evaluation, and/or 5-10 model layers
Level 3: simulation of three or more contaminants required, and/or more than 10 model layers
Level 4: rigorous simulation of both unsaturated and saturated zones, and/or multiple phases, and/or fractured bedrock in transport model

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Current System

Site: McClellan AFB, Sacramento, CA

pumping rate	20
number of wells	2
Discount Rate:	5%

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$1,000	20	$13,085	$13,085
O&M labor	$0	$5,000	20	$65,427	$65,427
Materials	$0	$1,000	20	$13,085	$13,085
Maintenance	$0	$4,000	20	$52,341	$52,341
Discharge Fees	$0	$100	20	$1,309	$1,309
Analytical	$0	$1,800	20	$23,554	$23,554
Other #1	$0	$0	20	$0	$0
Other #2	$0	$0	20	$0	$0
Other #3	$0	$0	20	$0	$0
Costs of Analysis					
-Flow Modeling	$0			$0	$0
-Transport Modeling	$0			$0	$0
-Optimization	$0			$0	$0
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$0			$0	$0
-Regulatory Process	$0			$0	$0
-New wells/pipes/equipment	$0			$0	$0
-Increased monitoring	$0			$0	$0
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$0**	**$12,900**		**$168,801**	**$168,801**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Scenario #1

Site: McClellan AFB, Sacramento, CA

pumping rate	13.4	(reduction of 33% from current system)
number of wells	2	(same as current system)
Discount Rate:	5%	

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$1,000	20	$13,085	$13,085
O&M labor	$0	$5,000	20	$65,427	$65,427
Materials	$0	$700	20	$9,160	$9,160
Maintenance	$0	$4,000	20	$52,341	$52,341
Discharge Fees	$0	$100	20	$1,309	$1,309
Analytical	$0	$1,800	20	$23,554	$23,554
Other #1	$0	$0	20	$0	$0
Other #2	$0	$0	20	$0	$0
Other #3	$0	$0	20	$0	$0
Costs of Analysis					
-Flow Modeling	$22,500			$0	$22,500
-Transport Modeling	$0			$0	$0
-Optimization	$22,500			$0	$22,500
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$50,000			$0	$50,000
-Regulatory Process	$25,000			$0	$25,000
-New wells/pipes/equipment	$0			$0	$0
-Increased monitoring	$30,000			$0	$30,000
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$150,000**	**$12,600**		**$164,875**	**$314,875**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Scenario #2

Site: McClellan AFB, Sacramento, CA

pumping rate	13.4	(reduction of 33% from current system)
number of wells	3	(increase of 33% from current system)
Discount Rate:	5%	

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$800	20	$10,468	$10,468
O&M labor	$0	$5,000	20	$65,427	$65,427
Materials	$0	$700	20	$9,160	$9,160
Maintenance	$0	$4,000	20	$52,341	$52,341
Discharge Fees	$0	$100	20	$1,309	$1,309
Analytical	$0	$2,500	20	$32,713	$32,713
Other #1	$0	$0	20	$0	$0
Other #2	$0	$0	20	$0	$0
Other #3	$0	$0	20	$0	$0
Costs of Analysis					
-Flow Modeling	$22,500			$0	$22,500
-Transport Modeling	$0			$0	$0
-Optimization	$22,500			$0	$22,500
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$75,000			$0	$75,000
-Regulatory Process	$25,000			$0	$25,000
-New wells/pipes/equipment	$150,000			$0	$150,000
-Increased monitoring	$30,000			$0	$30,000
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$325,000**	**$13,100**		**$171,418**	**$496,418**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Transport Optimization Screening Analysis -- All Scenarios

Site: McClellan AFB, Sacramento, CA

Discount Rate: 5%

Scenario 1: pumping rate decreased by 33%, no new wells
Scenario 2: pumping rate decreased by 33%, plus 33% additional wells (new)
Scenario 3: current pumping rate, plus 33% additional wells (new)
Scenario 4: pumping rate increased by 33%, no new wells
Scenario 5: pumping rate increased by 33%, plus 33% additional wells (new)

	Current	Scenario #1	Scenario #2	Scenario #3	Scenario #4	Scenario #5
pumping rate (gpm)	**20**	**13.4**	**13.4**	**20**	**26.6**	**26.6**
number of wells	**2**	**2**	**3**	**3**	**2**	**3**
	Annual	**Annual**	**Annual**	**Annual**	**Annual**	**Annual**
O&M Costs						
Electric	$1,000	$1,000	$800	$0	$0	$0
O&M labor	$5,000	$5,000	$5,000	$0	$0	$0
Materials	$1,000	$700	$700	$0	$0	$0
Maintenance	$4,000	$4,000	$4,000	$0	$0	$0
Discharge Fees	$100	$100	$100	$0	$0	$0
Analytical	$1,800	$1,800	$2,500	$0	$0	$0
Other #1	$0	$0	$0	$0	$0	$0
Other #2	$0	$0	$0	$0	$0	$0
Other #3	$0	$0	$0	$0	$0	$0
Annual Subtotal	$12,900	$12,600	$13,100	$0	$0	$0
	Upfront	**Upfront**	**Upfront**	**Upfront**	**Upfront**	**Upfront**
Costs of Analysis						
-Flow Modeling	$0	$22,500	$22,500	$0	$0	$0
-Transport Modeling	$0	$22,500	$22,500	$0	$0	$0
-Optimization	$0	$75,000	$75,000	$0	$0	$0
System Modification Costs						
-Engineering design	$0	$50,000	$75,000	$0	$0	$0
-Regulatory Process	$0	$25,000	$25,000	$0	$0	$0
-New wells/pipes/equipment	$0	$0	$150,000	$0	$0	$0
-Increased monitoring	$0	$30,000	$30,000	$0	$0	$0
-Increased treatment capacity	$0	$0	$0	$0	$0	$0
-Other #1	$0	$0	$0	$0	$0	$0
-Other #2	$0	$0	$0	$0	$0	$0
Upfront Subtotal	$0	$225,000	$400,000	$0	$0	$0
Life-cycle costs (NPV)	$168,801	$389,875	$571,418	$0	$0	$0

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic and Transport Optimization Potential Cost Savings Analysis

Site: McClellan AFB, Sacramento, CA

Expected Duration:	20
Discount Rate:	5%
Current forecasted cost (NPV):	$168,801

	Assumed Reduction in Time-to-Close-Out	Cost Savings by Scenario		
		Current	Scenario #1	Scenario #2
Hydraulic Optimization	0%	$0	($146,074)	($327,617)
Transport Optimization	0%	$0	($221,074)	($402,617)
	10%	N/A	N/A	($391,990)
	20%	N/A	N/A	($380,273)
	30%	N/A	N/A	($367,355)

Pre-Optimization Screening for Transport and Hydraulic Optimization

Site Classification

Site: McClellan AFB, Sacramento, CA

Basic Information:

Both cleanup and containment are site objectives.
The presence of a continuing source or immobile zones prevents a feasible pump-and-treat cleanup
There are unknown sources of contamination at the site, but the site can be divided into regions with known and unknown sources.

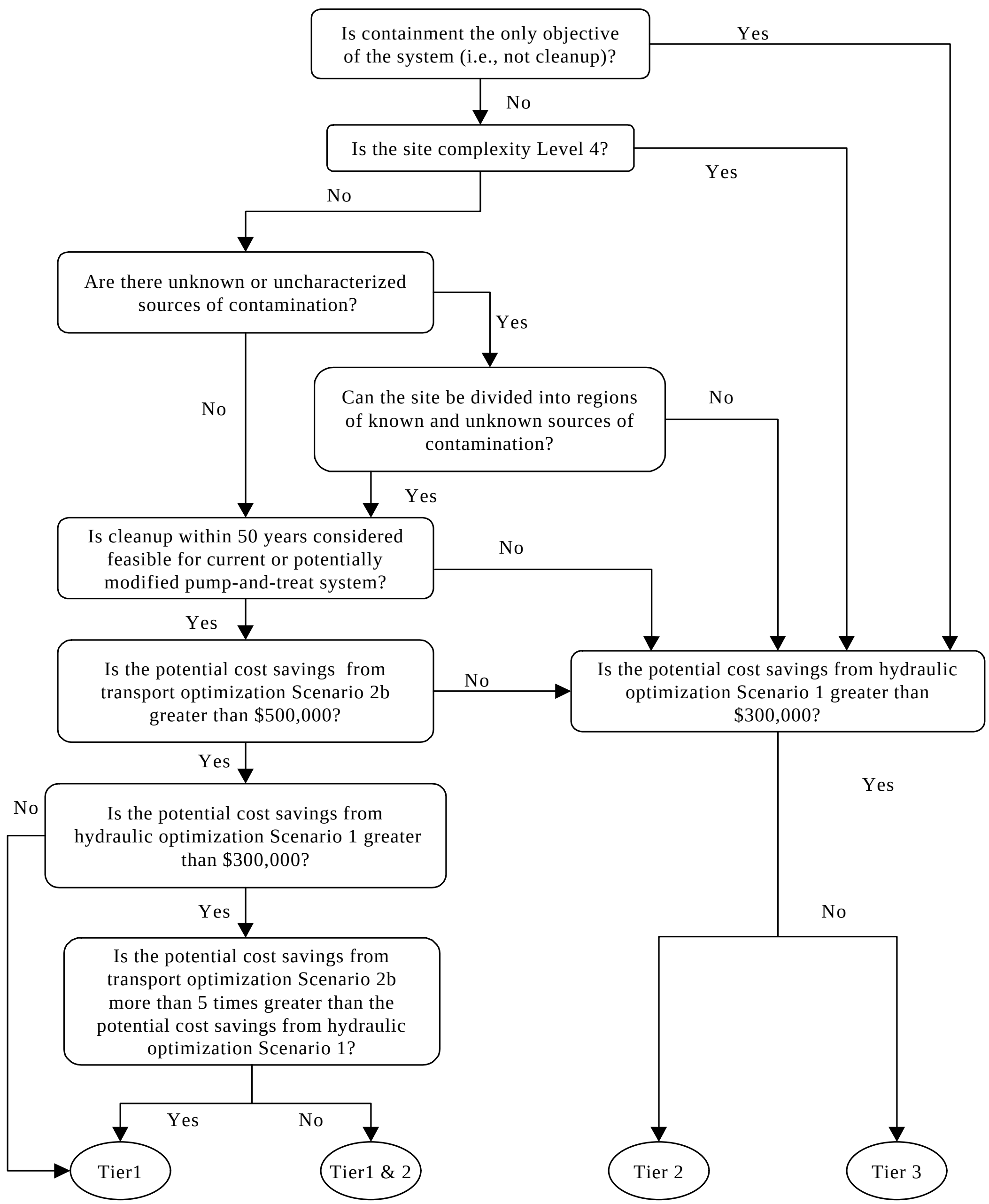
Site Classification: Tier **3**

***Note: Please review the "Cost_Comp" worksheet for more detailed information regarding the potential cost savings associated with specific scenarios.

For additonal scenarios, go to ----------> Infosheet (2)

Pre-Optimization Screening for Transport and Hydraulic Optimization

Rationale for Classifying Sites into Tiers



Pre-Optimization Screening for Transport and Hydraulic Optimization

USER INPUT INTO THIS SHEET IS OPTIONAL
Fill out this table ONLY if the site is classified as Tier 1 (or Tier 1 and 2), and if you are interested in evaluating additional transport optimization alternatives.

Site: McClellan AFB, Sacramento, CA

Estimated Costs for Transport Optimization Scenarios

10a) Enter Annual Costs for Each Scenario

Item	Scenario #3 new extraction wells (33% more) no change to pumping	Scenario #4 no new extraction wells 33% more pumping	Scenario #5 new extraction wells (33% more) 33% more pumping
pumping rate (gpm)	20	26.6	26.6
number of wells	3	2	3
Electric			
O&M labor			
Materials			
Maintenance			
Discharge Fees			
Analytical			
Other #1			
Other #2			
Other #3			

10b) Enter Up-Front Costs for Each Scenario

Item	Scenario #3 new extraction wells (33% more) no change to pumping	Scenario #4 no new extraction wells 33% more pumping	Scenario #5 new extraction wells (33% more) 33% more pumping
Engineering design			
Regulatory Process			
New wells/pipes/equipment			
Increased monitoring			
Increased treatment capacity			
Other #1			
Other #2			
Other #3			

Check for cost savings analysis, go to -------> Total_Analysis

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic and Transport Optimization Potential Cost Savings Analysis

Site: McClellan AFB, Sacramento, CA

Expected Duration:	20
Discount Rate:	5%
Current forecasted cost (NPV):	$168,801

	Reduction in time-to-close-out	Cost Savings by Scenario					
		Current	Scenario #1	Scenario #2	Scenario #3	Scenario #4	Scenario #5
Hydraulic Optimization	0%	$0	($146,074)	($327,617)	N/A	N/A	N/A
Transport Optimization	0%	$0	($221,074)	($402,617)			
	10%	N/A	N/A	($391,990)			
	20%	N/A	N/A	($380,273)			
	30%	N/A	N/A	($367,355)			

Hydraulic Optimization Summary

Maximum potential cost savings: $0

Transport Optimization Summary

Maximum potential cost savings, no reduction in cleanup time: $0
Maximum potential cost savings, 10% reduction in cleanup time: ($391,990)
Maximum potential cost savings, 20% reduction in cleanup time: ($380,273)
Maximum potential cost savings, 30% reduction in cleanup time: ($367,355)

Pre-Optimization Screening for Transport and Hydraulic Optimization

THIS WORKSHEET SUMMARIZES INPUT REQUIRED BY USER

Notes:

Users are only allowed to input information in "**General_Screening**", "**Infosheet (1)**", and "**Infosheet (2)**", other sheets are calculated automatically.

The fields that need to be filled out by users are highlighted in light-blue.

Instructions:

*Items 1 - 5c need to be entered in worksheet "**General_Screening**".*	
Item 1	Enter the name of the site or plume. This name will be used to identify the site throughout the screening process. The name should uniquely identify the site.
Item 2	Enter the date that this spreadsheet is completed.
Item 3	Enter your name. You will be the point of contact for this site during the pre-optimization screening process.
Item 4	Enter your affiliation (i.e., EPA, USACE, name of private contractor, etc.) and contact information.
Item 5a	Is the system annual O&M cost greater than $100K/yr? If lower than $100K/yr, this site is unlikely to benefit from hydraulic and/or transport optimization.
Item 5b	Is the flowrate lower than 50gpm? If less than 50 gpm, this site is unlikely to benefit from hydraulic and/or transport optimization.
Item 5c	Is site cleanup expected within 5 years? If less than 5 years, this site is unlikely to benefit from hydraulic and/or transport optimization.
*Only if the answers to Item 5a, 5b, and 5c are "Yes", and the user is insterested in quantifying potential cost savings by hydraulic and/or transport optimization, the following lines in worksheet "**Infosheet (1)**" need to be entered.*	
Item 6a	Enter the primary objective of the remediation system.
Item 6b	Enter the ease with which modifications (e.g., new wells, increased pumping rate, increased treatment capacity, etc.) can be made to the current remediation system.
Item 6c	Is cleanup of the site a feasible goal within 50 years based on the current system or a potentially modified pump-and-treat system? If there are continuing sources or contaminated immobile zones, cleanup may not be a realistic objective.
Item 6d	Are there unknown or uncharacterized sources of contamination at the site? If there are, transport model simulations will likely yield unreliable results. Containing the current plume may be a more practical objective until these sources are characterized.
Item 6e	If the answer to 5d is “yes”, can the site be divided into two regions, one with and one without uncharacterized sources? If the site can be divided into these two regions, transport optimization can be used potentially for the region with known and characterized sources.
Item 7	Enter the correct information about the system (number of wells, pumping rate, etc.) in the cells to the right of list. This information will be used to estimate the life-cycle costs associated with modified systems according to Scenarios.
Item 8a	Enter information regarding the site complexity (ranging from Level 1-- 4). This information is used to estimate the cost of the optimization analysis. Costs increase with site complexity.
Item 8b	Enter information regarding the flow and transport models for the site. This information is used to estimate the cost of the optimization analysis. If updated models are not available, costs for updating them will be included.
Item 9a	Enter the annual costs of the current O&M system and the estimated annual costs for Scenarios 1 and 2.
Item 9b	Enter the estimated up-front costs for Scenarios 1 and 2.
*Only if the site is classified as Tier 1 or Tier 1 and 2, and the user is insterested in other optimization alternatives, the following lines in worksheet "**Infosheet (2)**" need to be entered.*	
Item 10a	Enter the estimated annual costs for Scenarios 3, 4, and 5.
Item 10b	Enter the estimated up-front costs for Scenarios 3, 4, and 5.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Step 1: General Information

1) Name of Site/Plume:	Shaw AFB, SC - OU-2B UBC TCE Plume, Sumner, SC
2) Todays Date:	02/15/01
3) Your Name:	Steven Ott
4a) Your Affiliation	USACE-Omaha District (NWO-PM-HC)
4b) Your Contact Information	
Address	215 N. 17th St. Omaha, NE 68102
email	steven.l.ott@usace.army.mil
Phone	402.221.7670
fax	402.221.7796

5) General Questions

5a) Are O&M costs > $100K/year (enter "y" or "n")?	**y**
5b) Is the system flowrate > 50gpm (enter "y" or "n")?	**y**
5c) Is the estimated cleanup time > 5 years (enter "y" or "n")?	**y**

**** Note: We strongly recommend applying quantitative screening to this site. Please fill in the required information on Infosheet (1).*

***** Note: If the anwer to all 3 questions above are "y", this site is more likely to potentially benefit from hydraulic and/or transport optimization. If the user is interested in quantifying potential cost savings that might result from hydraulic and/or transport optimzation simulation, please fill in the required information on "Infosheet(1)". Additionally, the user can goes to the FRTR optimization web site for information on hydraulic and transport optimization software.**

Click to go to -------> Infosheet (1)
Click to go to -------> FRTR Optimization Web site

Pre-Optimization Screening for Transport and Hydraulic Optimization

USER INPUT INTO THIS SHEET IS OPTIONAL
Fill in this sheet ONLY if the answer to all 3 questions in sheet "General_Screening" are "Yes" and you are interested in quantifying potential cost savings from hydraulic and/or transport optimization.

Site: Shaw AFB, SC - OU-2B UBC TCE Plume, Sumner, SC

Step 2a: Site Background and Information

6) Background Questions

6a) What is the current main objective for the remediation system? *Choose one (1, 2 or 3)* 1. Cleanup 2. Containment 3. Both	**3**
6b) If optimization were to recommend modifications that would result in a significant reduction in remediation system life-cycle costs, describe the ease of implementing these modifications. *Choose one (1, 2, 3, 4, or 5)* 1. Easy 2. Relatively easy 3. Relatively difficult 4. Difficult 5. Impossible	**2**
6c) Are there any continuing sources, immobile zones, or other factors that likely would prevent a feasible pump-and-treat solution in 50 years or less? *Choose one (1, 2, or 3)* 1. Yes 2. No 3. Don't know	**3**
6d) Are there unknown or uncharacterized sources of contamination at the site? *Choose one (1, 2, or 3)* 1. Yes 2. No 3. Don't know	**1**
6e) If the anwer to question 6d) is Yes, can the site be divided into different operable units in which the unknown sources are contained or addressed by an alternative solution and the remaining portion can be cleaned up by a pump and treat system? *Choose one (1, 2, or 3) (Leave it **blank** if the answer to question 6d) is "No".)* 1. Yes 2. No 3. Don't know	**1**

7) System Information

Expected duration (years)	**30**
Number of extraction wells	**4**
Total pumping rate (gpm)	**275**
Total treatment capacity (gpm)	**400**
Discount rate	**5%**

Pre-Optimization Screening for Transport and Hydraulic Optimization

8) Model/Site Information

8a) How complex is the site? (Level 1 -- 4)	**1**
Choose one (1, 2, 3, or 4)	
Level 1: simulation of one contaminant sufficient for remedy evaluation, and less than 5 model layers	
Level 2: simulation of two contaminants sufficient for remedy evaluation, and/or 5-10 model layers	
Level 3: simulation of three or more contaminants required, and/or more than 10 model layers	
Level 4: rigorous simulation of both unsaturated and saturated zones, and/or multiple phases, and/or fractured bedrock in transport model	
8b) Model information *(Choose one, 1 or 2)*	
Is there an existing flow model?	**1**
1. Yes	
2. No	
Is the flow model up-to-date?	**1**
1. Yes	
2. No	
Is there an existing transport model?	**1**
1. Yes	
2. No	
Is the transport model up-to-date?	**1**
1. Yes	
2. No	

Step 2b: Current Costs		**Step 2c: Estimated Costs for Scenarios 1 & 2**	
		9a) Enter Annual Costs for Each Scenario	
Item	Current System	Scenario #1 no new extraction wells 33% less pumping	Scenario #2 new extraction wells (33% more) 33% less pumping
pumping rate (gpm)	275	184.25	184.25
number of wells	4	4	6
Electric	$4,500	$3,000	$3,000
O&M labor	$98,000	$98,000	$98,000
Materials	$20,000	$20,000	$13,400
Maintenance			
Discharge Fees			
Analytical	$30,000	$30,000	$33,000
Other #1			
Other #2			
Other #3			
		9b) Enter Up-Front Costs for Each Scenario	
Item	Current System	Scenario #1 no new extraction wells 33% less pumping	Scenario #2 new extraction wells (33% more) 33% less pumping
Engineering design	$0		$30,000
Regulatory Process	$0		$20,000
New wells/pipes/equipment	$0		$175,000
Increased monitoring	$0		$3,500
Increased treatment capacity	$0		
Other #1	$0		
Other #2	$0		
Other #3	$0		

Check cost savings, go to ---------> Cost_Comp
Check site classification, go to ---------> Classify

Pre-Optimization Screening for Transport and Hydraulic Optimization

Costs of Modeling and Optimization Analyses

Site: Shaw AFB, SC - OU-2B UBC TCE Plume, Sumner, SC

Based on information input by user, this site is Level: 1

	Flow Modeling	Transport Modeling	Optimization	Total
Hydraulic Optimization	$0	$0	$15,000	$15,000
Transport Optimization	$0	$0	$50,000	$50,000

Assumed Costs for Level 1: one contaminant simulated and less than 5 model layers

1. Cost for creating a new flow model for Level 1 is $30,000
2. Cost for updating an existing flow model for Level 1 is $15,000
3. Cost for hydraulic optimization for Level 1 is $15,000
4. Cost for creating a new transport model for Level 1 is $30,000
5. Cost for updating an existing transport model for Level 1 is $15,000
6. Cost for tranport optimization for Level 1 is $50,000

Escalation Factors for Levels 2-4

Level 2: Level 1 * 1.5
Level 3: Level 1 * 2.0
Level 4: Level 1 * 2.5

Note:

Level 1: simulation of one contaminant sufficient for remedy evaluation, and less than 5 model layers
Level 2: simulation of two contaminants sufficient for remedy evaluation, and/or 5-10 model layers
Level 3: simulation of three or more contaminants required, and/or more than 10 model layers
Level 4: rigorous simulation of both unsaturated and saturated zones, and/or multiple phases, and/or fractured bedrock in transport model

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Current System

Site: Shaw AFB, SC - OU-2B UBC TCE Plume, Sumner, SC

pumping rate	275
number of wells	4
Discount Rate:	5%

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$4,500	30	$72,635	$72,635
O&M labor	$0	$98,000	30	$1,581,825	$1,581,825
Materials	$0	$20,000	30	$322,821	$322,821
Maintenance	$0	$0	30	$0	$0
Discharge Fees	$0	$0	30	$0	$0
Analytical	$0	$30,000	30	$484,232	$484,232
Other #1	$0	$0	30	$0	$0
Other #2	$0	$0	30	$0	$0
Other #3	$0	$0	30	$0	$0
Costs of Analysis					
-Flow Modeling	$0			$0	$0
-Transport Modeling	$0			$0	$0
-Optimization	$0			$0	$0
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$0			$0	$0
-Regulatory Process	$0			$0	$0
-New wells/pipes/equipment	$0			$0	$0
-Increased monitoring	$0			$0	$0
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$0**	**$152,500**		**$2,461,514**	**$2,461,514**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Scenario #1

Site: Shaw AFB, SC - OU-2B UBC TCE Plume, Sumner, SC

pumping rate	184.25	(reduction of 33% from current system)
number of wells	4	(same as current system)
Discount Rate:	5%	

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$3,000	30	$48,423	$48,423
O&M labor	$0	$98,000	30	$1,581,825	$1,581,825
Materials	$0	$20,000	30	$322,821	$322,821
Maintenance	$0	$0	30	$0	$0
Discharge Fees	$0	$0	30	$0	$0
Analytical	$0	$30,000	30	$484,232	$484,232
Other #1	$0	$0	30	$0	$0
Other #2	$0	$0	30	$0	$0
Other #3	$0	$0	30	$0	$0
Costs of Analysis					
-Flow Modeling	$0			$0	$0
-Transport Modeling	$0			$0	$0
-Optimization	$15,000			$0	$15,000
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$0			$0	$0
-Regulatory Process	$0			$0	$0
-New wells/pipes/equipment	$0			$0	$0
-Increased monitoring	$0			$0	$0
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$15,000**	**$151,000**		**$2,437,302**	**$2,452,302**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Scenario #2

Site: Shaw AFB, SC - OU-2B UBC TCE Plume, Sumner, SC

pumping rate	184.25	(reduction of 33% from current system)
number of wells	6	(increase of 33% from current system)
Discount Rate:	5%	

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$3,000	30	$48,423	$48,423
O&M labor	$0	$98,000	30	$1,581,825	$1,581,825
Materials	$0	$13,400	30	$216,290	$216,290
Maintenance	$0	$0	30	$0	$0
Discharge Fees	$0	$0	30	$0	$0
Analytical	$0	$33,000	30	$532,655	$532,655
Other #1	$0	$0	30	$0	$0
Other #2	$0	$0	30	$0	$0
Other #3	$0	$0	30	$0	$0
Costs of Analysis					
-Flow Modeling	$0			$0	$0
-Transport Modeling	$0			$0	$0
-Optimization	$15,000			$0	$15,000
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$30,000			$0	$30,000
-Regulatory Process	$20,000			$0	$20,000
-New wells/pipes/equipment	$175,000			$0	$175,000
-Increased monitoring	$3,500			$0	$3,500
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$243,500**	**$147,400**		**$2,379,194**	**$2,622,694**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Transport Optimization Screening Analysis -- All Scenarios

Site: Shaw AFB, SC - OU-2B UBC TCE Plume, Sumner, SC

Discount Rate: 5%

Scenario 1: pumping rate decreased by 33%, no new wells
Scenario 2: pumping rate decreased by 33%, plus 33% additional wells (new)
Scenario 3: current pumping rate, plus 33% additional wells (new)
Scenario 4: pumping rate increased by 33%, no new wells
Scenario 5: pumping rate increased by 33%, plus 33% additional wells (new)

	Current	Scenario #1	Scenario #2	Scenario #3	Scenario #4	Scenario #5
pumping rate (gpm)	**275**	**184.25**	**184.25**	**275**	**365.75**	**365.75**
number of wells	**4**	**4**	**6**	**6**	**4**	**6**
	Annual	**Annual**	**Annual**	**Annual**	**Annual**	**Annual**
O&M Costs						
Electric	$4,500	$3,000	$3,000	$0	$0	$0
O&M labor	$98,000	$98,000	$98,000	$0	$0	$0
Materials	$20,000	$20,000	$13,400	$0	$0	$0
Maintenance	$0	$0	$0	$0	$0	$0
Discharge Fees	$0	$0	$0	$0	$0	$0
Analytical	$30,000	$30,000	$33,000	$0	$0	$0
Other #1	$0	$0	$0	$0	$0	$0
Other #2	$0	$0	$0	$0	$0	$0
Other #3	$0	$0	$0	$0	$0	$0
Annual Subtotal	$152,500	$151,000	$147,400	$0	$0	$0
	Upfront	**Upfront**	**Upfront**	**Upfront**	**Upfront**	**Upfront**
Costs of Analysis						
-Flow Modeling	$0	$0	$0	$0	$0	$0
-Transport Modeling	$0	$0	$0	$0	$0	$0
-Optimization	$0	$50,000	$50,000	$0	$0	$0
System Modification Costs						
-Engineering design	$0	$0	$30,000	$0	$0	$0
-Regulatory Process	$0	$0	$20,000	$0	$0	$0
-New wells/pipes/equipment	$0	$0	$175,000	$0	$0	$0
-Increased monitoring	$0	$0	$3,500	$0	$0	$0
-Increased treatment capacity	$0	$0	$0	$0	$0	$0
-Other #1	$0	$0	$0	$0	$0	$0
-Other #2	$0	$0	$0	$0	$0	$0
Upfront Subtotal	$0	$50,000	$278,500	$0	$0	$0
Life-cycle costs (NPV)	$2,461,514	$2,487,302	$2,657,694	$0	$0	$0

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic and Transport Optimization Potential Cost Savings Analysis

Site: Shaw AFB, SC - OU-2B UBC TCE Plume, Sumner, SC

Expected Duration:	30
Discount Rate:	5%
Current forecasted cost (NPV):	$2,461,514

	Assumed Reduction in Time-to-Close-Out	**Cost Savings by Scenario**		
		Current	Scenario #1	Scenario #2
Hydraulic Optimization	0%	$0	$9,212	($161,181)
Transport Optimization	0%	$0	($25,788)	($196,181)
	10%	N/A	N/A	($83,289)
	20%	N/A	N/A	$47,398
	30%	N/A	N/A	$198,684

Pre-Optimization Screening for Transport and Hydraulic Optimization

Site Classification

Site: Shaw AFB, SC - OU-2B UBC TCE Plume, Sumner, SC

Basic Information:

Both cleanup and containment are site objectives.
The presence of a continuing source or immobile zones prevents a feasible pump-and-treat cleanup
There are unknown sources of contamination at the site, but the site can be divided into regions with known and unknown sources.

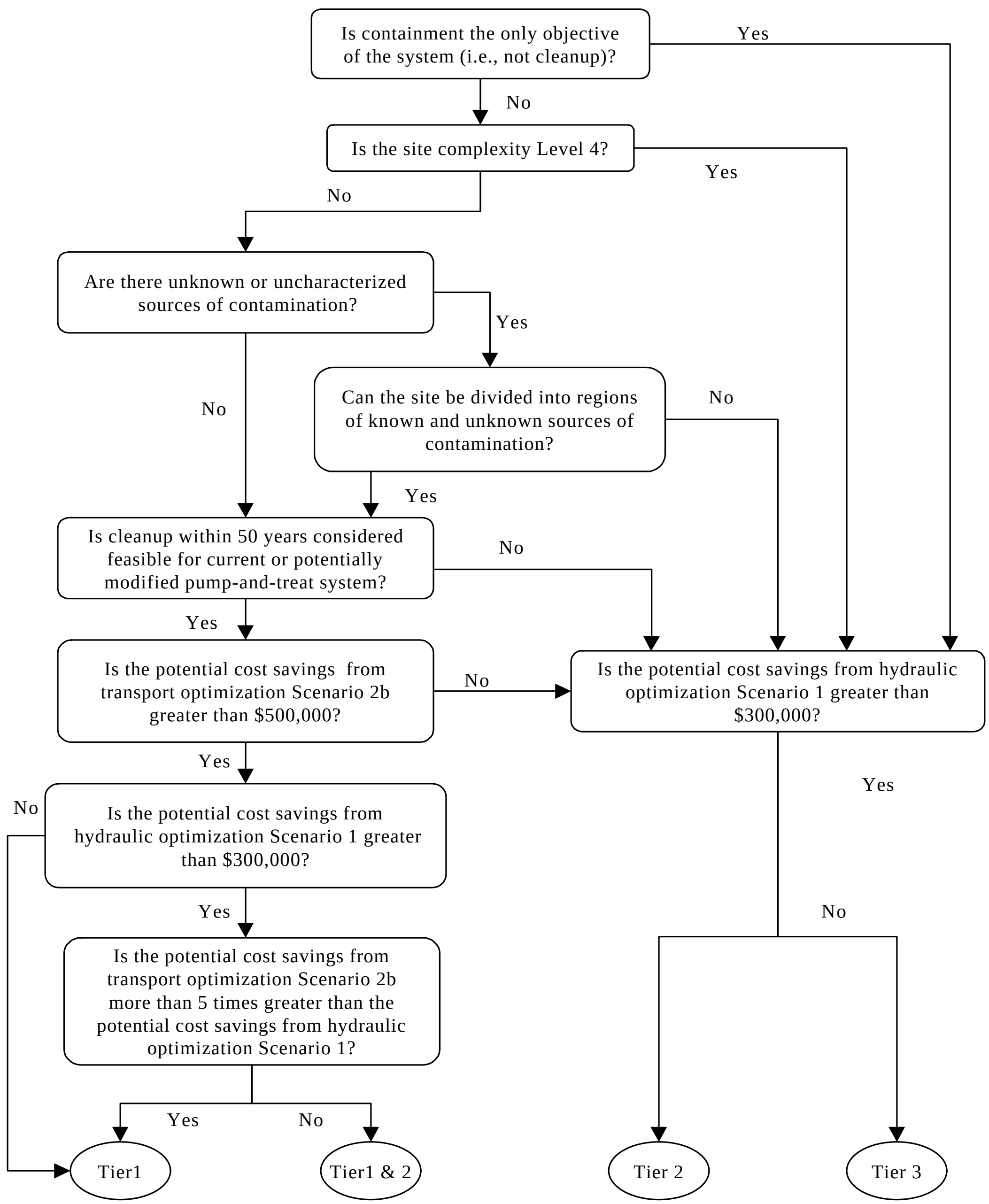
Site Classification: Tier **3**

****Note: Please review the "Cost_Comp" worksheet for more detailed information regarding the potential cost savings associated with specific scenarios.*

For additonal scenarios, go to ----------> Infosheet (2)

Pre-Optimization Screening for Transport and Hydraulic Optimization

Rationale for Classifying Sites into Tiers



File: ShawScr_Draft 042701.xls, Sheet:Classify

Pre-Optimization Screening for Transport and Hydraulic Optimization

USER INPUT INTO THIS SHEET IS OPTIONAL
Fill out this table ONLY if the site is classified as Tier 1 (or Tier 1 and 2), and if you are interested in evaluating additional transport optimization alternatives.

Site: Shaw AFB, SC - OU-2B UBC TCE Plume, Sumner, SC

Estimated Costs for Transport Optimization Scenarios

10a) Enter Annual Costs for Each Scenario

Item	Scenario #3 new extraction wells (33% more) no change to pumping	Scenario #4 no new extraction wells 33% more pumping	Scenario #5 new extraction wells (33% more) 33% more pumping
pumping rate (gpm)	275	365.75	365.75
number of wells	6	4	6
Electric			
O&M labor			
Materials			
Maintenance			
Discharge Fees			
Analytical			
Other #1			
Other #2			
Other #3			

10b) Enter Up-Front Costs for Each Scenario

Item	Scenario #3 new extraction wells (33% more) no change to pumping	Scenario #4 no new extraction wells 33% more pumping	Scenario #5 new extraction wells (33% more) 33% more pumping
Engineering design			
Regulatory Process			
New wells/pipes/equipment			
Increased monitoring			
Increased treatment capacity			
Other #1			
Other #2			
Other #3			

Check for cost savings analysis, go to -------> Total_Analysis

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic and Transport Optimization Potential Cost Savings Analysis

Site: Shaw AFB, SC - OU-2B UBC TCE Plume, Sumner, SC

Expected Duration:	30
Discount Rate:	5%
Current forecasted cost (NPV):	$2,461,514

	Reduction in time-to-close-out	Cost Savings by Scenario					
		Current	Scenario #1	Scenario #2	Scenario #3	Scenario #4	Scenario #5
Hydraulic Optimization	0%	$0	$9,212	($161,181)	N/A	N/A	N/A
Transport Optimization	0%	$0	($25,788)	($196,181)			
	10%	N/A	N/A	($83,289)			
	20%	N/A	N/A	$47,398			
	30%	N/A	N/A	$198,684			

<u>Hydraulic Optimization Summary</u>

Maximum potential cost savings:	$9,212

<u>Transport Optimization Summary</u>

Maximum potential cost savings, no reduction in cleanup time:	$0
Maximum potential cost savings, 10% reduction in cleanup time:	($83,289)
Maximum potential cost savings, 20% reduction in cleanup time:	$47,398
Maximum potential cost savings, 30% reduction in cleanup time:	$198,684

Pre-Optimization Screening for Transport and Hydraulic Optimization

THIS WORKSHEET SUMMARIZES INPUT REQUIRED BY USER

Notes:

Users are only allowed to input information in "**General_Screening**", "**Infosheet (1)**", and "**Infosheet (2)**", other sheets are calculated automatically.

The fields that need to be filled out by users are highlighted in light-blue.

Instructions:

*Items 1 - 5c need to be entered in worksheet "**General_Screening**".*

Item 1	Enter the name of the site or plume. This name will be used to identify the site throughout the screening process. The name should uniquely identify the site.
Item 2	Enter the date that this spreadsheet is completed.
Item 3	Enter your name. You will be the point of contact for this site during the pre-optimization screening process.
Item 4	Enter your affiliation (i.e., EPA, USACE, name of private contractor, etc.) and contact information.
Item 5a	Is the system annual O&M cost greater than $100K/yr? If lower than $100K/yr, this site is unlikely to benefit from hydraulic and/or transport optimization.
Item 5b	Is the flowrate lower than 50gpm? If less than 50 gpm, this site is unlikely to benefit from hydraulic and/or transport optimization.
Item 5c	Is site cleanup expected within 5 years? If less than 5 years, this site is unlikely to benefit from hydraulic and/or transport optimization.

*Only if the answers to Item 5a, 5b, and 5c are "Yes", and the user is insterested in quantifying potential cost savings by hydraulic and/or transport optimization, the following lines in worksheet "**Infosheet (1)**" need to be entered.*

Item 6a	Enter the primary objective of the remediation system.
Item 6b	Enter the ease with which modifications (e.g., new wells, increased pumping rate, increased treatment capacity, etc.) can be made to the current remediation system.
Item 6c	Is cleanup of the site a feasible goal within 50 years based on the current system or a potentially modified pump-and-treat system? If there are continuing sources or contaminated immobile zones, cleanup may not be a realistic objective.
Item 6d	Are there unknown or uncharacterized sources of contamination at the site? If there are, transport model simulations will likely yield unreliable results. Containing the current plume may be a more practical objective until these sources are characterized.
Item 6e	If the answer to 5d is “yes”, can the site be divided into two regions, one with and one without uncharacterized sources? If the site can be divided into these two regions, transport optimization can be used potentially for the region with known and characterized sources.
Item 7	Enter the correct information about the system (number of wells, pumping rate, etc.) in the cells to the right of list. This information will be used to estimate the life-cycle costs associated with modified systems according to Scenarios.
Item 8a	Enter information regarding the site complexity (ranging from Level 1-- 4). This information is used to estimate the cost of the optimization analysis. Costs increase with site complexity.
Item 8b	Enter information regarding the flow and transport models for the site. This information is used to estimate the cost of the optimization analysis. If updated models are not available, costs for updating them will be included.
Item 9a	Enter the annual costs of the current O&M system and the estimated annual costs for Scenarios 1 and 2.
Item 9b	Enter the estimated up-front costs for Scenarios 1 and 2.

*Only if the site is classified as Tier 1 or Tier 1 and 2, and the user is insterested in other optimization alternatives, the following lines in worksheet "**Infosheet (2)**" need to be entered.*

Item 10a	Enter the estimated annual costs for Scenarios 3, 4, and 5.
Item 10b	Enter the estimated up-front costs for Scenarios 3, 4, and 5.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Step 1: General Information

1) Name of Site/Plume:	Cornhusker Army Ammunition Plant, Grand Island, Nebraska
2) Todays Date:	02/23/01
3) Your Name:	Dave Becker
4a) Your Affiliation	USACE
4b) Your Contact Information	
Address	12565 W. Center Rd. Omaha, NE 68144-3869
email	dave.j.becker@usace.army.mil
Phone	402-697-2655
fax	402-697-2613

5) General Questions

5a) Are O&M costs > $100K/year (enter "y" or "n")?	**y**
5b) Is the system flowrate > 50gpm (enter "y" or "n")?	**y**
5c) Is the estimated cleanup time > 5 years (enter "y" or "n")?	**y**

**** Note: We strongly recommend applying quantitative screening to this site. Please fill in the required information on Infosheet (1).*

***** Note: If the anwer to all 3 questions above are "y", this site is more likely to potentially benefit from hydraulic and/or transport optimization. If the user is interested in quantifying potential cost savings that might result from hydraulic and/or transport optimzation simulation, please fill in the required information on "Infosheet(1)". Additionally, the user can goes to the FRTR optimization web site for information on hydraulic and transport optimization software.**

Click to go to -------> **Infosheet (1)**
Click to go to -------> **FRTR Optimization Web site**

Pre-Optimization Screening for Transport and Hydraulic Optimization

USER INPUT INTO THIS SHEET IS OPTIONAL
Fill in this sheet ONLY if the answer to all 3 questions in sheet "General_Screening" are "Yes" and you are interested in quantifying potential cost savings from hydraulic and/or transport optimization.

Site: Cornhusker Army Ammunition Plant, Grand Island, Nebraska

Step 2a: Site Background and Information

6) Background Questions

6a) What is the current main objective for the remediation system? *Choose one (1, 2 or 3)* 1. Cleanup 2. Containment 3. Both	**3**
6b) If optimization were to recommend modifications that would result in a significant reduction in remediation system life-cycle costs, describe the ease of implementing these modifications. *Choose one (1, 2, 3, 4, or 5)* 1. Easy 2. Relatively easy 3. Relatively difficult 4. Difficult 5. Impossible	**2**
6c) Are there any continuing sources, immobile zones, or other factors that likely would prevent a feasible pump-and-treat solution in 50 years or less? *Choose one (1, 2, or 3)* 1. Yes 2. No 3. Don't know	**2**
6d) Are there unknown or uncharacterized sources of contamination at the site? *Choose one (1, 2, or 3)* 1. Yes 2. No 3. Don't know	**2**
6e) If the anwer to question 6d) is Yes, can the site be divided into different operable units in which the unknown sources are contained or addressed by an alternative solution and the remaining portion can be cleaned up by a pump and treat system? *Choose one (1, 2, or 3) (Leave it **blank** if the answer to question 6d) is "No".)* 1. Yes 2. No 3. Don't know	

7) System Information

Expected duration (years)	**50**
Number of extraction wells	**5**
Total pumping rate (gpm)	**700**
Total treatment capacity (gpm)	**750**
Discount rate	**5%**

Pre-Optimization Screening for Transport and Hydraulic Optimization

8) Model/Site Information

8a) How complex is the site? (Level 1 -- 4)	**2**
Choose one (1, 2, 3, or 4)	
Level 1: simulation of one contaminant sufficient for remedy evaluation, and less than 5 model layers	
Level 2: simulation of two contaminants sufficient for remedy evaluation, and/or 5-10 model layers	
Level 3: simulation of three or more contaminants required, and/or more than 10 model layers	
Level 4: rigorous simulation of both unsaturated and saturated zones, and/or multiple phases, and/or fractured bedrock in transport model	
8b) Model information *(Choose one, 1 or 2)*	
Is there an existing flow model?	**1**
1. Yes	
2. No	
Is the flow model up-to-date?	**1**
1. Yes	
2. No	
Is there an existing transport model?	**1**
1. Yes	
2. No	
Is the transport model up-to-date?	**1**
1. Yes	
2. No	

Step 2b: Current Costs		**Step 2c: Estimated Costs for Scenarios 1 & 2**	
		9a) Enter Annual Costs for Each Scenario	
Item	Current System	Scenario #1 no new extraction wells 33% less pumping	Scenario #2 new extraction wells (33% more) 33% less pumping
pumping rate (gpm)	700	469	469
number of wells	5	5	7
Electric	$24,000	$18,000	$18,000
O&M labor	$200,000	$200,000	$200,000
Materials	$28,000	$20,000	$20,000
Maintenance	$10,000	$10,000	$10,000
Discharge Fees			
Analytical	$100,000	$100,000	$100,000
Other #1			
Other #2			
Other #3			
		9b) Enter Up-Front Costs for Each Scenario	
Item	Current System	Scenario #1 no new extraction wells 33% less pumping	Scenario #2 new extraction wells (33% more) 33% less pumping
Engineering design	$0	$25,000	$45,000
Regulatory Process	$0	$5,000	$10,000
New wells/pipes/equipment	$0		$650,000
Increased monitoring	$0		
Increased treatment capacity	$0		
Other #1	$0		
Other #2	$0		
Other #3	$0		

Check cost savings, go to ---------> Cost_Comp
Check site classification, go to ---------> Classify

Pre-Optimization Screening for Transport and Hydraulic Optimization

Costs of Modeling and Optimization Analyses

Site: Cornhusker Army Ammunition Plant, Grand Island, Nebraska

Based on information input by user, this site is Level: 2

	Flow Modeling	Transport Modeling	Optimization	Total
Hydraulic Optimization	$0	$0	$22,500	$22,500
Transport Optimization	$0	$0	$75,000	$75,000

Assumed Costs for Level 1: one contaminant simulated and less than 5 model layers
1. Cost for creating a new flow model for Level 1 is $30,000
2. Cost for updating an existing flow model for Level 1 is $15,000
3. Cost for hydraulic optimization for Level 1 is $15,000
4. Cost for creating a new transport model for Level 1 is $30,000
5. Cost for updating an existing transport model for Level 1 is $15,000
6. Cost for tranport optimization for Level 1 is $50,000

Escalation Factors for Levels 2-4
Level 2: Level 1 * 1.5
Level 3: Level 1 * 2.0
Level 4: Level 1 * 2.5

Note:
Level 1: simulation of one contaminant sufficient for remedy evaluation, and less than 5 model layers
Level 2: simulation of two contaminants sufficient for remedy evaluation, and/or 5-10 model layers
Level 3: simulation of three or more contaminants required, and/or more than 10 model layers
Level 4: rigorous simulation of both unsaturated and saturated zones, and/or multiple phases, and/or fractured bedrock in transport model

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Current System

Site: Cornhusker Army Ammunition Plant, Grand Island, Nebraska

pumping rate 700
number of wells 5

Discount Rate: 5%

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$24,000	50	$460,049	$460,049
O&M labor	$0	$200,000	50	$3,833,744	$3,833,744
Materials	$0	$28,000	50	$536,724	$536,724
Maintenance	$0	$10,000	50	$191,687	$191,687
Discharge Fees	$0	$0	50	$0	$0
Analytical	$0	$100,000	50	$1,916,872	$1,916,872
Other #1	$0	$0	50	$0	$0
Other #2	$0	$0	50	$0	$0
Other #3	$0	$0	50	$0	$0
Costs of Analysis					
-Flow Modeling	$0			$0	$0
-Transport Modeling	$0			$0	$0
-Optimization	$0			$0	$0
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$0			$0	$0
-Regulatory Process	$0			$0	$0
-New wells/pipes/equipment	$0			$0	$0
-Increased monitoring	$0			$0	$0
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$0**	**$362,000**		**$6,939,077**	**$6,939,077**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Scenario #1

Site: Cornhusker Army Ammunition Plant, Grand Island, Nebraska

pumping rate	469	(reduction of 33% from current system)
number of wells	5	(same as current system)
Discount Rate:	5%	

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$18,000	50	$345,037	$345,037
O&M labor	$0	$200,000	50	$3,833,744	$3,833,744
Materials	$0	$20,000	50	$383,374	$383,374
Maintenance	$0	$10,000	50	$191,687	$191,687
Discharge Fees	$0	$0	50	$0	$0
Analytical	$0	$100,000	50	$1,916,872	$1,916,872
Other #1	$0	$0	50	$0	$0
Other #2	$0	$0	50	$0	$0
Other #3	$0	$0	50	$0	$0
Costs of Analysis					
-Flow Modeling	$0			$0	$0
-Transport Modeling	$0			$0	$0
-Optimization	$22,500			$0	$22,500
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$25,000			$0	$25,000
-Regulatory Process	$5,000			$0	$5,000
-New wells/pipes/equipment	$0			$0	$0
-Increased monitoring	$0			$0	$0
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$52,500**	**$348,000**		**$6,670,715**	**$6,723,215**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Scenario #2

Site: Cornhusker Army Ammunition Plant, Grand Island, Nebraska

pumping rate	469	(reduction of 33% from current system)
number of wells	7	(increase of 33% from current system)
Discount Rate:	5%	

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$18,000	50	$345,037	$345,037
O&M labor	$0	$200,000	50	$3,833,744	$3,833,744
Materials	$0	$20,000	50	$383,374	$383,374
Maintenance	$0	$10,000	50	$191,687	$191,687
Discharge Fees	$0	$0	50	$0	$0
Analytical	$0	$100,000	50	$1,916,872	$1,916,872
Other #1	$0	$0	50	$0	$0
Other #2	$0	$0	50	$0	$0
Other #3	$0	$0	50	$0	$0
Costs of Analysis					
-Flow Modeling	$0			$0	$0
-Transport Modeling	$0			$0	$0
-Optimization	$22,500			$0	$22,500
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$45,000			$0	$45,000
-Regulatory Process	$10,000			$0	$10,000
-New wells/pipes/equipment	$650,000			$0	$650,000
-Increased monitoring	$0			$0	$0
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$727,500**	**$348,000**		**$6,670,715**	**$7,398,215**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Transport Optimization Screening Analysis -- All Scenarios

Site: Cornhusker Army Ammunition Plant, Grand Island, Nebraska

Discount Rate: 5%

Scenario 1: pumping rate decreased by 33%, no new wells
Scenario 2: pumping rate decreased by 33%, plus 33% additional wells (new)
Scenario 3: current pumping rate, plus 33% additional wells (new)
Scenario 4: pumping rate increased by 33%, no new wells
Scenario 5: pumping rate increased by 33%, plus 33% additional wells (new)

	Current	Scenario #1	Scenario #2	Scenario #3	Scenario #4	Scenario #5
pumping rate (gpm)	**700**	**469**	**469**	**700**	**931**	**931**
number of wells	**5**	**5**	**7**	**7**	**5**	**7**
	Annual	**Annual**	**Annual**	**Annual**	**Annual**	**Annual**
O&M Costs						
Electric	$24,000	$18,000	$18,000	$0	$0	$0
O&M labor	$200,000	$200,000	$200,000	$0	$0	$0
Materials	$28,000	$20,000	$20,000	$0	$0	$0
Maintenance	$10,000	$10,000	$10,000	$0	$0	$0
Discharge Fees	$0	$0	$0	$0	$0	$0
Analytical	$100,000	$100,000	$100,000	$0	$0	$0
Other #1	$0	$0	$0	$0	$0	$0
Other #2	$0	$0	$0	$0	$0	$0
Other #3	$0	$0	$0	$0	$0	$0
Annual Subtotal	$362,000	$348,000	$348,000	$0	$0	$0
	Upfront	**Upfront**	**Upfront**	**Upfront**	**Upfront**	**Upfront**
Costs of Analysis						
-Flow Modeling	$0	$0	$0	$0	$0	$0
-Transport Modeling	$0	$0	$0	$0	$0	$0
-Optimization	$0	$75,000	$75,000	$0	$0	$0
System Modification Costs						
-Engineering design	$0	$25,000	$45,000	$0	$0	$0
-Regulatory Process	$0	$5,000	$10,000	$0	$0	$0
-New wells/pipes/equipment	$0	$0	$650,000	$0	$0	$0
-Increased monitoring	$0	$0	$0	$0	$0	$0
-Increased treatment capacity	$0	$0	$0	$0	$0	$0
-Other #1	$0	$0	$0	$0	$0	$0
-Other #2	$0	$0	$0	$0	$0	$0
Upfront Subtotal	$0	$105,000	$780,000	$0	$0	$0
Life-cycle costs (NPV)	$6,939,077	$6,775,715	$7,450,715	$0	$0	$0

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic and Transport Optimization Potential Cost Savings Analysis

Site: Cornhusker Army Ammunition Plant, Grand Island, Nebraska

Expected Duration: 50
Discount Rate: 5%
Current forecasted cost (NPV): $6,939,077

	Assumed Reduction in Time-to-Close-Out	Cost Savings by Scenario		
		Current	Scenario #1	Scenario #2
Hydraulic Optimization	0%	$0	$215,862	($459,138)
Transport Optimization	0%	$0	$163,362	($511,638)
	10%	N/A	N/A	($335,568)
	20%	N/A	N/A	($110,853)
	30%	N/A	N/A	$175,947

Pre-Optimization Screening for Transport and Hydraulic Optimization

Site Classification

Site: Cornhusker Army Ammunition Plant, Grand Island, Nebraska

Basic Information:

Both cleanup and containment are site objectives.
A feasible pump-and-treat cleanup solution with a time frame of less than 50 years exists.
There are no uncharacterized or unknown sources of contamination at the site.

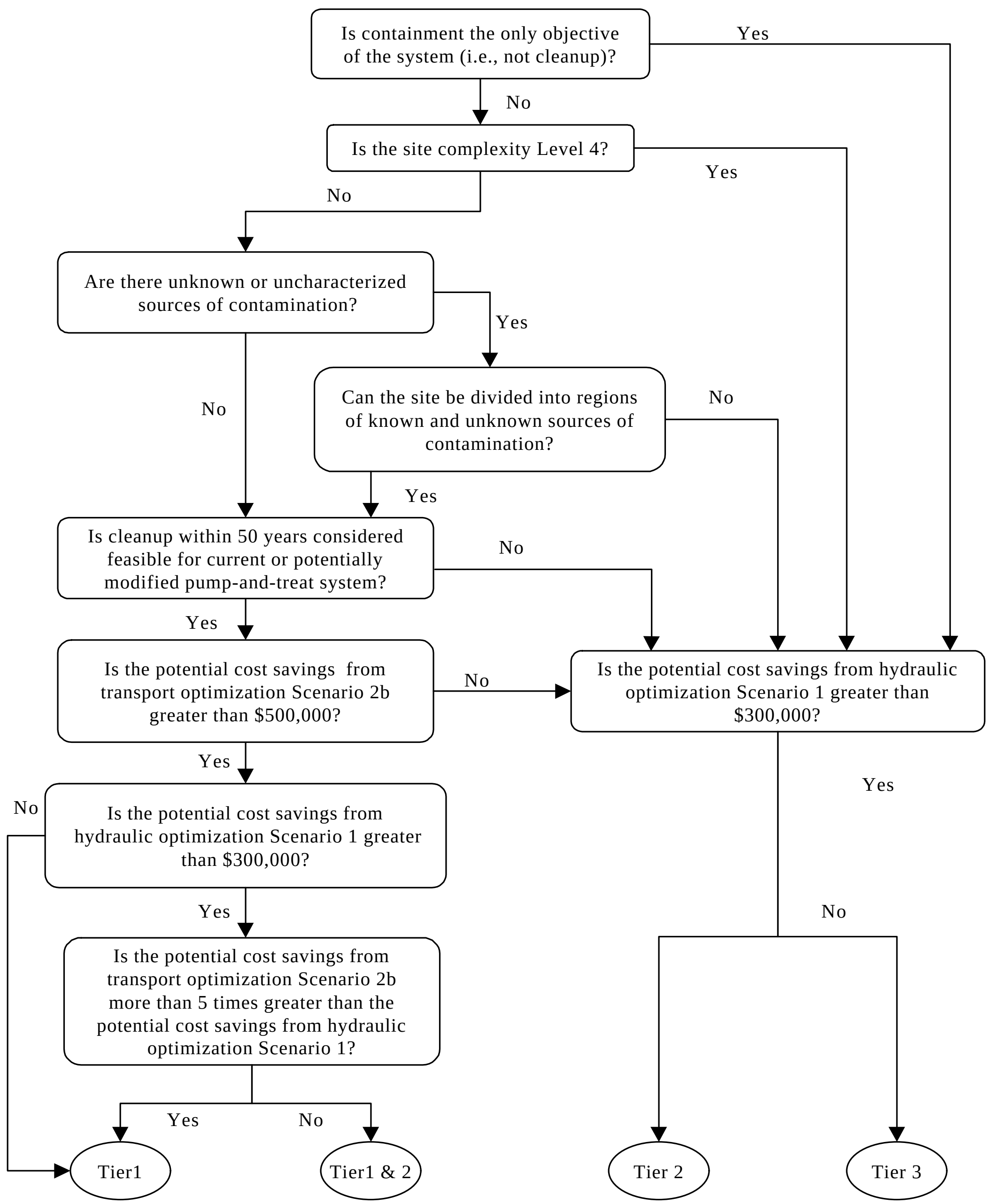
Site Classification: Tier **3**

****Note: Please review the "**Cost_Comp**" worksheet for more detailed information regarding the potential cost savings associated with specific scenarios.*

For additonal scenarios, go to ----------> Infosheet (2)

Pre-Optimization Screening for Transport and Hydraulic Optimization

Rationale for Classifying Sites into Tiers



File: CHAAPScr_Draft 042701.xls, Sheet:Classify

Pre-Optimization Screening for Transport and Hydraulic Optimization

USER INPUT INTO THIS SHEET IS OPTIONAL
Fill out this table ONLY if the site is classified as Tier 1 (or Tier 1 and 2), and if you are interested in evaluating additional transport optimization alternatives.

Site: Cornhusker Army Ammunition Plant, Grand Island, Nebraska

Estimated Costs for Transport Optimization Scenarios

10a) Enter Annual Costs for Each Scenario

Item	Scenario #3 new extraction wells (33% more) no change to pumping	Scenario #4 no new extraction wells 33% more pumping	Scenario #5 new extraction wells (33% more) 33% more pumping
pumping rate (gpm)	700	931	931
number of wells	7	5	7
Electric			
O&M labor			
Materials			
Maintenance			
Discharge Fees			
Analytical			
Other #1			
Other #2			
Other #3			

****Warning: Total pumping rates exceed the current treatment capacity in Scenarios 4 & 5. Thus, the treatment capacity needs to be increased. Please enter capital costs for 'increased treatment capacity' in the table below.*

10b) Enter Up-Front Costs for Each Scenario

Item	Scenario #3 new extraction wells (33% more) no change to pumping	Scenario #4 no new extraction wells 33% more pumping	Scenario #5 new extraction wells (33% more) 33% more pumping
Engineering design			
Regulatory Process			
New wells/pipes/equipment			
Increased monitoring			
Increased treatment capacity			
Other #1			
Other #2			
Other #3			

Check for cost savings analysis, go to -------> Total_Analysis

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic and Transport Optimization Potential Cost Savings Analysis

Site: Cornhusker Army Ammunition Plant, Grand Island, Nebraska

Expected Duration:	50
Discount Rate:	5%
Current forecasted cost (NPV):	$6,939,077

	Reduction in time-to-close-out	**Cost Savings by Scenario**					
		Current	Scenario #1	Scenario #2	Scenario #3	Scenario #4	Scenario #5
Hydraulic Optimization	0%	$0	$215,862	($459,138)	N/A	N/A	N/A
Transport Optimization	0%	$0	$163,362	($511,638)			
	10%	N/A	N/A	($335,568)			
	20%	N/A	N/A	($110,853)			
	30%	N/A	N/A	$175,947			

Hydraulic Optimization Summary

Maximum potential cost savings:	$215,862

Transport Optimization Summary

Maximum potential cost savings, no reduction in cleanup time:	$163,362
Maximum potential cost savings, 10% reduction in cleanup time:	($335,568)
Maximum potential cost savings, 20% reduction in cleanup time:	($110,853)
Maximum potential cost savings, 30% reduction in cleanup time:	$175,947

Pre-Optimization Screening for Transport and Hydraulic Optimization

THIS WORKSHEET SUMMARIZES INPUT REQUIRED BY USER

Notes:
Users are only allowed to input information in "**General_Screening**", "**Infosheet (1)**", and "**Infosheet (2)**", other sheets are calculated automatically.

The fields that need to be filled out by users are highlighted in light-blue.

Instructions:

*Items 1 - 5c need to be entered in worksheet "**General_Screening**".*

Item 1	Enter the name of the site or plume. This name will be used to identify the site throughout the screening process. The name should uniquely identify the site.
Item 2	Enter the date that this spreadsheet is completed.
Item 3	Enter your name. You will be the point of contact for this site during the pre-optimization screening process.
Item 4	Enter your affiliation (i.e., EPA, USACE, name of private contractor, etc.) and contact information.
Item 5a	Is the system annual O&M cost greater than $100K/yr? If lower than $100K/yr, this site is unlikely to benefit from hydraulic and/or transport optimization.
Item 5b	Is the flowrate lower than 50gpm? If less than 50 gpm, this site is unlikely to benefit from hydraulic and/or transport optimization.
Item 5c	Is site cleanup expected within 5 years? If less than 5 years, this site is unlikely to benefit from hydraulic and/or transport optimization.

*Only if the answers to Item 5a, 5b, and 5c are "Yes", and the user is insterested in quantifying potential cost savings by hydraulic and/or transport optimization, the following lines in worksheet "**Infosheet (1)**" need to be entered.*

Item 6a	Enter the primary objective of the remediation system.
Item 6b	Enter the ease with which modifications (e.g., new wells, increased pumping rate, increased treatment capacity, etc.) can be made to the current remediation system.
Item 6c	Is cleanup of the site a feasible goal within 50 years based on the current system or a potentially modified pump-and-treat system? If there are continuing sources or contaminated immobile zones, cleanup may not be a realistic objective.
Item 6d	Are there unknown or uncharacterized sources of contamination at the site? If there are, transport model simulations will likely yield unreliable results. Containing the current plume may be a more practical objective until these sources are characterized.
Item 6e	If the answer to 5d is “yes”, can the site be divided into two regions, one with and one without uncharacterized sources? If the site can be divided into these two regions, transport optimization can be used potentially for the region with known and characterized sources.
Item 7	Enter the correct information about the system (number of wells, pumping rate, etc.) in the cells to the right of list. This information will be used to estimate the life-cycle costs associated with modified systems according to Scenarios.
Item 8a	Enter information regarding the site complexity (ranging from Level 1-- 4). This information is used to estimate the cost of the optimization analysis. Costs increase with site complexity.
Item 8b	Enter information regarding the flow and transport models for the site. This information is used to estimate the cost of the optimization analysis. If updated models are not available, costs for updating them will be included.
Item 9a	Enter the annual costs of the current O&M system and the estimated annual costs for Scenarios 1 and 2.
Item 9b	Enter the estimated up-front costs for Scenarios 1 and 2.

*Only if the site is classified as Tier 1 or Tier 1 and 2, and the user is insterested in other optimization alternatives, the following lines in worksheet "**Infosheet (2)**" need to be entered.*

Item 10a	Enter the estimated annual costs for Scenarios 3, 4, and 5.
Item 10b	Enter the estimated up-front costs for Scenarios 3, 4, and 5.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Step 1: General Information

1) Name of Site/Plume:	Lakehurst Area A, NJ
2) Todays Date:	03/01/01
3) Your Name:	Michael Figura
4a) Your Affiliation	Naval Air Engineering Station Lakehurst
4b) Your Contact Information	
Address	Code 832300 B5-2 Lakehurst, NJ 08733
email	FIGURAMJ@NAVAIR.NAVY.MIL
Phone	(732) 323 4857
fax	(732) 323 2792

5) General Questions

5a) Are O&M costs > $100K/year (enter "y" or "n")?	**y**
5b) Is the system flowrate > 50gpm (enter "y" or "n")?	**y**
5c) Is the estimated cleanup time > 5 years (enter "y" or "n")?	**y**

***** Note: We strongly recommend applying quantitative screening to this site. Please fill in the required information on Infosheet (1).**

***** Note: If the anwer to all 3 questions above are "y", this site is more likely to potentially benefit from hydraulic and/or transport optimization. If the user is interested in quantifying potential cost savings that might result from hydraulic and/or transport optimzation simulation, please fill in the required information on "Infosheet(1)". Additionally, the user can goes to the FRTR optimization web site for information on hydraulic and transport optimization software.**

Click to go to -------> Infosheet (1)
Click to go to -------> FRTR Optimization Web site

Pre-Optimization Screening for Transport and Hydraulic Optimization

USER INPUT INTO THIS SHEET IS OPTIONAL
Fill in this sheet ONLY if the answer to all 3 questions in sheet "General_Screening" are "Yes" and you are interested in quantifying potential cost savings from hydraulic and/or transport optimization.

Site: Lakehurst Area A, NJ

Step 2a: Site Background and Information

6) Background Questions

6a) What is the current main objective for the remediation system? *Choose one (1, 2 or 3)* 1. Cleanup 2. Containment 3. Both	**3**
6b) If optimization were to recommend modifications that would result in a significant reduction in remediation system life-cycle costs, describe the ease of implementing these modifications. *Choose one (1, 2, 3, 4, or 5)* 1. Easy 2. Relatively easy 3. Relatively difficult 4. Difficult 5. Impossible	**3**
6c) Are there any continuing sources, immobile zones, or other factors that likely would prevent a feasible pump-and-treat solution in 50 years or less? *Choose one (1, 2, or 3)* 1. Yes 2. No 3. Don't know	**2**
6d) Are there unknown or uncharacterized sources of contamination at the site? *Choose one (1, 2, or 3)* 1. Yes 2. No 3. Don't know	**2**
6e) If the anwer to question 6d) is Yes, can the site be divided into different operable units in which the unknown sources are contained or addressed by an alternative solution and the remaining portion can be cleaned up by a pump and treat system? *Choose one (1, 2, or 3) (Leave it **blank** if the answer to question 6d) is "No".)* 1. Yes 2. No 3. Don't know	

7) System Information

Expected duration (years)	**15**
Number of extraction wells	**6**
Total pumping rate (gpm)	**585**
Total treatment capacity (gpm)	**725**
Discount rate	**5%**

Pre-Optimization Screening for Transport and Hydraulic Optimization

8) Model/Site Information	
8a) How complex is the site? (Level 1 -- 4)	**3**
Choose one (1, 2, 3, or 4)	
Level 1: simulation of one contaminant sufficient for remedy evaluation, and less than 5 model layers	
Level 2: simulation of two contaminants sufficient for remedy evaluation, and/or 5-10 model layers	
Level 3: simulation of three or more contaminants required, and/or more than 10 model layers	
Level 4: rigorous simulation of both unsaturated and saturated zones, and/or multiple phases, and/or fractured bedrock in transport model	
8b) Model information *(Choose one, 1 or 2)*	
Is there an existing flow model?	**1**
1. Yes	
2. No	
Is the flow model up-to-date?	**1**
1. Yes	
2. No	
Is there an existing transport model?	**1**
1. Yes	
2. No	
Is the transport model up-to-date?	**1**
1. Yes	
2. No	

Step 2b: Current Costs		**Step 2c: Estimated Costs for Scenarios 1 & 2**	
		9a) Enter Annual Costs for Each Scenario	
Item	Current System	Scenario #1 no new extraction wells 33% less pumping	Scenario #2 new extraction wells (33% more) 33% less pumping
pumping rate (gpm)	585	391.95	391.95
number of wells	6	6	8
Electric	$120,000	$100,000	$120,000
O&M labor	$90,000	$90,000	$100,000
Materials	$90,000	$90,000	$100,000
Maintenance			
Discharge Fees			
Analytical	$90,000	$90,000	$120,000
Other #1	$50,000	$50,000	$50,000
Other #2	$30,000	$30,000	$50,000
Other #3	$20,000	$20,000	$30,000
		9b) Enter Up-Front Costs for Each Scenario	
Item	Current System	Scenario #1 no new extraction wells 33% less pumping	Scenario #2 new extraction wells (33% more) 33% less pumping
Engineering design	$0	$10,000	$15,000
Regulatory Process	$0	$10,000	$15,000
New wells/pipes/equipment	$0		$45,000
Increased monitoring	$0		$10,000
Increased treatment capacity	$0		
Other #1	$0		
Other #2	$0		
Other #3	$0		

Check cost savings, go to ---------> Cost_Comp
Check site classification, go to ---------> Classify

Pre-Optimization Screening for Transport and Hydraulic Optimization

Costs of Modeling and Optimization Analyses

Site: Lakehurst Area A, NJ

Based on information input by user, this site is Level: 3

	Flow Modeling	Transport Modeling	Optimization	Total
Hydraulic Optimization	$0	$0	$30,000	$30,000
Transport Optimization	$0	$0	$100,000	$100,000

Assumed Costs for Level 1: one contaminant simulated and less than 5 model layers

1. Cost for creating a new flow model for Level 1 is $30,000
2. Cost for updating an existing flow model for Level 1 is $15,000
3. Cost for hydraulic optimization for Level 1 is $15,000
4. Cost for creating a new transport model for Level 1 is $30,000
5. Cost for updating an existing transport model for Level 1 is $15,000
6. Cost for tranport optimization for Level 1 is $50,000

Escalation Factors for Levels 2-4

Level 2: Level 1 * 1.5
Level 3: Level 1 * 2.0
Level 4: Level 1 * 2.5

Note:

Level 1: simulation of one contaminant sufficient for remedy evaluation, and less than 5 model layers
Level 2: simulation of two contaminants sufficient for remedy evaluation, and/or 5-10 model layers
Level 3: simulation of three or more contaminants required, and/or more than 10 model layers
Level 4: rigorous simulation of both unsaturated and saturated zones, and/or multiple phases, and/or fractured bedrock in transport model

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Current System

Site: Lakehurst Area A, NJ

pumping rate	585
number of wells	6
Discount Rate:	5%

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$120,000	15	$1,307,837	$1,307,837
O&M labor	$0	$90,000	15	$980,878	$980,878
Materials	$0	$90,000	15	$980,878	$980,878
Maintenance	$0	$0	15	$0	$0
Discharge Fees	$0	$0	15	$0	$0
Analytical	$0	$90,000	15	$980,878	$980,878
Other #1	$0	$50,000	15	$544,932	$544,932
Other #2	$0	$30,000	15	$326,959	$326,959
Other #3	$0	$20,000	15	$217,973	$217,973
Costs of Analysis					
-Flow Modeling	$0			$0	$0
-Transport Modeling	$0			$0	$0
-Optimization	$0			$0	$0
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$0			$0	$0
-Regulatory Process	$0			$0	$0
-New wells/pipes/equipment	$0			$0	$0
-Increased monitoring	$0			$0	$0
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$0**	**$490,000**		**$5,340,334**	**$5,340,334**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Scenario #1

Site: Lakehurst Area A, NJ

pumping rate	391.95	(reduction of 33% from current system)
number of wells	6	(same as current system)
Discount Rate:	5%	

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$100,000	15	$1,089,864	$1,089,864
O&M labor	$0	$90,000	15	$980,878	$980,878
Materials	$0	$90,000	15	$980,878	$980,878
Maintenance	$0	$0	15	$0	$0
Discharge Fees	$0	$0	15	$0	$0
Analytical	$0	$90,000	15	$980,878	$980,878
Other #1	$0	$50,000	15	$544,932	$544,932
Other #2	$0	$30,000	15	$326,959	$326,959
Other #3	$0	$20,000	15	$217,973	$217,973
Costs of Analysis					
-Flow Modeling	$0			$0	$0
-Transport Modeling	$0			$0	$0
-Optimization	$30,000			$0	$30,000
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$10,000			$0	$10,000
-Regulatory Process	$10,000			$0	$10,000
-New wells/pipes/equipment	$0			$0	$0
-Increased monitoring	$0			$0	$0
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$50,000**	**$470,000**		**$5,122,361**	**$5,172,361**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Scenario #2

Site: Lakehurst Area A, NJ

pumping rate	391.95	(reduction of 33% from current system)
number of wells	8	(increase of 33% from current system)
Discount Rate:	5%	

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$120,000	15	$1,307,837	$1,307,837
O&M labor	$0	$100,000	15	$1,089,864	$1,089,864
Materials	$0	$100,000	15	$1,089,864	$1,089,864
Maintenance	$0	$0	15	$0	$0
Discharge Fees	$0	$0	15	$0	$0
Analytical	$0	$120,000	15	$1,307,837	$1,307,837
Other #1	$0	$50,000	15	$544,932	$544,932
Other #2	$0	$50,000	15	$544,932	$544,932
Other #3	$0	$30,000	15	$326,959	$326,959
Costs of Analysis					
-Flow Modeling	$0			$0	$0
-Transport Modeling	$0			$0	$0
-Optimization	$30,000			$0	$30,000
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$15,000			$0	$15,000
-Regulatory Process	$15,000			$0	$15,000
-New wells/pipes/equipment	$45,000			$0	$45,000
-Increased monitoring	$10,000			$0	$10,000
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$115,000**	**$570,000**		**$6,212,225**	**$6,327,225**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Transport Optimization Screening Analysis -- All Scenarios

Site: Lakehurst Area A, NJ

Discount Rate: 5%

Scenario 1: pumping rate decreased by 33%, no new wells
Scenario 2: pumping rate decreased by 33%, plus 33% additional wells (new)
Scenario 3: current pumping rate, plus 33% additional wells (new)
Scenario 4: pumping rate increased by 33%, no new wells
Scenario 5: pumping rate increased by 33%, plus 33% additional wells (new)

	Current	Scenario #1	Scenario #2	Scenario #3	Scenario #4	Scenario #5
pumping rate (gpm)	**585**	**391.95**	**391.95**	**585**	**778.05**	**778.05**
number of wells	**6**	**6**	**8**	**8**	**6**	**8**
	Annual	**Annual**	**Annual**	**Annual**	**Annual**	**Annual**
O&M Costs						
Electric	$120,000	$100,000	$120,000	$0	$0	$0
O&M labor	$90,000	$90,000	$100,000	$0	$0	$0
Materials	$90,000	$90,000	$100,000	$0	$0	$0
Maintenance	$0	$0	$0	$0	$0	$0
Discharge Fees	$0	$0	$0	$0	$0	$0
Analytical	$90,000	$90,000	$120,000	$0	$0	$0
Other #1	$50,000	$50,000	$50,000	$0	$0	$0
Other #2	$30,000	$50,000	$50,000	$0	$0	$0
Other #3	$20,000	$30,000	$20,000	$0	$0	$0
Annual Subtotal	$490,000	$500,000	$560,000	$0	$0	$0
	Upfront	**Upfront**	**Upfront**	**Upfront**	**Upfront**	**Upfront**
Costs of Analysis						
-Flow Modeling	$0	$0	$0	$0	$0	$0
-Transport Modeling	$0	$0	$0	$0	$0	$0
-Optimization	$0	$100,000	$100,000	$0	$0	$0
System Modification Costs						
-Engineering design	$0	$10,000	$15,000	$0	$0	$0
-Regulatory Process	$0	$10,000	$15,000	$0	$0	$0
-New wells/pipes/equipment	$0	$0	$45,000	$0	$0	$0
-Increased monitoring	$0	$0	$10,000	$0	$0	$0
-Increased treatment capacity	$0	$0	$0	$0	$0	$0
-Other #1	$0	$0	$0	$0	$0	$0
-Other #2	$0	$0	$0	$0	$0	$0
Upfront Subtotal	$0	$120,000	$185,000	$0	$0	$0
Life-cycle costs (NPV)	$5,340,334	$5,569,320	$6,288,239	$0	$0	$0

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic and Transport Optimization Potential Cost Savings Analysis

Site: Lakehurst Area A, NJ

Expected Duration:	15
Discount Rate:	5%
Current forecasted cost (NPV):	$5,340,334

	Assumed Reduction in Time-to-Close-Out	**Cost Savings by Scenario**		
		Current	Scenario #1	Scenario #2
Hydraulic Optimization	0%	$0	$167,973	($986,891)
Transport Optimization	0%	$0	($228,986)	($947,905)
	10%	N/A	N/A	($518,388)
	20%	N/A	N/A	($56,258)
	30%	N/A	N/A	$440,962

Pre-Optimization Screening for Transport and Hydraulic Optimization

Site Classification

Site: Lakehurst Area A, NJ

Basic Information:

Both cleanup and containment are site objectives.
A feasible pump-and-treat cleanup solution with a time frame of less than 50 years exists.
There are no uncharacterized or unknown sources of contamination at the site.

Site Classification: Tier **3**

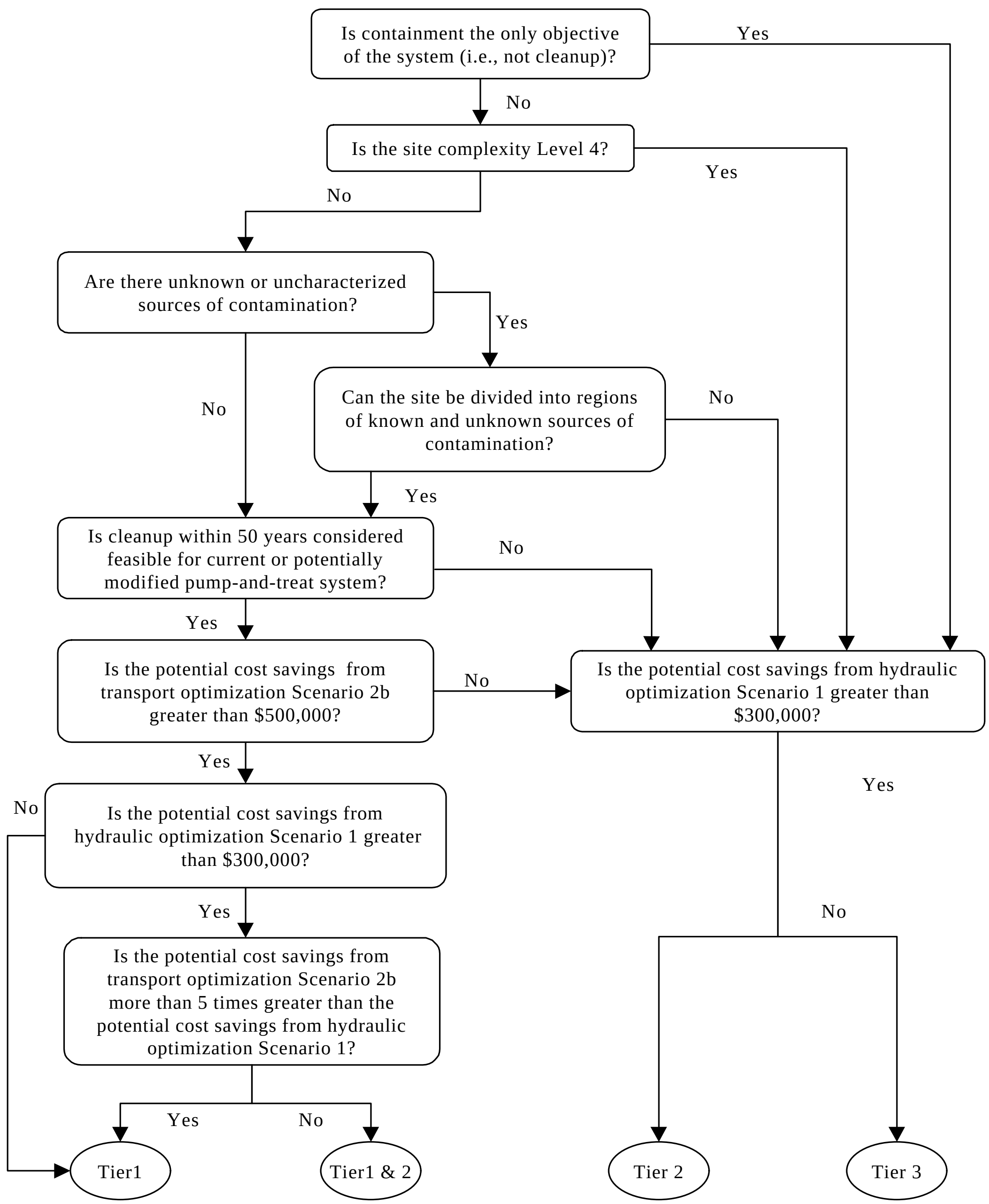
****Note: Please review the "**Cost_Comp**" worksheet for more detailed information regarding the potential cost savings associated with specific scenarios.*

******Note: Potential obstacles to implementing modifications should be considered as the cost of optimization is likely not warranted if modifications cannot be made.***

For additonal scenarios, go to ----------> Infosheet (2)

Pre-Optimization Screening for Transport and Hydraulic Optimization

Rationale for Classifying Sites into Tiers



File: LakehurstScr_Draft 042701.xls, Sheet:Classify

Pre-Optimization Screening for Transport and Hydraulic Optimization

USER INPUT INTO THIS SHEET IS OPTIONAL
Fill out this table ONLY if the site is classified as Tier 1 (or Tier 1 and 2), and if you are interested in evaluating additional transport optimization alternatives.

Site: Lakehurst Area A, NJ

Estimated Costs for Transport Optimization Scenarios

10a) Enter Annual Costs for Each Scenario

Item	Scenario #3 new extraction wells (33% more) no change to pumping	Scenario #4 no new extraction wells 33% more pumping	Scenario #5 new extraction wells (33% more) 33% more pumping
pumping rate (gpm)	585	778.05	778.05
number of wells	8	6	8
Electric			
O&M labor			
Materials			
Maintenance			
Discharge Fees			
Analytical			
Other #1			
Other #2			
Other #3			

****Warning: Total pumping rates exceed the current treatment capacity in Scenarios 4 & 5. Thus, the treatment capacity needs to be increased. Please enter capital costs for 'increased treatment capacity' in the table below.*

10b) Enter Up-Front Costs for Each Scenario

Item	Scenario #3 new extraction wells (33% more) no change to pumping	Scenario #4 no new extraction wells 33% more pumping	Scenario #5 new extraction wells (33% more) 33% more pumping
Engineering design			
Regulatory Process			
New wells/pipes/equipment			
Increased monitoring			
Increased treatment capacity			
Other #1			
Other #2			
Other #3			

Check for cost savings analysis, go to -------> Total_Analysis

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic and Transport Optimization Potential Cost Savings Analysis

Site: Lakehurst Area A, NJ

Expected Duration:	15
Discount Rate:	5%
Current forecasted cost (NPV):	$5,340,334

	Reduction in time-to-close-out	Cost Savings by Scenario					
		Current	Scenario #1	Scenario #2	Scenario #3	Scenario #4	Scenario #5
Hydraulic Optimization	0%	$0	$167,973	($986,891)	N/A	N/A	N/A
Transport Optimization	0%	$0	($228,986)	($947,905)			
	10%	N/A	N/A	($518,388)			
	20%	N/A	N/A	($56,258)			
	30%	N/A	N/A	$440,962			

Hydraulic Optimization Summary

Maximum potential cost savings:	$167,973

Transport Optimization Summary

Maximum potential cost savings, no reduction in cleanup time:	$0
Maximum potential cost savings, 10% reduction in cleanup time:	($518,388)
Maximum potential cost savings, 20% reduction in cleanup time:	($56,258)
Maximum potential cost savings, 30% reduction in cleanup time:	$440,962

Pre-Optimization Screening for Transport and Hydraulic Optimization

THIS WORKSHEET SUMMARIZES INPUT REQUIRED BY USER

Notes:

Users are only allowed to input information in "**General_Screening**", "**Infosheet (1)**", and "**Infosheet (2)**", other sheets are calculated automatically.

The fields that need to be filled out by users are highlighted in light-blue.

Instructions:

*Items 1 - 5c need to be entered in worksheet "**General_Screening**".*

Item 1	Enter the name of the site or plume. This name will be used to identify the site throughout the screening process. The name should uniquely identify the site.
Item 2	Enter the date that this spreadsheet is completed.
Item 3	Enter your name. You will be the point of contact for this site during the pre-optimization screening process.
Item 4	Enter your affiliation (i.e., EPA, USACE, name of private contractor, etc.) and contact information.
Item 5a	Is the system annual O&M cost greater than $100K/yr? If lower than $100K/yr, this site is unlikely to benefit from hydraulic and/or transport optimization.
Item 5b	Is the flowrate lower than 50gpm? If less than 50 gpm, this site is unlikely to benefit from hydraulic and/or transport optimization.
Item 5c	Is site cleanup expected within 5 years? If less than 5 years, this site is unlikely to benefit from hydraulic and/or transport optimization.

*Only if the answers to Item 5a, 5b, and 5c are "Yes", and the user is insterested in quantifying potential cost savings by hydraulic and/or transport optimization, the following lines in worksheet "**Infosheet (1)**" need to be entered.*

Item 6a	Enter the primary objective of the remediation system.
Item 6b	Enter the ease with which modifications (e.g., new wells, increased pumping rate, increased treatment capacity, etc.) can be made to the current remediation system.
Item 6c	Is cleanup of the site a feasible goal within 50 years based on the current system or a potentially modified pump-and-treat system? If there are continuing sources or contaminated immobile zones, cleanup may not be a realistic objective.
Item 6d	Are there unknown or uncharacterized sources of contamination at the site? If there are, transport model simulations will likely yield unreliable results. Containing the current plume may be a more practical objective until these sources are characterized.
Item 6e	If the answer to 5d is "yes", can the site be divided into two regions, one with and one without uncharacterized sources? If the site can be divided into these two regions, transport optimization can be used potentially for the region with known and characterized sources.
Item 7	Enter the correct information about the system (number of wells, pumping rate, etc.) in the cells to the right of list. This information will be used to estimate the life-cycle costs associated with modified systems according to Scenarios.
Item 8a	Enter information regarding the site complexity (ranging from Level 1-- 4). This information is used to estimate the cost of the optimization analysis. Costs increase with site complexity.
Item 8b	Enter information regarding the flow and transport models for the site. This information is used to estimate the cost of the optimization analysis. If updated models are not available, costs for updating them will be included.
Item 9a	Enter the annual costs of the current O&M system and the estimated annual costs for Scenarios 1 and 2.
Item 9b	Enter the estimated up-front costs for Scenarios 1 and 2.

*Only if the site is classified as Tier 1 or Tier 1 and 2, and the user is interested in other optimization alternatives, the following lines in worksheet "**Infosheet (2)**" need to be entered.*

Item 10a	Enter the estimated annual costs for Scenarios 3, 4, and 5.
Item 10b	Enter the estimated up-front costs for Scenarios 3, 4, and 5.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Step 1: General Information

1) Name of Site/Plume:	MCAS - Cherry Point, NC
2) Todays Date:	04/16/01
3) Your Name:	Yan Zhang
4a) Your Affiliation	
4b) Your Contact Information	
Address	2 Paragon Way Freehold, NJ 07728
email	yzhang@geotransinc.com
Phone	732-409-0344
fax	732-409-3020

5) General Questions

5a) Are O&M costs > $100K/year (enter "y" or "n")?	**y**
5b) Is the system flowrate > 50gpm (enter "y" or "n")?	**y**
5c) Is the estimated cleanup time > 5 years (enter "y" or "n")?	**y**

**** Note: We strongly recommend applying quantitative screening to this site. Please fill in the required information on Infosheet (1).*

***** Note: If the anwer to all 3 questions above are "y", this site is more likely to potentially benefit from hydraulic and/or transport optimization. If the user is interested in quantifying potential cost savings that might result from hydraulic and/or transport optimzation simulation, please fill in the required information on "Infosheet(1)". Additionally, the user can goes to the FRTR optimization web site for information on hydraulic and transport optimization software.**

Click to go to -------> Infosheet (1)
Click to go to -------> FRTR Optimization Web site

Pre-Optimization Screening for Transport and Hydraulic Optimization

USER INPUT INTO THIS SHEET IS OPTIONAL
Fill in this sheet ONLY if the answer to all 3 questions in sheet "General_Screening" are "Yes" and you are interested in quantifying potential cost savings from hydraulic and/or transport optimization.

Site: MCAS - Cherry Point, NC

Step 2a: Site Background and Information

6) Background Questions	
6a) What is the current main objective for the remediation system? *Choose one (1, 2 or 3)* 1. Cleanup 2. Containment 3. Both	**2**
6b) If optimization were to recommend modifications that would result in a significant reduction in remediation system life-cycle costs, describe the ease of implementing these modifications. *Choose one (1, 2, 3, 4, or 5)* 1. Easy 2. Relatively easy 3. Relatively difficult 4. Difficult 5. Impossible	**2**
6c) Are there any continuing sources, immobile zones, or other factors that likely would prevent a feasible pump-and-treat solution in 50 years or less? *Choose one (1, 2, or 3)* 1. Yes 2. No 3. Don't know	**2**
6d) Are there unknown or uncharacterized sources of contamination at the site? *Choose one (1, 2, or 3)* 1. Yes 2. No 3. Don't know	**2**
6e) If the anwer to question 6d) is Yes, can the site be divided into different operable units in which the unknown sources are contained or addressed by an alternative solution and the remaining portion can be cleaned up by a pump and treat system? *Choose one (1, 2, or 3) (Leave it **blank** if the answer to question 6d) is "No".)* 1. Yes 2. No 3. Don't know	
7) System Information	
Expected duration (years)	**20**
Number of extraction wells	**10**
Total pumping rate (gpm)	**90**
Total treatment capacity (gpm)	**440**
Discount rate	**5%**

Pre-Optimization Screening for Transport and Hydraulic Optimization

8) Model/Site Information	
8a) How complex is the site? (Level 1 -- 4)	**1**
Choose one (1, 2, 3, or 4)	
Level 1: simulation of one contaminant sufficient for remedy evaluation, and less than 5 model layers	
Level 2: simulation of two contaminants sufficient for remedy evaluation, and/or 5-10 model layers	
Level 3: simulation of three or more contaminants required, and/or more than 10 model layers	
Level 4: rigorous simulation of both unsaturated and saturated zones, and/or multiple phases, and/or fractured bedrock in transport model	
8b) Model information *(Choose one, 1 or 2)*	
Is there an existing flow model?	**1**
1. Yes	
2. No	
Is the flow model up-to-date?	**1**
1. Yes	
2. No	
Is there an existing transport model?	**1**
1. Yes	
2. No	
Is the transport model up-to-date?	**2**
1. Yes	
2. No	

Step 2b: Current Costs		**Step 2c: Estimated Costs for Scenarios 1 & 2**	
		9a) Enter Annual Costs for Each Scenario	
Item	Current System	Scenario #1 no new extraction wells 33% less pumping	Scenario #2 new extraction wells (33% more) 33% less pumping
pumping rate (gpm)	90	60.3	60.3
number of wells	10	10	14
Electric	$15,000	$12,000	$12,000
O&M labor	$220,000	$220,000	$220,000
Materials			
Maintenance			
Discharge Fees	$35,000	$23,450	$23,450
Analytical			
Other #1			
Other #2			
Other #3			
		9b) Enter Up-Front Costs for Each Scenario	
Item	Current System	Scenario #1 no new extraction wells 33% less pumping	Scenario #2 new extraction wells (33% more) 33% less pumping
Engineering design	$0	$10,000	$15,000
Regulatory Process	$0	$10,000	$15,000
New wells/pipes/equipment	$0		$1,000,000
Increased monitoring	$0		
Increased treatment capacity	$0		
Other #1	$0		
Other #2	$0		
Other #3	$0		

Check cost savings, go to ---------> Cost_Comp
Check site classification, go to ---------> Classify

Pre-Optimization Screening for Transport and Hydraulic Optimization

Costs of Modeling and Optimization Analyses

Site: MCAS - Cherry Point, NC

Based on information input by user, this site is Level: 1

	Flow Modeling	Transport Modeling	Optimization	Total
Hydraulic Optimization	$0	$0	$15,000	$15,000
Transport Optimization	$0	$15,000	$50,000	$65,000

Assumed Costs for Level 1: one contaminant simulated and less than 5 model layers

1. Cost for creating a new flow model for Level 1 is $30,000
2. Cost for updating an existing flow model for Level 1 is $15,000
3. Cost for hydraulic optimization for Level 1 is $15,000
4. Cost for creating a new transport model for Level 1 is $30,000
5. Cost for updating an existing transport model for Level 1 is $15,000
6. Cost for tranport optimization for Level 1 is $50,000

Escalation Factors for Levels 2-4

Level 2: Level 1 * 1.5
Level 3: Level 1 * 2.0
Level 4: Level 1 * 2.5

Note:

Level 1: simulation of one contaminant sufficient for remedy evaluation, and less than 5 model layers
Level 2: simulation of two contaminants sufficient for remedy evaluation, and/or 5-10 model layers
Level 3: simulation of three or more contaminants required, and/or more than 10 model layers
Level 4: rigorous simulation of both unsaturated and saturated zones, and/or multiple phases, and/or fractured bedrock in transport model

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Current System

Site: MCAS - Cherry Point, NC

pumping rate	90
number of wells	10
Discount Rate:	5%

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$15,000	20	$196,280	$196,280
O&M labor	$0	$220,000	20	$2,878,771	$2,878,771
Materials	$0	$0	20	$0	$0
Maintenance	$0	$0	20	$0	$0
Discharge Fees	$0	$35,000	20	$457,986	$457,986
Analytical	$0	$0	20	$0	$0
Other #1	$0	$0	20	$0	$0
Other #2	$0	$0	20	$0	$0
Other #3	$0	$0	20	$0	$0
Costs of Analysis					
-Flow Modeling	$0			$0	$0
-Transport Modeling	$0			$0	$0
-Optimization	$0			$0	$0
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$0			$0	$0
-Regulatory Process	$0			$0	$0
-New wells/pipes/equipment	$0			$0	$0
-Increased monitoring	$0			$0	$0
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$0**	**$270,000**		**$3,533,037**	**$3,533,037**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Scenario #1

Site: MCAS - Cherry Point, NC

pumping rate	60.3	(reduction of 33% from current system)
number of wells	10	(same as current system)
Discount Rate:	5%	

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$12,000	20	$157,024	$157,024
O&M labor	$0	$220,000	20	$2,878,771	$2,878,771
Materials	$0	$0	20	$0	$0
Maintenance	$0	$0	20	$0	$0
Discharge Fees	$0	$23,450	20	$306,851	$306,851
Analytical	$0	$0	20	$0	$0
Other #1	$0	$0	20	$0	$0
Other #2	$0	$0	20	$0	$0
Other #3	$0	$0	20	$0	$0
Costs of Analysis					
-Flow Modeling	$0			$0	$0
-Transport Modeling	$0			$0	$0
-Optimization	$15,000			$0	$15,000
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$10,000			$0	$10,000
-Regulatory Process	$10,000			$0	$10,000
-New wells/pipes/equipment	$0			$0	$0
-Increased monitoring	$0			$0	$0
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$35,000**	**$255,450**		**$3,342,645**	**$3,377,645**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Scenario #2

Site: MCAS - Cherry Point, NC

pumping rate	60.3	(reduction of 33% from current system)
number of wells	14	(increase of 33% from current system)
Discount Rate:	5%	

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$12,000	20	$157,024	$157,024
O&M labor	$0	$220,000	20	$2,878,771	$2,878,771
Materials	$0	$0	20	$0	$0
Maintenance	$0	$0	20	$0	$0
Discharge Fees	$0	$23,450	20	$306,851	$306,851
Analytical	$0	$0	20	$0	$0
Other #1	$0	$0	20	$0	$0
Other #2	$0	$0	20	$0	$0
Other #3	$0	$0	20	$0	$0
Costs of Analysis					
-Flow Modeling	$0			$0	$0
-Transport Modeling	$0			$0	$0
-Optimization	$15,000			$0	$15,000
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$15,000			$0	$15,000
-Regulatory Process	$15,000			$0	$15,000
-New wells/pipes/equipment	$1,000,000			$0	$1,000,000
-Increased monitoring	$0			$0	$0
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$1,045,000**	**$255,450**		**$3,342,645**	**$4,387,645**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Transport Optimization Screening Analysis -- All Scenarios

Site: MCAS - Cherry Point, NC

Discount Rate: 5%

Scenario 1: pumping rate decreased by 33%, no new wells
Scenario 2: pumping rate decreased by 33%, plus 33% additional wells (new)
Scenario 3: current pumping rate, plus 33% additional wells (new)
Scenario 4: pumping rate increased by 33%, no new wells
Scenario 5: pumping rate increased by 33%, plus 33% additional wells (new)

	Current	Scenario #1	Scenario #2	Scenario #3	Scenario #4	Scenario #5
pumping rate (gpm)	**90**	**60.3**	**60.3**	**90**	**119.7**	**119.7**
number of wells	**10**	**10**	**14**	**14**	**10**	**14**
	Annual	**Annual**	**Annual**	**Annual**	**Annual**	**Annual**
O&M Costs						
Electric	$15,000	$12,000	$12,000	$0	$0	$0
O&M labor	$220,000	$220,000	$220,000	$0	$0	$0
Materials	$0	$0	$0	$0	$0	$0
Maintenance	$0	$0	$0	$0	$0	$0
Discharge Fees	$35,000	$23,450	$23,450	$0	$0	$0
Analytical	$0	$0	$0	$0	$0	$0
Other #1	$0	$0	$0	$0	$0	$0
Other #2	$0	$0	$0	$0	$0	$0
Other #3	$0	$0	$0	$0	$0	$0
Annual Subtotal	$270,000	$255,450	$255,450	$0	$0	$0
	Upfront	**Upfront**	**Upfront**	**Upfront**	**Upfront**	**Upfront**
Costs of Analysis						
-Flow Modeling	$0	$0	$0	$0	$0	$0
-Transport Modeling	$0	$15,000	$15,000	$0	$0	$0
-Optimization	$0	$50,000	$50,000	$0	$0	$0
System Modification Costs						
-Engineering design	$0	$10,000	$15,000	$0	$0	$0
-Regulatory Process	$0	$10,000	$15,000	$0	$0	$0
-New wells/pipes/equipment	$0	$0	$1,000,000	$0	$0	$0
-Increased monitoring	$0	$0	$0	$0	$0	$0
-Increased treatment capacity	$0	$0	$0	$0	$0	$0
-Other #1	$0	$0	$0	$0	$0	$0
-Other #2	$0	$0	$0	$0	$0	$0
Upfront Subtotal	$0	$85,000	$1,095,000	$0	$0	$0
Life-cycle costs (NPV)	$3,533,037	$3,427,645	$4,437,645	$0	$0	$0

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic and Transport Optimization Potential Cost Savings Analysis

Site: MCAS - Cherry Point, NC

Expected Duration:	20
Discount Rate:	5%
Current forecasted cost (NPV):	$3,533,037

	Assumed Reduction in Time-to-Close-Out	Cost Savings by Scenario		
		Current	Scenario #1	Scenario #2
Hydraulic Optimization	0%	$0	$155,391	($854,609)
Transport Optimization	0%	$0	$105,391	($904,609)
	10%	N/A	N/A	($697,374)
	20%	N/A	N/A	($468,897)
	30%	N/A	N/A	($217,002)

Pre-Optimization Screening for Transport and Hydraulic Optimization

Site Classification

Site: MCAS - Cherry Point, NC

Basic Information:

The primary site objective is containment.
There are no uncharacterized or unknown sources of contamination at the site.

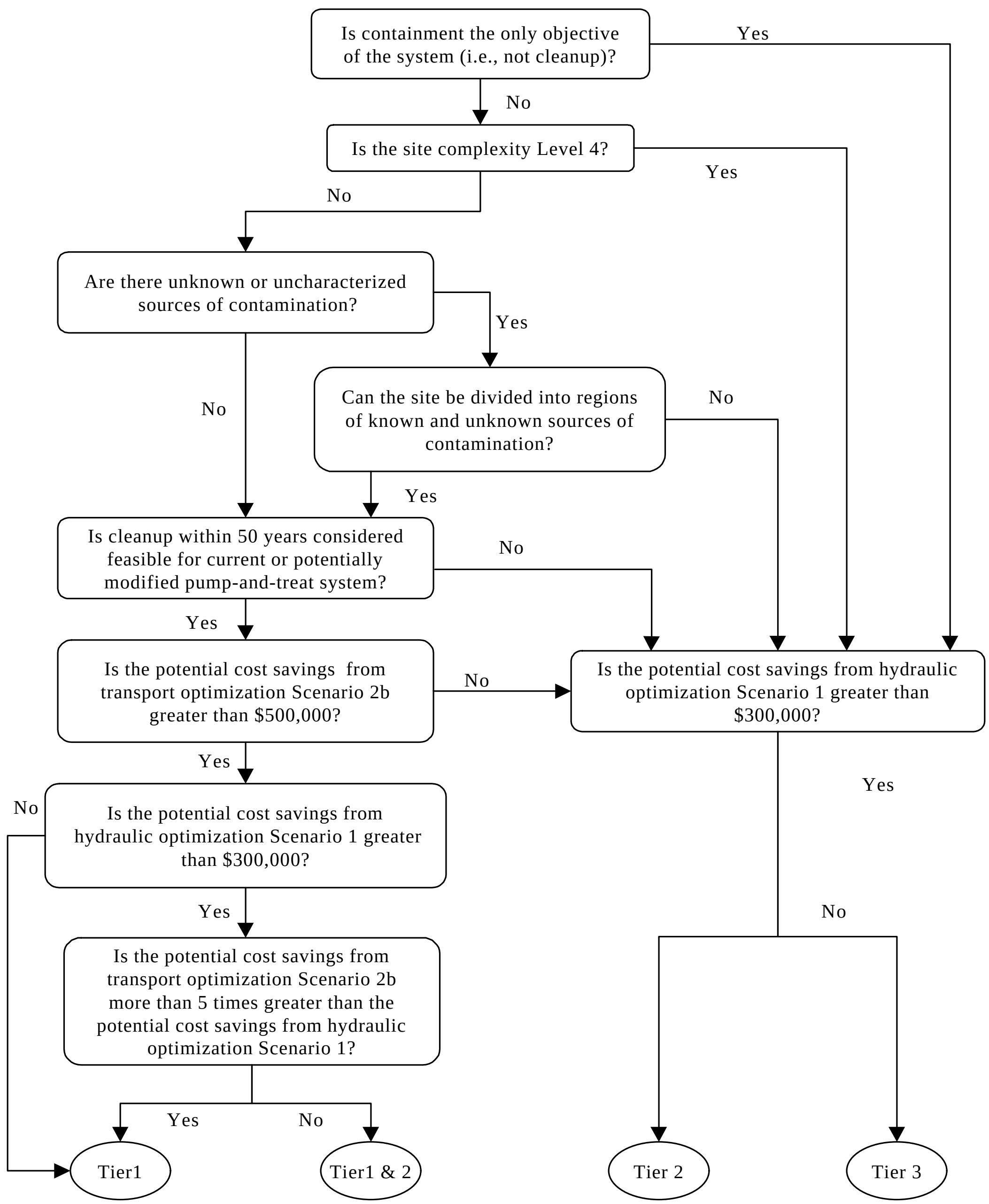
Site Classification: Tier **3**

****Note: Please review the "**Cost_Comp**" worksheet for more detailed information regarding the potential cost savings associated with specific scenarios.*

For additonal scenarios, go to ----------> Infosheet (2)

Pre-Optimization Screening for Transport and Hydraulic Optimization

Rationale for Classifying Sites into Tiers



File: CherryPointScr_Draft 042701.xls, Sheet:Classify

Pre-Optimization Screening for Transport and Hydraulic Optimization

USER INPUT INTO THIS SHEET IS OPTIONAL
Fill out this table ONLY if the site is classified as Tier 1 (or Tier 1 and 2), and if you are interested in evaluating additional transport optimization alternatives.

Site: MCAS - Cherry Point, NC

Estimated Costs for Transport Optimization Scenarios

10a) Enter Annual Costs for Each Scenario

Item	Scenario #3 new extraction wells (33% more) no change to pumping	Scenario #4 no new extraction wells 33% more pumping	Scenario #5 new extraction wells (33% more) 33% more pumping
pumping rate (gpm)	90	119.7	119.7
number of wells	14	10	14
Electric			
O&M labor			
Materials			
Maintenance			
Discharge Fees			
Analytical			
Other #1			
Other #2			
Other #3			

10b) Enter Up-Front Costs for Each Scenario

Item	Scenario #3 new extraction wells (33% more) no change to pumping	Scenario #4 no new extraction wells 33% more pumping	Scenario #5 new extraction wells (33% more) 33% more pumping
Engineering design			
Regulatory Process			
New wells/pipes/equipment			
Increased monitoring			
Increased treatment capacity			
Other #1			
Other #2			
Other #3			

Check for cost savings analysis, go to -------> Total_Analysis

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic and Transport Optimization Potential Cost Savings Analysis

Site: MCAS - Cherry Point, NC

Expected Duration: 20
Discount Rate: 5%
Current forecasted cost (NPV): $3,533,037

	Reduction in time-to-close-out	Cost Savings by Scenario					
		Current	Scenario #1	Scenario #2	Scenario #3	Scenario #4	Scenario #5
Hydraulic Optimization	0%	$0	$155,391	($854,609)	N/A	N/A	N/A
Transport Optimization	0%	$0	$105,391	($904,609)			
	10%	N/A	N/A	($697,374)			
	20%	N/A	N/A	($468,897)			
	30%	N/A	N/A	($217,002)			

Hydraulic Optimization Summary

Maximum potential cost savings: $155,391

Transport Optimization Summary

Maximum potential cost savings, no reduction in cleanup time: $105,391
Maximum potential cost savings, 10% reduction in cleanup time: ($697,374)
Maximum potential cost savings, 20% reduction in cleanup time: ($468,897)
Maximum potential cost savings, 30% reduction in cleanup time: ($217,002)

Pre-Optimization Screening for Transport and Hydraulic Optimization

THIS WORKSHEET SUMMARIZES INPUT REQUIRED BY USER

Notes:

Users are only allowed to input information in "**General_Screening**", "**Infosheet (1)**", and "**Infosheet (2)**", other sheets are calculated automatically.

The fields that need to be filled out by users are highlighted in light-blue.

Instructions:

*Items 1 - 5c need to be entered in worksheet "**General_Screening**".*	
Item 1	Enter the name of the site or plume. This name will be used to identify the site throughout the screening process. The name should uniquely identify the site.
Item 2	Enter the date that this spreadsheet is completed.
Item 3	Enter your name. You will be the point of contact for this site during the pre-optimization screening process.
Item 4	Enter your affiliation (i.e., EPA, USACE, name of private contractor, etc.) and contact information.
Item 5a	Is the system annual O&M cost greater than $100K/yr? If lower than $100K/yr, this site is unlikely to benefit from hydraulic and/or transport optimization.
Item 5b	Is the flowrate lower than 50gpm? If less than 50 gpm, this site is unlikely to benefit from hydraulic and/or transport optimization.
Item 5c	Is site cleanup expected within 5 years? If less than 5 years, this site is unlikely to benefit from hydraulic and/or transport optimization.
*Only if the answers to Item 5a, 5b, and 5c are "Yes", and the user is insterested in quantifying potential cost savings by hydraulic and/or transport optimization, the following lines in worksheet "**Infosheet (1)**" need to be entered.*	
Item 6a	Enter the primary objective of the remediation system.
Item 6b	Enter the ease with which modifications (e.g., new wells, increased pumping rate, increased treatment capacity, etc.) can be made to the current remediation system.
Item 6c	Is cleanup of the site a feasible goal within 50 years based on the current system or a potentially modified pump-and-treat system? If there are continuing sources or contaminated immobile zones, cleanup may not be a realistic objective.
Item 6d	Are there unknown or uncharacterized sources of contamination at the site? If there are, transport model simulations will likely yield unreliable results. Containing the current plume may be a more practical objective until these sources are characterized.
Item 6e	If the answer to 5d is "yes", can the site be divided into two regions, one with and one without uncharacterized sources? If the site can be divided into these two regions, transport optimization can be used potentially for the region with known and characterized sources.
Item 7	Enter the correct information about the system (number of wells, pumping rate, etc.) in the cells to the right of list. This information will be used to estimate the life-cycle costs associated with modified systems according to Scenarios.
Item 8a	Enter information regarding the site complexity (ranging from Level 1-- 4). This information is used to estimate the cost of the optimization analysis. Costs increase with site complexity.
Item 8b	Enter information regarding the flow and transport models for the site. This information is used to estimate the cost of the optimization analysis. If updated models are not available, costs for updating them will be included.
Item 9a	Enter the annual costs of the current O&M system and the estimated annual costs for Scenarios 1 and 2.
Item 9b	Enter the estimated up-front costs for Scenarios 1 and 2.
*Only if the site is classified as Tier 1 or Tier 1 and 2, and the user is insterested in other optimization alternatives, the following lines in worksheet "**Infosheet (2)**" need to be entered.*	
Item 10a	Enter the estimated annual costs for Scenarios 3, 4, and 5.
Item 10b	Enter the estimated up-front costs for Scenarios 3, 4, and 5.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Step 1: General Information

1) Name of Site/Plume:	MCAS - Yuma, AZ
2) Todays Date:	04/16/01
3) Your Name:	Yan Zhang
4a) Your Affiliation	
4b) Your Contact Information	
Address	2 Paragon Way Freehold, NJ 07728
email	yzhang@geotransinc.com
Phone	732-409-0344
fax	732-409-3020

5) General Questions

5a) Are O&M costs > $100K/year (enter "y" or "n")?	**y**
5b) Is the system flowrate > 50gpm (enter "y" or "n")?	**y**
5c) Is the estimated cleanup time > 5 years (enter "y" or "n")?	**n**

**** Note: Quantitative screening analysis is not recommended for this site.*

***** Note: If the anwer to all 3 questions above are "y", this site is more likely to potentially benefit from hydraulic and/or transport optimization. If the user is interested in quantifying potential cost savings that might result from hydraulic and/or transport optimzation simulation, please fill in the required information on "Infosheet(1)". Additionally, the user can goes to the FRTR optimization web site for information on hydraulic and transport optimization software.**

Click to go to -------> Infosheet (1)
Click to go to -------> FRTR Optimization Web site

**** Note: The estimated cleanup year for this site is too short. It is less likely to benefit from hydraulic optimization and/or transport optimization.*

Pre-Optimization Screening for Transport and Hydraulic Optimization

USER INPUT INTO THIS SHEET IS OPTIONAL
Fill in this sheet ONLY if the answer to all 3 questions in sheet "General_Screening" are "Yes" and you are interested in quantifying potential cost savings from hydraulic and/or transport optimization.

Site: MCAS - Yuma, AZ

Step 2a: Site Background and Information

6) Background Questions	
6a) What is the current main objective for the remediation system? *Choose one (1, 2 or 3)* 1. Cleanup 2. Containment 3. Both	**1**
6b) If optimization were to recommend modifications that would result in a significant reduction in remediation system life-cycle costs, describe the ease of implementing these modifications. *Choose one (1, 2, 3, 4, or 5)* 1. Easy 2. Relatively easy 3. Relatively difficult 4. Difficult 5. Impossible	**2**
6c) Are there any continuing sources, immobile zones, or other factors that likely would prevent a feasible pump-and-treat solution in 50 years or less? *Choose one (1, 2, or 3)* 1. Yes 2. No 3. Don't know	**2**
6d) Are there unknown or uncharacterized sources of contamination at the site? *Choose one (1, 2, or 3)* 1. Yes 2. No 3. Don't know	**1**
6e) If the anwer to question 6d) is Yes, can the site be divided into different operable units in which the unknown sources are contained or addressed by an alternative solution and the remaining portion can be cleaned up by a pump and treat system? *Choose one (1, 2, or 3) (Leave it **blank** if the answer to question 6d) is "No".)* 1. Yes 2. No 3. Don't know	**1**

7) System Information	
Expected duration (years)	**2**
Number of extraction wells	**5**
Total pumping rate (gpm)	**200**
Total treatment capacity (gpm)	**200**
Discount rate	**5%**

Pre-Optimization Screening for Transport and Hydraulic Optimization

8) Model/Site Information	
8a) How complex is the site? (Level 1 -- 4)	**1**
Choose one (1, 2, 3, or 4)	
Level 1: simulation of one contaminant sufficient for remedy evaluation, and less than 5 model layers	
Level 2: simulation of two contaminants sufficient for remedy evaluation, and/or 5-10 model layers	
Level 3: simulation of three or more contaminants required, and/or more than 10 model layers	
Level 4: rigorous simulation of both unsaturated and saturated zones, and/or multiple phases, and/or fractured bedrock in transport model	
8b) Model information *(Choose one, 1 or 2)*	
Is there an existing flow model?	**1**
1. Yes	
2. No	
Is the flow model up-to-date?	**1**
1. Yes	
2. No	
Is there an existing transport model?	**2**
1. Yes	
2. No	
Is the transport model up-to-date?	**2**
1. Yes	
2. No	

Step 2b: Current Costs		**Step 2c: Estimated Costs for Scenarios 1 & 2**	
		9a) Enter Annual Costs for Each Scenario	
Item	Current System	Scenario #1 no new extraction wells 33% less pumping	Scenario #2 new extraction wells (33% more) 33% less pumping
pumping rate (gpm)	200	134	134
number of wells	5	5	7
Electric			
O&M labor	$150,000	$120,000	$120,000
Materials			
Maintenance			
Discharge Fees			
Analytical			
Other #1			
Other #2			
Other #3			
		9b) Enter Up-Front Costs for Each Scenario	
Item	Current System	Scenario #1 no new extraction wells 33% less pumping	Scenario #2 new extraction wells (33% more) 33% less pumping
Engineering design	$0	$10,000	$15,000
Regulatory Process	$0	$10,000	$15,000
New wells/pipes/equipment	$0		$13,000
Increased monitoring	$0		
Increased treatment capacity	$0		
Other #1	$0		
Other #2	$0		
Other #3	$0		

Check cost savings, go to ---------> Cost_Comp
Check site classification, go to ---------> Classify

Pre-Optimization Screening for Transport and Hydraulic Optimization

Costs of Modeling and Optimization Analyses

Site: MCAS - Yuma, AZ

Based on information input by user, this site is Level: 1

	Flow Modeling	Transport Modeling	Optimization	Total
Hydraulic Optimization	$0	$0	$15,000	$15,000
Transport Optimization	$0	$30,000	$50,000	$80,000

Assumed Costs for Level 1: one contaminant simulated and less than 5 model layers

1. Cost for creating a new flow model for Level 1 is $30,000
2. Cost for updating an existing flow model for Level 1 is $15,000
3. Cost for hydraulic optimization for Level 1 is $15,000
4. Cost for creating a new transport model for Level 1 is $30,000
5. Cost for updating an existing transport model for Level 1 is $15,000
6. Cost for tranport optimization for Level 1 is $50,000

Escalation Factors for Levels 2-4

Level 2: Level 1 * 1.5
Level 3: Level 1 * 2.0
Level 4: Level 1 * 2.5

Note:

Level 1: simulation of one contaminant sufficient for remedy evaluation, and less than 5 model layers
Level 2: simulation of two contaminants sufficient for remedy evaluation, and/or 5-10 model layers
Level 3: simulation of three or more contaminants required, and/or more than 10 model layers
Level 4: rigorous simulation of both unsaturated and saturated zones, and/or multiple phases, and/or fractured bedrock in transport model

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Current System

Site: MCAS - Yuma, AZ

pumping rate	200
number of wells	5
Discount Rate:	5%

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$0	2	$0	$0
O&M labor	$0	$150,000	2	$292,857	$292,857
Materials	$0	$0	2	$0	$0
Maintenance	$0	$0	2	$0	$0
Discharge Fees	$0	$0	2	$0	$0
Analytical	$0	$0	2	$0	$0
Other #1	$0	$0	2	$0	$0
Other #2	$0	$0	2	$0	$0
Other #3	$0	$0	2	$0	$0
Costs of Analysis					
-Flow Modeling	$0			$0	$0
-Transport Modeling	$0			$0	$0
-Optimization	$0			$0	$0
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$0			$0	$0
-Regulatory Process	$0			$0	$0
-New wells/pipes/equipment	$0			$0	$0
-Increased monitoring	$0			$0	$0
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$0**	**$150,000**		**$292,857**	**$292,857**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Scenario #1

Site: MCAS - Yuma, AZ

pumping rate	134	(reduction of 33% from current system)
number of wells	5	(same as current system)
Discount Rate:	5%	

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$0	2	$0	$0
O&M labor	$0	$120,000	2	$234,286	$234,286
Materials	$0	$0	2	$0	$0
Maintenance	$0	$0	2	$0	$0
Discharge Fees	$0	$0	2	$0	$0
Analytical	$0	$0	2	$0	$0
Other #1	$0	$0	2	$0	$0
Other #2	$0	$0	2	$0	$0
Other #3	$0	$0	2	$0	$0
Costs of Analysis					
-Flow Modeling	$0			$0	$0
-Transport Modeling	$0			$0	$0
-Optimization	$15,000			$0	$15,000
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$10,000			$0	$10,000
-Regulatory Process	$10,000			$0	$10,000
-New wells/pipes/equipment	$0			$0	$0
-Increased monitoring	$0			$0	$0
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$35,000**	**$120,000**		**$234,286**	**$269,286**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Scenario #2

Site: MCAS - Yuma, AZ

pumping rate	134	(reduction of 33% from current system)
number of wells	7	(increase of 33% from current system)
Discount Rate:	5%	

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$0	2	$0	$0
O&M labor	$0	$120,000	2	$234,286	$234,286
Materials	$0	$0	2	$0	$0
Maintenance	$0	$0	2	$0	$0
Discharge Fees	$0	$0	2	$0	$0
Analytical	$0	$0	2	$0	$0
Other #1	$0	$0	2	$0	$0
Other #2	$0	$0	2	$0	$0
Other #3	$0	$0	2	$0	$0
Costs of Analysis					
-Flow Modeling	$0			$0	$0
-Transport Modeling	$0			$0	$0
-Optimization	$15,000			$0	$15,000
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$15,000			$0	$15,000
-Regulatory Process	$15,000			$0	$15,000
-New wells/pipes/equipment	$13,000			$0	$13,000
-Increased monitoring	$0			$0	$0
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$58,000**	**$120,000**		**$234,286**	**$292,286**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Transport Optimization Screening Analysis -- All Scenarios

Site: MCAS - Yuma, AZ

Discount Rate: 5%

Scenario 1: pumping rate decreased by 33%, no new wells
Scenario 2: pumping rate decreased by 33%, plus 33% additional wells (new)
Scenario 3: current pumping rate, plus 33% additional wells (new)
Scenario 4: pumping rate increased by 33%, no new wells
Scenario 5: pumping rate increased by 33%, plus 33% additional wells (new)

	Current	Scenario #1	Scenario #2	Scenario #3	Scenario #4	Scenario #5
pumping rate (gpm)	**200**	**134**	**134**	**200**	**266**	**266**
number of wells	**5**	**5**	**7**	**7**	**5**	**7**
	Annual	**Annual**	**Annual**	**Annual**	**Annual**	**Annual**
O&M Costs						
Electric	$0	$0	$0	$0	$0	$0
O&M labor	$150,000	$120,000	$120,000	$0	$0	$0
Materials	$0	$0	$0	$0	$0	$0
Maintenance	$0	$0	$0	$0	$0	$0
Discharge Fees	$0	$0	$0	$0	$0	$0
Analytical	$0	$0	$0	$0	$0	$0
Other #1	$0	$0	$0	$0	$0	$0
Other #2	$0	$0	$0	$0	$0	$0
Other #3	$0	$0	$0	$0	$0	$0
Annual Subtotal	$150,000	$120,000	$120,000	$0	$0	$0
	Upfront	**Upfront**	**Upfront**	**Upfront**	**Upfront**	**Upfront**
Costs of Analysis						
-Flow Modeling	$0	$0	$0	$0	$0	$0
-Transport Modeling	$0	$30,000	$30,000	$0	$0	$0
-Optimization	$0	$50,000	$50,000	$0	$0	$0
System Modification Costs						
-Engineering design	$0	$10,000	$15,000	$0	$0	$0
-Regulatory Process	$0	$10,000	$15,000	$0	$0	$0
-New wells/pipes/equipment	$0	$0	$13,000	$0	$0	$0
-Increased monitoring	$0	$0	$0	$0	$0	$0
-Increased treatment capacity	$0	$0	$0	$0	$0	$0
-Other #1	$0	$0	$0	$0	$0	$0
-Other #2	$0	$0	$0	$0	$0	$0
Upfront Subtotal	$0	$100,000	$123,000	$0	$0	$0
Life-cycle costs (NPV)	$292,857	$334,286	$357,286	$0	$0	$0

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic and Transport Optimization Potential Cost Savings Analysis

Site: MCAS - Yuma, AZ

Expected Duration: 2
Discount Rate: 5%
Current forecasted cost (NPV): $292,857

	Assumed Reduction in Time-to-Close-Out	Cost Savings by Scenario		
		Current	Scenario #1	Scenario #2
Hydraulic Optimization	0%	$0	$23,571	$571
Transport Optimization	0%	$0	($41,429)	($64,429)
	10%	N/A	N/A	($42,015)
	20%	N/A	N/A	($19,382)
	30%	N/A	N/A	$3,473

File: YumaScr_Draft 042701.xls, Sheet:Cost_Comp

Pre-Optimization Screening for Transport and Hydraulic Optimization

Site Classification

Site: MCAS - Yuma, AZ

Basic Information:

The primary site objective is cleanup.
A feasible pump-and-treat cleanup solution with a time frame of less than 50 years exists.
There are unknown sources of contamination at the site, but the site can be divided into regions with known and unknown sources.

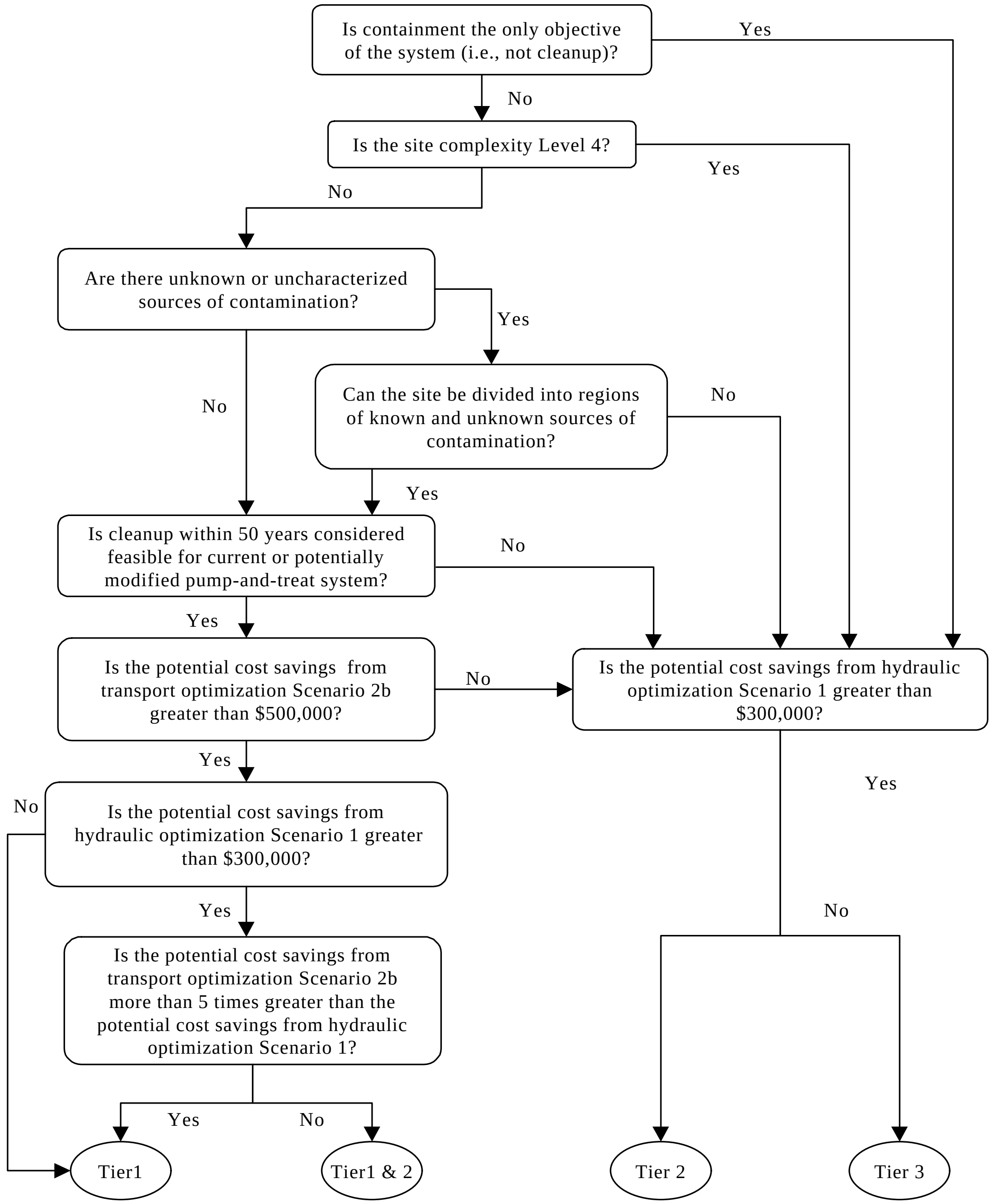
Site Classification: Tier **3**

****Note: Please review the "**Cost_Comp**" worksheet for more detailed information regarding the potential cost savings associated with specific scenarios.*

For additonal scenarios, go to ----------> Infosheet (2)

Pre-Optimization Screening for Transport and Hydraulic Optimization

Rationale for Classifying Sites into Tiers



File: YumaScr_Draft 042701.xls, Sheet:Classify

Pre-Optimization Screening for Transport and Hydraulic Optimization

USER INPUT INTO THIS SHEET IS OPTIONAL
Fill out this table ONLY if the site is classified as Tier 1 (or Tier 1 and 2), and if you are interested in evaluating additional transport optimization alternatives.

Site: MCAS - Yuma, AZ

Estimated Costs for Transport Optimization Scenarios			
10a) Enter Annual Costs for Each Scenario			
Item	Scenario #3 new extraction wells (33% more) no change to pumping	Scenario #4 no new extraction wells 33% more pumping	Scenario #5 new extraction wells (33% more) 33% more pumping
pumping rate (gpm)	200	266	266
number of wells	7	5	7
Electric			
O&M labor			
Materials			
Maintenance			
Discharge Fees			
Analytical			
Other #1			
Other #2			
Other #3			
****Warning: Total pumping rates exceed the current treatment capacity in Scenarios 4 & 5. Thus, the treatment capacity needs to be increased. Please enter capital costs for 'increased treatment capacity' in the table below.*			
10b) Enter Up-Front Costs for Each Scenario			
Item	Scenario #3 new extraction wells (33% more) no change to pumping	Scenario #4 no new extraction wells 33% more pumping	Scenario #5 new extraction wells (33% more) 33% more pumping
Engineering design			
Regulatory Process			
New wells/pipes/equipment			
Increased monitoring			
Increased treatment capacity			
Other #1			
Other #2			
Other #3			

Check for cost savings analysis, go to -------> Total_Analysis

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic and Transport Optimization Potential Cost Savings Analysis

Site: MCAS - Yuma, AZ

Expected Duration:	2
Discount Rate:	5%
Current forecasted cost (NPV):	$292,857

	Reduction in time-to-close-out	Cost Savings by Scenario					
		Current	Scenario #1	Scenario #2	Scenario #3	Scenario #4	Scenario #5
Hydraulic Optimization	0%	$0	$23,571	$571	N/A	N/A	N/A
Transport Optimization	0%	$0	($41,429)	($64,429)			
	10%	N/A	N/A	($42,015)			
	20%	N/A	N/A	($19,382)			
	30%	N/A	N/A	$3,473			

<u>Hydraulic Optimization Summary</u>

Maximum potential cost savings:	$23,571

<u>Transport Optimization Summary</u>

Maximum potential cost savings, no reduction in cleanup time:	$0
Maximum potential cost savings, 10% reduction in cleanup time:	($42,015)
Maximum potential cost savings, 20% reduction in cleanup time:	($19,382)
Maximum potential cost savings, 30% reduction in cleanup time:	$3,473

Pre-Optimization Screening for Transport and Hydraulic Optimization

THIS WORKSHEET SUMMARIZES INPUT REQUIRED BY USER

Notes:

Users are only allowed to input information in "**General_Screening**", "**Infosheet (1)**", and "**Infosheet (2)**", other sheets are calculated automatically.

The fields that need to be filled out by users are highlighted in light-blue.

Instructions:

*Items 1 - 5c need to be entered in worksheet "**General_Screening**".*

Item 1	Enter the name of the site or plume. This name will be used to identify the site throughout the screening process. The name should uniquely identify the site.
Item 2	Enter the date that this spreadsheet is completed.
Item 3	Enter your name. You will be the point of contact for this site during the pre-optimization screening process.
Item 4	Enter your affiliation (i.e., EPA, USACE, name of private contractor, etc.) and contact information.
Item 5a	Is the system annual O&M cost greater than $100K/yr? If lower than $100K/yr, this site is unlikely to benefit from hydraulic and/or transport optimization.
Item 5b	Is the flowrate lower than 50gpm? If less than 50 gpm, this site is unlikely to benefit from hydraulic and/or transport optimization.
Item 5c	Is site cleanup expected within 5 years? If less than 5 years, this site is unlikely to benefit from hydraulic and/or transport optimization.

*Only if the answers to Item 5a, 5b, and 5c are "Yes", and the user is insterested in quantifying potential cost savings by hydraulic and/or transport optimization, the following lines in worksheet "**Infosheet (1)**" need to be entered.*

Item 6a	Enter the primary objective of the remediation system.
Item 6b	Enter the ease with which modifications (e.g., new wells, increased pumping rate, increased treatment capacity, etc.) can be made to the current remediation system.
Item 6c	Is cleanup of the site a feasible goal within 50 years based on the current system or a potentially modified pump-and-treat system? If there are continuing sources or contaminated immobile zones, cleanup may not be a realistic objective.
Item 6d	Are there unknown or uncharacterized sources of contamination at the site? If there are, transport model simulations will likely yield unreliable results. Containing the current plume may be a more practical objective until these sources are characterized.
Item 6e	If the answer to 5d is “yes”, can the site be divided into two regions, one with and one without uncharacterized sources? If the site can be divided into these two regions, transport optimization can be used potentially for the region with known and characterized sources.
Item 7	Enter the correct information about the system (number of wells, pumping rate, etc.) in the cells to the right of list. This information will be used to estimate the life-cycle costs associated with modified systems according to Scenarios.
Item 8a	Enter information regarding the site complexity (ranging from Level 1-- 4). This information is used to estimate the cost of the optimization analysis. Costs increase with site complexity.
Item 8b	Enter information regarding the flow and transport models for the site. This information is used to estimate the cost of the optimization analysis. If updated models are not available, costs for updating them will be included.
Item 9a	Enter the annual costs of the current O&M system and the estimated annual costs for Scenarios 1 and 2.
Item 9b	Enter the estimated up-front costs for Scenarios 1 and 2.

*Only if the site is classified as Tier 1 or Tier 1 and 2, and the user is insterested in other optimization alternatives, the following lines in worksheet "**Infosheet (2)**" need to be entered.*

Item 10a	Enter the estimated annual costs for Scenarios 3, 4, and 5.
Item 10b	Enter the estimated up-front costs for Scenarios 3, 4, and 5.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Step 1: General Information

1) Name of Site/Plume:	Former Blaine Navy Ammunition Depot, Hastings, Nebraska
2) Todays Date:	12/04/02
3) Your Name:	Yan Zhang
4a) Your Affiliation	GeoTrans, Inc.
4b) Your Contact Information	
Address	GeoTrans, Inc. 2 Paragon Way Freehold, NJ 07728
email	yzhang@geotransinc.com
Phone	(732) 409-0344
fax	(732) 409-3020

5) General Questions

5a) Are O&M costs > $100K/year (enter "y" or "n")?	**y**
5b) Is the system flowrate > 50gpm (enter "y" or "n")?	**y**
5c) Is the estimated cleanup time > 5 years (enter "y" or "n")?	**y**

**** Note: We strongly recommend applying quantitative screening to this site. Please fill in the required information on Infosheet (1).*

***** Note: If the anwer to all 3 questions above are "y", this site is more likely to potentially benefit from hydraulic and/or transport optimization. If the user is interested in quantifying potential cost savings that might result from hydraulic and/or transport optimzation simulation, please fill in the required information on "Infosheet(1)". Additionally, the user can goes to the FRTR optimization web site for information on hydraulic and transport optimization software.**

Click to go to -------> Infosheet (1)
Click to go to -------> FRTR Optimization Web site

Pre-Optimization Screening for Transport and Hydraulic Optimization

USER INPUT INTO THIS SHEET IS OPTIONAL
Fill in this sheet ONLY if the answer to all 3 questions in sheet "General_Screening" are "Yes" and you are interested in quantifying potential cost savings from hydraulic and/or transport optimization.

Site: Former Blaine Navy Ammunition Depot, Hastings, Nebraska

Step 2a: Site Background and Information

6) Background Questions

6a) What is the current main objective for the remediation system? *Choose one (1, 2 or 3)* 1. Cleanup 2. Containment 3. Both	**1**
6b) If optimization were to recommend modifications that would result in a significant reduction in remediation system life-cycle costs, describe the ease of implementing these modifications. *Choose one (1, 2, 3, 4, or 5)* 1. Easy 2. Relatively easy 3. Relatively difficult 4. Difficult 5. Impossible	**2**
6c) Are there any continuing sources, immobile zones, or other factors that likely would prevent a feasible pump-and-treat solution in 50 years or less? *Choose one (1, 2, or 3)* 1. Yes 2. No 3. Don't know	**2**
6d) Are there unknown or uncharacterized sources of contamination at the site? *Choose one (1, 2, or 3)* 1. Yes 2. No 3. Don't know	**2**
6e) If the anwer to question 6d) is Yes, can the site be divided into different operable units in which the unknown sources are contained or addressed by an alternative solution and the remaining portion can be cleaned up by a pump and treat system? *Choose one (1, 2, or 3) (Leave it **blank** if the answer to question 6d) is "No".)* 1. Yes 2. No 3. Don't know	

7) System Information

Expected duration (years)	**50**
Number of extraction wells	**17**
Total pumping rate (gpm)	**4068**
Total treatment capacity (gpm)	**8000**
Discount rate	**3.5%**

Pre-Optimization Screening for Transport and Hydraulic Optimization

8) Model/Site Information	
8a) How complex is the site? (Level 1 -- 4)	**2**
Choose one (1, 2, 3, or 4)	
Level 1: simulation of one contaminant sufficient for remedy evaluation, and less than 5 model layers	
Level 2: simulation of two contaminants sufficient for remedy evaluation, and/or 5-10 model layers	
Level 3: simulation of three or more contaminants required, and/or more than 10 model layers	
Level 4: rigorous simulation of both unsaturated and saturated zones, and/or multiple phases, and/or fractured bedrock in transport model	
8b) Model information *(Choose one, 1 or 2)*	
Is there an existing flow model?	**1**
1. Yes	
2. No	
Is the flow model up-to-date?	**1**
1. Yes	
2. No	
Is there an existing transport model?	**1**
1. Yes	
2. No	
Is the transport model up-to-date?	**1**
1. Yes	
2. No	

Step 2b: Current Costs		**Step 2c: Estimated Costs for Scenarios 1 & 2**	
		9a) Enter Annual Costs for Each Scenario	
Item	Current System	Scenario #1 no new extraction wells 33% less pumping	Scenario #2 new extraction wells (33% more) 33% less pumping
pumping rate (gpm)	4068	2725.56	2725.56
number of wells	17	17	23
Electric	$187,128	$125,376	$125,376
O&M labor	$115,000	$115,000	$115,000
Materials	$1,151,244	$771,333	$771,333
Maintenance			
Discharge Fees	$268,488	$179,887	$179,887
Analytical			
Other #1	$300,000	$300,000	$300,000
Other #2			
Other #3			
		9b) Enter Up-Front Costs for Each Scenario	
Item	Current System	Scenario #1 no new extraction wells 33% less pumping	Scenario #2 new extraction wells (33% more) 33% less pumping
Engineering design	$0	$10,000	$15,000
Regulatory Process	$0	$10,000	$15,000
New wells/pipes/equipment	$0		$2,400,000
Increased monitoring	$0		
Increased treatment capacity	$0	$1,342,440	$1,342,440
Other #1	$0	$2,013,660	$2,013,660
Other #2	$0		
Other #3	$0		

Check cost savings, go to ---------> Cost_Comp
Check site classification, go to ---------> Classify

Pre-Optimization Screening for Transport and Hydraulic Optimization

Costs of Modeling and Optimization Analyses

Site: Former Blaine Navy Ammunition Depot, Hastings, Nebraska

Based on information input by user, this site is Level: 2

	Flow Modeling	Transport Modeling	Optimization	Total
Hydraulic Optimization	$0	$0	$22,500	$22,500
Transport Optimization	$0	$0	$75,000	$75,000

Assumed Costs for Level 1: one contaminant simulated and less than 5 model layers

1. Cost for creating a new flow model for Level 1 is $30,000
2. Cost for updating an existing flow model for Level 1 is $15,000
3. Cost for hydraulic optimization for Level 1 is $15,000
4. Cost for creating a new transport model for Level 1 is $30,000
5. Cost for updating an existing transport model for Level 1 is $15,000
6. Cost for tranport optimization for Level 1 is $50,000

Escalation Factors for Levels 2-4

Level 2: Level 1 * 1.5
Level 3: Level 1 * 2.0
Level 4: Level 1 * 2.5

Note:

Level 1: simulation of one contaminant sufficient for remedy evaluation, and less than 5 model layers
Level 2: simulation of two contaminants sufficient for remedy evaluation, and/or 5-10 model layers
Level 3: simulation of three or more contaminants required, and/or more than 10 model layers
Level 4: rigorous simulation of both unsaturated and saturated zones, and/or multiple phases, and/or fractured bedrock in transport model

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Current System

Site: Former Blaine Navy Ammunition Depot, Hastings, Nebraska

pumping rate 4068
number of wells 17

Discount Rate: 4%

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$187,128	50	$4,542,825	$4,542,825
O&M labor	$0	$115,000	50	$2,791,805	$2,791,805
Materials	$0	$1,151,244	50	$27,948,249	$27,948,249
Maintenance	$0	$0	50	$0	$0
Discharge Fees	$0	$268,488	50	$6,517,966	$6,517,966
Analytical	$0	$0	50	$0	$0
Other #1	$0	$300,000	50	$7,282,969	$7,282,969
Other #2	$0	$0	50	$0	$0
Other #3	$0	$0	50	$0	$0
Costs of Analysis					
-Flow Modeling	$0			$0	$0
-Transport Modeling	$0			$0	$0
-Optimization	$0			$0	$0
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$0			$0	$0
-Regulatory Process	$0			$0	$0
-New wells/pipes/equipment	$0			$0	$0
-Increased monitoring	$0			$0	$0
-Increased treatment capacity	$0			$0	$0
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$0**	**$2,021,860**		**$49,083,815**	**$49,083,815**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Scenario #1

Site: Former Blaine Navy Ammunition Depot, Hastings, Nebraska

pumping rate	2725.56	(reduction of 33% from current system)
number of wells	17	(same as current system)
Discount Rate:	4%	

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$125,376	50	$3,043,693	$3,043,693
O&M labor	$0	$115,000	50	$2,791,805	$2,791,805
Materials	$0	$771,333	50	$18,725,327	$18,725,327
Maintenance	$0	$0	50	$0	$0
Discharge Fees	$0	$179,887	50	$4,367,037	$4,367,037
Analytical	$0	$0	50	$0	$0
Other #1	$0	$300,000	50	$7,282,969	$7,282,969
Other #2	$0	$0	50	$0	$0
Other #3	$0	$0	50	$0	$0
Costs of Analysis					
-Flow Modeling	$0			$0	$0
-Transport Modeling	$0			$0	$0
-Optimization	$22,500			$0	$22,500
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$10,000			$0	$10,000
-Regulatory Process	$10,000			$0	$10,000
-New wells/pipes/equipment	$0			$0	$0
-Increased monitoring	$0			$0	$0
-Increased treatment capacity	$1,342,440			$0	$1,342,440
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$1,384,940**	**$1,491,596**		**$36,210,831**	**$37,595,771**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic Optimization Screening Analysis -- Scenario #2

Site: Former Blaine Navy Ammunition Depot, Hastings, Nebraska

pumping rate	2725.56	(reduction of 33% from current system)
number of wells	23	(increase of 33% from current system)
Discount Rate:	4%	

	Up-Front Costs	Annual Costs	# Years	Total of Annual Costs	Total Costs
O&M Costs					
Electric	$0	$125,376	50	$3,043,693	$3,043,693
O&M labor	$0	$115,000	50	$2,791,805	$2,791,805
Materials	$0	$771,333	50	$18,725,327	$18,725,327
Maintenance	$0	$0	50	$0	$0
Discharge Fees	$0	$179,887	50	$4,367,037	$4,367,037
Analytical	$0	$0	50	$0	$0
Other #1	$0	$300,000	50	$7,282,969	$7,282,969
Other #2	$0	$0	50	$0	$0
Other #3	$0	$0	50	$0	$0
Costs of Analysis					
-Flow Modeling	$0			$0	$0
-Transport Modeling	$0			$0	$0
-Optimization	$22,500			$0	$22,500
-Other 1	$0			$0	$0
System Modification Costs					
-Engineering design	$15,000			$0	$15,000
-Regulatory Process	$15,000			$0	$15,000
-New wells/pipes/equipment	$2,400,000			$0	$2,400,000
-Increased monitoring	$0			$0	$0
-Increased treatment capacity	$1,342,440			$0	$1,342,440
-Other #1	$0			$0	$0
-Other #2	$0			$0	$0
Total Costs	**$3,794,940**	**$1,491,596**		**$36,210,831**	**$40,005,771**

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Transport Optimization Screening Analysis -- All Scenarios

Site: Former Blaine Navy Ammunition Depot, Hastings, Nebraska

Discount Rate: 4%

Scenario 1: pumping rate decreased by 33%, no new wells
Scenario 2: pumping rate decreased by 33%, plus 33% additional wells (new)
Scenario 3: current pumping rate, plus 33% additional wells (new)
Scenario 4: pumping rate increased by 33%, no new wells
Scenario 5: pumping rate increased by 33%, plus 33% additional wells (new)

	Current	Scenario #1	Scenario #2	Scenario #3	Scenario #4	Scenario #5
pumping rate (gpm)	**4068**	**2725.56**	**2725.56**	**4068**	**5410.44**	**5410.44**
number of wells	**17**	**17**	**23**	**23**	**17**	**23**
	Annual	**Annual**	**Annual**	**Annual**	**Annual**	**Annual**
O&M Costs						
Electric	$187,128	$125,376	$125,376	$187,128	$248,880	$248,880
O&M labor	$115,000	$115,000	$115,000	$115,000	$115,000	$115,000
Materials	$1,151,244	$771,333	$771,333	$1,151,244	$1,531,155	$1,531,155
Maintenance	$0	$0	$0	$0	$0	$0
Discharge Fees	$268,488	$179,887	$179,887	$268,488	$357,089	$357,089
Analytical	$0	$0	$0	$0	$0	$0
Other #1	$300,000	$300,000	$300,000	$300,000	$300,000	$300,000
Other #2	$0	$0	$0	$0	$0	$0
Other #3	$0	$0	$0	$0	$0	$0
Annual Subtotal	$2,021,860	$1,491,596	$1,491,596	$2,021,860	$2,552,124	$2,552,124
	Upfront	**Upfront**	**Upfront**	**Upfront**	**Upfront**	**Upfront**
Costs of Analysis						
-Flow Modeling	$0	$0	$0	$0	$0	$0
-Transport Modeling	$0	$0	$0	$0	$0	$0
-Optimization	$0	$75,000	$75,000	$75,000	$75,000	$75,000
System Modification Costs						
-Engineering design	$0	$10,000	$15,000	$0	$0	$0
-Regulatory Process	$0	$10,000	$15,000	$0	$0	$0
-New wells/pipes/equipment	$0	$0	$2,400,000	$2,400,000	$0	$2,400,000
-Increased monitoring	$0	$0	$0	$0	$0	$0
-Increased treatment capacity	$0	$1,342,440	$1,342,440	$0	$1,342,440	$134,244,000
-Other #1	$0	$0	$0	$0	$20,136,600	$20,136,600
-Other #2	$0	$0	$0	$0	$0	$0
Upfront Subtotal	$0	$1,437,440	$3,847,440	$2,475,000	$21,554,040	$156,855,600
Life-cycle costs (NPV)	$49,083,815	$37,648,271	$40,058,271	$51,558,815	$83,510,838	$218,812,398

Note: All costs are in present-day dollars. The discount rate is applied to annual costs to calculate the total worth of annual costs (in present-day dollars) over the specified number of years.

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic and Transport Optimization Potential Cost Savings Analysis

Site: Former Blaine Navy Ammunition Depot, Hastings, Nebraska

Expected Duration: 50
Discount Rate: 3.5%
Current forecasted cost (NPV): $49,083,815

	Assumed Reduction in Time-to-Close-Out	Cost Savings by Scenario		
		Current	Scenario #1	Scenario #2
Hydraulic Optimization	0%	$0	$11,488,043	$9,078,043
Transport Optimization	0%	$0	$11,435,543	$9,025,543
	10%	N/A	N/A	$10,507,852
	20%	N/A	N/A	$12,268,370
	30%	N/A	N/A	$14,359,313

Pre-Optimization Screening for Transport and Hydraulic Optimization

Site Classification

Site: Former Blaine Navy Ammunition Depot, Hastings, Nebraska

Basic Information:

The primary site objective is cleanup.
A feasible pump-and-treat cleanup solution with a time frame of less than 50 years exists.
There are no uncharacterized or unknown sources of contamination at the site.

Site Classification: Tier **1 and 2**

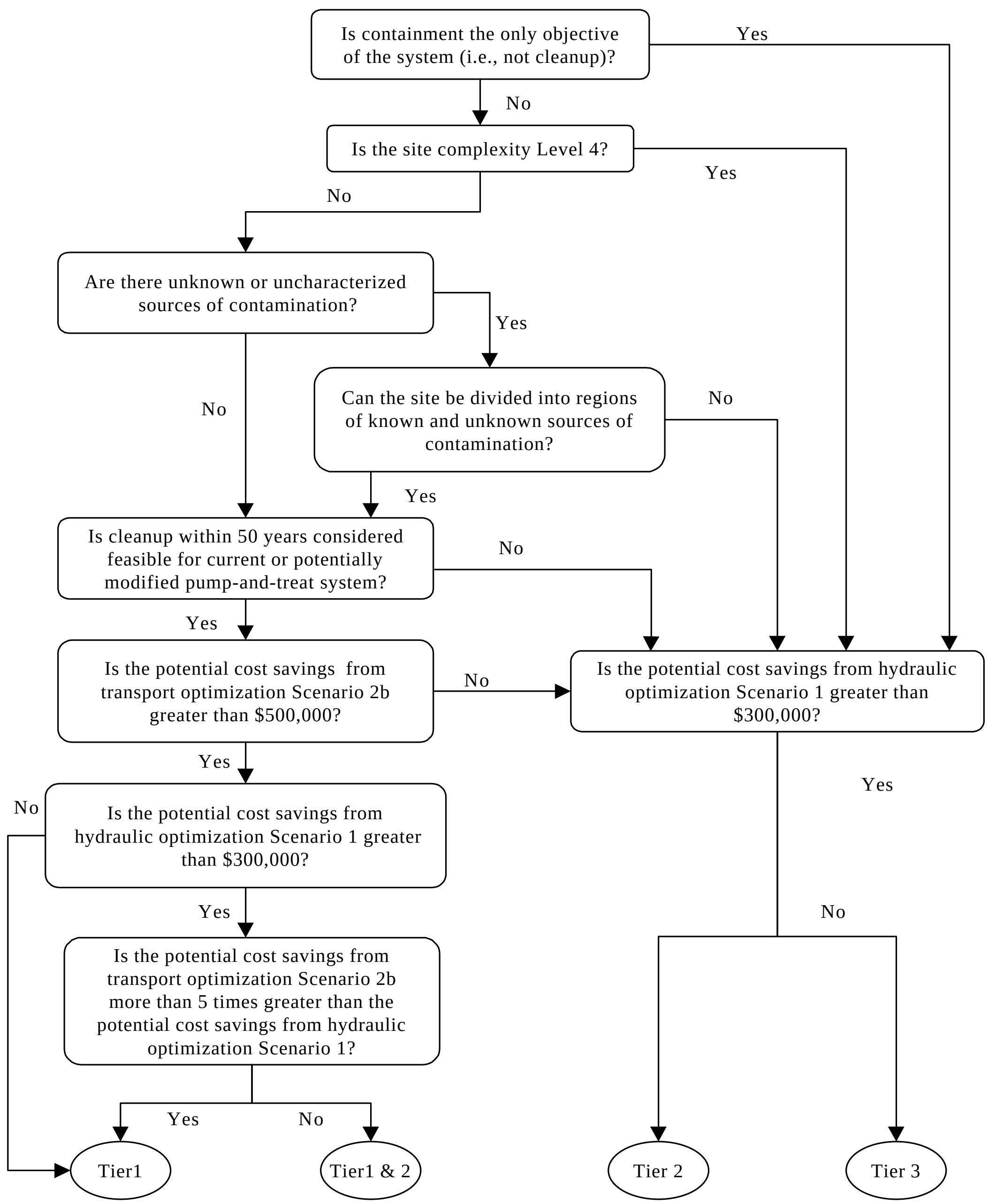
****Note: Please review the "**Cost_Comp**" worksheet for more detailed information regarding the potential cost savings associated with specific scenarios.*

******We strongly suggest applying alternative transport optimization scenarios to this site. Please go to Infosheet (2) to enter additional cost information for Scenarios 3 through 5.***

For additonal scenarios, go to ----------> Infosheet (2)

Pre-Optimization Screening for Transport and Hydraulic Optimization

Rationale for Classifying Sites into Tiers



File: HastingsScr_Draft 120402.xls, Sheet:Classify

Pre-Optimization Screening for Transport and Hydraulic Optimization

USER INPUT INTO THIS SHEET IS OPTIONAL
Fill out this table ONLY if the site is classified as Tier 1 (or Tier 1 and 2), and if you are interested in evaluating additional transport optimization alternatives.

Site: Former Blaine Navy Ammunition Depot, Hastings, Nebraska

Estimated Costs for Transport Optimization Scenarios

10a) Enter Annual Costs for Each Scenario

Item	Scenario #3 new extraction wells (33% more) no change to pumping	Scenario #4 no new extraction wells 33% more pumping	Scenario #5 new extraction wells (33% more) 33% more pumping
pumping rate (gpm)	4068	5410.44	5410.44
number of wells	23	17	23
Electric	$187,128	$248,880	$248,880
O&M labor	$115,000	$115,000	$115,000
Materials	$1,151,244	$1,531,155	$1,531,155
Maintenance			
Discharge Fees	$268,488	$357,089	$357,089
Analytical			
Other #1	$300,000	$300,000	$300,000
Other #2			
Other #3			

10b) Enter Up-Front Costs for Each Scenario

Item	Scenario #3 new extraction wells (33% more) no change to pumping	Scenario #4 no new extraction wells 33% more pumping	Scenario #5 new extraction wells (33% more) 33% more pumping
Engineering design			
Regulatory Process			
New wells/pipes/equipment	$2,400,000		$2,400,000
Increased monitoring			
Increased treatment capacity		$1,342,440	$134,244,000
Other #1		$20,136,600	$20,136,600
Other #2			
Other #3			

Check for cost savings analysis, go to -------> Total_Analysis

Pre-Optimization Screening for Transport and Hydraulic Optimization

Hydraulic and Transport Optimization Potential Cost Savings Analysis

Site: Former Blaine Navy Ammunition Depot, Hastings, Nebraska

Expected Duration: 50
Discount Rate: 3.5%
Current forecasted cost (NPV): $49,083,815

	Reduction in time-to-close-out	Cost Savings by Scenario					
		Current	Scenario #1	Scenario #2	Scenario #3	Scenario #4	Scenario #5
Hydraulic Optimization	0%	$0	$11,488,043	$9,078,043	N/A	N/A	N/A
Transport Optimization	0%	$0	$11,435,543	$9,025,543	($2,475,000)	($34,427,023)	($169,728,583)
	10%	N/A	N/A	$10,507,852	($465,729)	($31,890,790)	($167,192,350)
	20%	N/A	N/A	$12,268,370	$1,920,654	($28,878,541)	($164,180,101)
	30%	N/A	N/A	$14,359,313	$4,754,929	($25,300,934)	($160,602,494)

Hydraulic Optimization Summary

Maximum potential cost savings: $11,488,043

Transport Optimization Summary

Maximum potential cost savings, no reduction in cleanup time: $11,435,543
Maximum potential cost savings, 10% reduction in cleanup time: $10,507,852
Maximum potential cost savings, 20% reduction in cleanup time: $12,268,370
Maximum potential cost savings, 30% reduction in cleanup time: $14,359,313