Final Validation Report

(Version 3.0)

for

RACER Services and Verification and Validation (V&V)

Contract Number: W91ZLK-07-D-0002

Delivery Order: 0008

Prepared for:
US Army Environmental Command
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Revision History

Date	Version	Description	Author
05/11/2009	1.0	Draft Report	Booz Allen Hamilton
06/23/2009	2.0	Final Report	Booz Allen Hamilton
9/23/2009	3.0	Revised Final Report	Booz Allen Hamilton

Executive Summary

On September 25, 2008, United States Army Environmental Command (USAEC) awarded Booz Allen Hamilton (Booz Allen) a contract (W91ZLK-07-D-0002, Task Order (TO) 0008) to "validate the Remedial Action Cost Engineering and Requirements (RACER) System 2008 cost models and underlying databases." The contract directs Booz Allen to "document comparison of RACER-generated costs with associated actual project costs on present models and, once comparisons are completed, a new Verification & Validation (V&V) report will be developed."[1] The opportunity to compare actual project data with RACER cost estimates represents a best practice in the development of parametric models and will allow continued enhancement of RACER as a budgetary estimating tool.

In 2004, Booz Allen Hamilton performed an assessment of the RACER 2004 software under contract to the Government.[2] In support of the contract scope requirements, the Booz Allen Hamilton data collection and analysis team (Booz Allen team) worked with the client team to develop a process and a protocol to be used for data collection, analysis, and management throughout the assessment process. The assessment resulted in a comprehensive set of recommendations for enhancements to RACER models (technologies), modifications to default and secondary parameters and technology assemblies, and the development of new technologies and assemblies. These recommendations were incorporated into RACER 2008. Major changes to RACER 2008 included the addition of two new technologies, the re-engineering of thirteen existing technologies, and updates to assembly prices using the 2006 Unit Price Book (UPB).[3] As a result of these changes, and in accordance with Department of Defense Instruction (DODI) 5000.61, the Government determined that Verification, Validation, & Accreditation (VV&A) of RACER 2008 should be performed. The objective of this report is to provide information sufficient for the validation portion of the VV&A.

To compare RACER 2008 cost technologies against actual project cost data, project information was collected from a variety of Government offices. The types of project information collected include technical reports and contracting documents for environmental remediation projects executed by the Government within the past five years. Under this USAEC TO, Booz Allen traveled to four Government offices to collect project information. In addition, Booz Allen conducted similar visits in 2007 and 2008 under a TO of a contract issued by the Air Force Center for Engineering and the Environment (AFCEE).[4] Table 1, on the following page, details all data collection locations conducted under both TOs:

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[1] Contract Order *W91ZLK-07-D-000 TO 0008* page 5, dated September 25, 2008

[2] *Assessment of RACER Cost Models and Database Project, (DACA45-03-F-0010 under Contract GS-10F-0090J)*

[3] The UPB is updated every two years. At the time of release of RACER 2008, the latest UPB update was 2006; therefore, RACER 2008 uses the 2006 UPB.

[4] Global Engineering, Integration, and Technical Assistance 2005 (GEITA05), *FA8903-05-D-8729 TO 0372* (Mod 2, dated 19 August 2008))

Government Office	Office Location	Status	Funding Source
USACE, Kansas City District	Kansas City, MO	13-15 November 2007	AFCEE TO
AFCEE	Brooks City-Base, TX	19-21 February 2008	AFCEE TO
USACE, Fort Worth District	Fort Worth, TX	22-24 April 2008	AFCEE TO
USACE, Alaska District	Anchorage, AK	21-23 October 2008	USAEC TO
USACE, Louisville District	Louisville, KY	18-20 November 2008	USAEC TO
USACE, Baltimore District	Baltimore, MD	9-11 December 2008	USAEC TO
USACE, Savannah District	Savannah, GA	27-29 January 2009	USAEC TO

Table 1 – Data collection locations

Data collection at the sites listed in Table 1 focused primarily on remedial actions, but other phases of remediation were also included when available, including remedial investigations, operations and maintenance, monitoring, and site closure. Additionally, data collection was directed toward projects completed during and after 2004 in order to minimize distortions due to old technologies or the evolution of best practices in environmental remediation. The data collection at the sites listed in Table 1, above, resulted in the selection of 88 projects for further analysis and simulation in RACER 2008.

The analysis performed on the data was based on a three-phase process: 1) deconstruct historical project documentation by identifying cost drivers, key parameters, and historical cost, 2) cross-walk key data parameters into RACER, and 3) generate a series of cost estimates for comparison to actual project costs, both at the RACER project and technology-level. Creation of the RACER cost estimates entailed a four-step approach, where modifications to RACER primary and secondary parameters could be isolated and analyzed. These four steps are referred to as "scenarios" in this report.

In general, the scenarios represent an increased level of interaction with the RACER technologies and specificity of the information entered into the technologies. In Scenario 1, the user populated default parameters of the technologies only; this is typical when planning data are very limited, such as when a site has been newly identified with little corresponding study or when a Record of Decision has not yet been finalized. In Scenario 2, the user populated default and modified secondary parameters, and in Scenario 3, the user populated default and modified secondary parameters as well as assemblies, where that information was available in the project documentation. Scenario 4 is a test case using the US 96 City Average location multiplier for comparison with the area cost factor (site-specific location multiplier) used in Scenario 3. This four-scenario approach enables the analysis to show how greater levels of specificity affect the RACER estimate. Section 2.0 provides more detail on the process and approach used in this analysis.

Following completion of the cost estimates, a three pronged analysis was used to evaluate the current performance of RACER as well as provide suggestions on how to best update the program. The first two prongs of the analysis consisted of comparing RACER-estimated costs to actual historical costs, as reported in the project documentation, via statistical methods first at the project-level, and then at the technology-level. The third prong of the analysis evaluated RACER model engineering to determine if the RACER program, technologies, assemblies, and unit costs reflect best practices in environmental restoration. This three pronged analysis will assist the Government in gaining a better understanding of the current performance of RACER as well as provide suggestions on how to best update the program.[5]

The RACER-estimated costs were compared to actual historical costs as reported in the project documentation via several statistical methods. Statistical analyses were performed at two levels: project-level and technology-level. The project-level analysis involves the statistical comparison of the historical costs of the 88 projects collected in 2007 and 2008 to the RACER-estimated costs of these efforts. The purpose of the project-level analysis is to evaluate the accuracy of the cost generated by a grouping of RACER technologies (for example, Excavation together with Professional Labor Management and Residual Waste Management) as compared to actual cost incurred for those activities. Each project-level cost is a roll-up of the specific technologies used in RACER to capture the historical contract activities.

Technology-level analysis was conducted by isolating, where feasible, the portions of the historical costs applicable to specific RACER technologies and comparing these costs to RACER-generated costs at the technology-level. In addition, RACER estimates created during the 2004 RACER Assessment[6] were upgraded, where possible, and included in the technology-level analysis.

A number of statistical measures were utilized to better understand the performance of RACER relative to historical project data. Figure 1, on the following page, shows the average percent difference in cost between RACER-estimated costs and actual historical project costs for each scenario at the project-level; this figure depicts cumulative results for projects from all seven location visits conducted as part of the 2008 validation. The cost difference, or delta, between historical costs and RACER-estimated costs in this figure was computed using the differential (expressed as a percent of the actual project cost) and applied to all projects, resulting in a cumulative mean difference in cost for each scenario.

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5 *Limitations to the analytical approach are discussed in detail in Section 5.0 of this document.*

6 *Assessment of RACER Cost Models and Database Project, (DACA45-03-F-0010 under Contract GS-10F-0090J)*

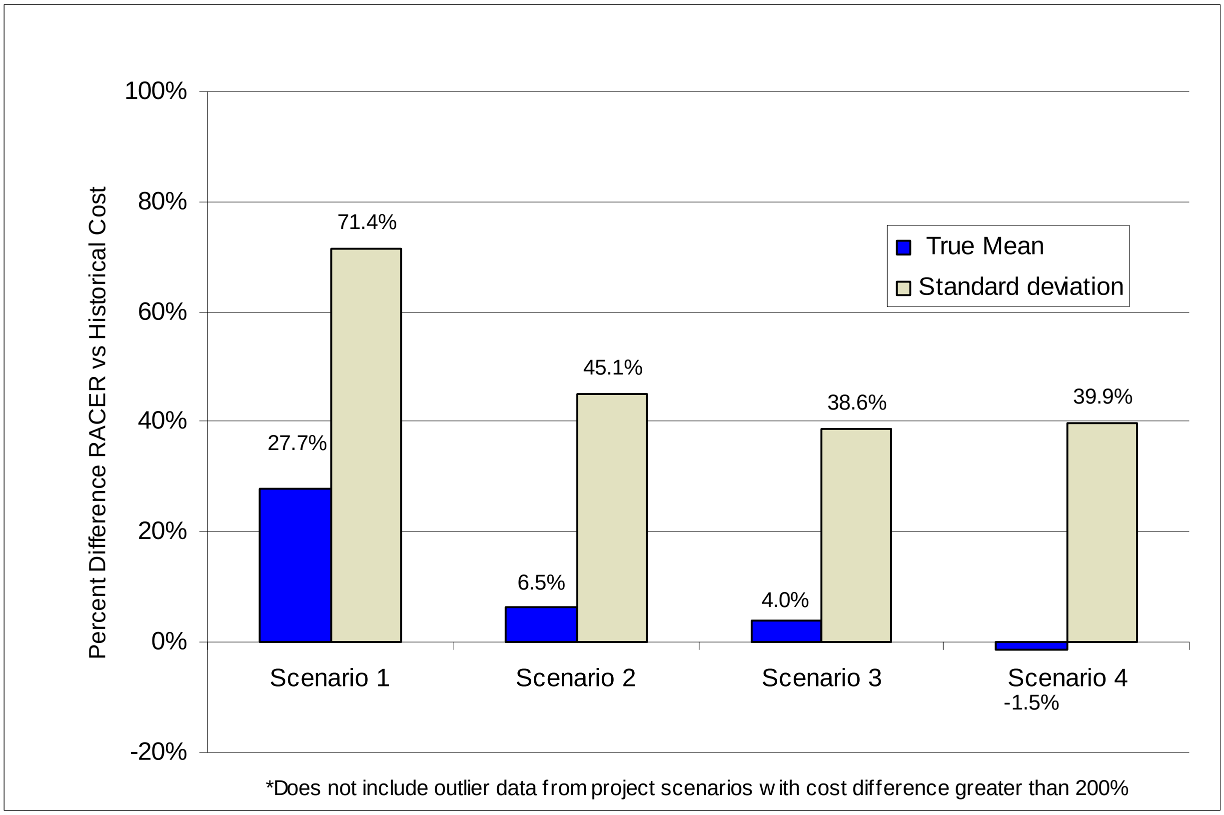

Figure 1 – True Mean Cost Difference Between RACER Estimate and Historical Project Cost by Scenario

Also presented in Figure 1 is the standard deviation for each scenario. The standard deviation is a measure of the dispersion of the data from the mean cost difference. A smaller standard deviation value (expressed as a percentage) indicates less variation in the results around the mean.

As illustrated in Figure 1, the true mean cost difference between RACER-estimated costs and historical costs is 28% for Scenario 1 with a standard deviation of 71%. In Scenario 2, by modifying important secondary parameters in the technology, the true mean cost difference is reduced to 7% with a standard deviation of 45%. In Scenario 3, the advanced user can modify specific assemblies that form the basis for the cost estimate and, with those modifications, the true mean cost difference is reduced to 4% with a standard deviation of 39%. In Scenario 4, the true mean cost difference is negative 2%, and the standard deviation is 40%.

The analysis depicts a large improvement in the RACER-estimated costs from Scenario 1 to 2 and then a leveling off of performance from Scenario 2 to 4. The improvement from Scenario 1 to 2 is logical as the user is able to input more site- or project-specific data into the estimate under Scenario 2. The leveling off from Scenario 2 to 4 indicates that modifications to assemblies for these projects did not produce a significant improvement, and that the use of specific location modifiers as opposed to the US average did not produce significantly different results. This analysis demonstrates a significant improvement in the difference between historical costs and the RACER-estimated costs when secondary parameters or assemblies are modified. This finding clearly demonstrates the benefit of utilizing detailed site or project-specific data, where available, in preparing RACER estimates.

A more detailed discussion of the statistical analysis is found in Section 6; the major findings are presented in Section 7.0, a summary of which is provided below.

Summary of Findings

The findings presented below are based on the results of the three pronged analysis employed in the validation to evaluate the performance of the RACER software. The three pronged analysis combines the project-level cost analysis, the technology-level cost analysis, and the technology engineering analysis to provide a more complete picture of software performance.

1. The historical data collection was successful in developing a sample population of sufficient size and diversity to analyze the performance of RACER relative to actual DoD remediation experience. The collection of historical data for completed remediation projects builds upon the previous 2004 RACER Assessment benchmark data. The additional data aids in evaluating and improving the RACER parametric model in two ways:
    - It allows for comparative analysis between the re-engineered RACER 2008 software and the RACER 2004 software
    - It provides a larger sample population for more reliable statistical analyses.
2. The data collection and analysis effort was limited due to the high incidence of Firm, Fixed-Price (FFP) contracting utilized at the data collection locations, resulting in difficulty isolating historical costs for comparison to applicable RACER technologies.[7]
3. The project-level cost analysis demonstrates that for the 88 selected projects, the accuracy of RACER as compared to actual costs averaged 28% when only default parameters were modified (Scenario 1), 7% when secondary parameters were also modified (Scenario 2), and 4% when assemblies were also modified (Scenario 3). This analysis demonstrates a significant improvement in the difference between historical costs and the RACER-estimated costs when secondary parameters or assemblies are modified. This finding clearly demonstrates the benefit of utilizing detailed site or project-specific data, where available, in preparing RACER estimates. However, in our project analysis, the use of RACER default values under Scenario 1 produced highly variable results. See Section 6.0 for further details.
4. There is no clear statistical evidence that RACER consistently produces higher or lower estimates in comparison to historical benchmark costs. There is also no clear

[7] *Refer to Section 5.0 for a complete discussion of study limitations.*

statistical evidence that RACER produces better estimates for "high cost" or "low cost" projects, defined as greater or less than $500,000 total project cost.

5. Under Scenarios 2, 3, and 4, the true mean cost difference at the project-level was lower using RACER 2008 than RACER 2004, indicating improved performance of the software relative to actual costs.
6. The 14 most frequently occurring technologies were analyzed statistically to determine how the technology-level costs compared to actual costs. Eight of those technologies had negative true mean cost differences, indicating that the average RACER-estimated cost for that technology was lower than actual costs. Six of those technologies had positive true mean cost differences, indicating that the average RACER-estimated cost for that technology was higher than actual costs. The true mean cost difference at Scenario 1 for the fourteen technologies ranged from -44%to 56%. However, only preliminary conclusions should be drawn from the technology-level cost analysis due to the small data sets available for this analysis.[8]
7. Significant recommendations for improved performance of the 14 most frequently occurring RACER technologies (and Well Abandonment) are provided in Section 6.0; recommendations for additional technologies are presented in Appendix D.

[8] *Refer to Section 5.0 for more detail on the size of the data sets.*

1.0 Objectives

The bullet point references below are objectives taken from the contract Performance Work Statement (PWS):

- The primary objective of this report is to provide sufficient documentation to support validation of the RACER 2008 cost models and underlying databases by documenting a comparison of RACER-generated costs against associated actual historical costs for current technologies. The Government intends to use this information to obtain Verification, Validation, and Accreditation (VV&A) of the RACER 2008 program.
- An additional objective is to perform a critical review of RACER technologies. As part of the validation effort, 14 technologies within RACER 2008 have been evaluated for cost reasonableness, the reasonableness and accuracy of default parameters, and environmental engineering best practices (i.e., whether the technology reflects current best practices). The results of this analysis will assist the Government in determining if any technologies need to be updated to reflect best practices in environmental restoration, if assemblies need to be changed or updated, if default parameters need to be changed, or if new technologies need to be developed. This review also provides the Government with a better understanding of when default parameters are best used and when they should be customized. The Government may use this information to understand how, or if, RACER needs to be modified to ensure RACER cost estimates are auditable and defensible and will provide a sound basis for developing estimated costs used to report environmental liabilities.
- Historical project parameters and costs have been collected and used in the analysis of RACER 2008, Version 10.0.2. Historical project data were collected for a total of 156 projects that fit the assessment criteria. Upon close examination and evaluation, 88 of these projects were actually estimated in RACER and incorporated into the statistical analysis. Although not used in the RACER analysis, the remaining projects were reviewed and filed for delivery to the Government. These data could potentially be sufficient for other future uses.

2.0 Project Process

2.1 GENERAL ASSUMPTIONS FOR RACER MODELING

This section details the general approach and assumptions used to generate the RACER estimates that were developed for comparison to actual historical project costs. In the absence of specific statements indicating a deviation from these assumptions, the following assumptions were used in the estimating process.

1. All estimates were generated using RACER 2008 (Version 10.0.2).
2. RACER default values were used in all cases for which more specific information was not available. The following list describes and defines items considered defaults for this process:
   - **Markup Calculation** – RACER uses markup templates to calculate general conditions, overhead, risk, owner cost, and prime and subcontractor profit as a percentage of direct costs.

     A user-defined RACER markup template was applied to all projects, which zeroed out the "owner cost."[9] All other markups were left as default in the template. At the kick-off meeting for this TO[10], held on October 14, 2008, the Government Point of Contact (POC) agreed to the use of this template.
   - **Safety Levels –** RACER assumes a default safety level of "D" in all technologies.
   - **Cost Database –** The default RACER cost database was used to define the costs associated with each assembly in the estimates for all scenarios. No new assemblies were created. Assembly cost rates were not changed, although changes to assembly quantities were made in Scenario 3 where that information was available and applicable.
   - **Escalation Factors –** Standard RACER escalation factors were used to "normalize" historical cost data such that it could be compared to RACER estimates created in RACER 2008 (Version 10.0.2).[11]
   - **Location Modifiers (Area Cost Factors (ACFs)) –** The default location modifiers found in RACER 2008 were used when estimating Scenarios 1, 2, and 3 (Section

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[9] *The default template includes an "owner cost" percentage of 11%, which is added to the total after prime contractor profit and overhead within RACER. For this assessment, the owner cost percentage has been zeroed out in the user defined markup template. This cost in the default template pertains to management costs and oversight activities incurred by the "owner." For the purposes of this project, the owner is the Government, and this 11% markup pertains to Government costs that are not included in the contractor's cost and thus should not be included in the comparison of RACER to historical costs for this assessment.*

[10] *USAEC A&AS Contract W91ZLK-07-D-0002-0008*

[11] *According to the Revised Final Database Update Report for RACER 2008 prepared by Earth Tech, Inc. (dated November 2007), the escalation index data for the RACER 2008 release were obtained from the Secretary of the Air Force / Financial Management and Comptroller (SAF/FMC) Web site at Hill AFB. The Raw Index for Other Procurement (3080) was used as a basis in the Air Force Inflation Tutorial.*

2.3, Subtask C should be referenced for a better understanding of these estimating scenarios). The RACER location closest to the actual project location was selected. Where specific cities were not available in RACER, the applicable state average was used. For Scenario 4, the U.S. 96 City Average was used.

- **Professional Labor Rates –** The direct professional labor rates found in the default RACER cost database were used in all cases. No changes were made to these assemblies.
- **Professional and Craft Labor Quantities –** The default labor quantities calculated within each RACER technology were retained. To ensure accurate comparisons between actual historical project costs and RACER-estimated costs, and to avoid prescriptive estimating scenarios where proposed Level of Effort (LOE) was substituted for RACER-generated LOE, labor hours were not altered at the assembly level to match proposed quantities.
- **Professional Labor Management –** The Professional Labor Management (PLM) technology was applied to each remedial action (RA) or interim remedial action (IRA) phase within each project to ensure that a valid comparison could be made for historical projects burdened with professional labor.

2.2 ADDITIONAL ASSUMPTIONS FOR MODELING/UPGRADE OF 2004 DATA

The following list details the general approach and assumptions used to select, upgrade, and price-level data gathered and estimated during the 2004 RACER assessment project. During the 2004 RACER assessment project, 11 site visits[12] and Internet research were performed. Technologies from each of these 12 data sets were included in the upgrade. The upgraded results were incorporated into the technology-level analysis presented in Section 6.2 of this report.

1. All estimates were originally generated using RACER 2004 (Version 6.0). RACER 2004 estimates were then upgraded to RACER 2006 (Version 8.1)[13] and price-leveled to reflect the costs current with RACER 2006. Finally, RACER 2006 estimates were upgraded into RACER 2008 (Version 10.0.2) and price-leveled to reflect costs current with RACER 2008. Following each upgrade, price-leveling was accomplished by selecting all projects in each RACER database to be "price-leveled to the current cost table." The steps used to perform database upgrading and price-leveling match exactly the steps used by the RACER software development contractor[14] to upgrade

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12 *Site visit locations included: Omaha, NE; San Antonio, TX; Sacramento, CA; Louisville, KY; Seattle, WA; Mobile, AL; Kansas City, MO; Baltimore, MD; Savannah, GA; Concord, MA; Tulsa, OK*

13 *Estimates prepared in RACER versions predating RACER 2006 are not compatible for upgrade into RACER 2008; therefore, the estimates prepared in RACER 2004 were upgraded to RACER 2006 and then upgraded to RACER 2008.*

14 *The RACER 2008 software developer was Earth Tech, Inc.; Earth Tech, Inc. is now known as AECOM.*

and price level databases in preparation of the *RACER 2008 Sensitivity Analysis Report.*[15]

2. During the 2004 RACER assessment, historical costs were escalated from the actual project dates to 2004; therefore, for an accurate cost comparison, all historical costs reported in 2004 were escalated further from 2004 to 2008.

3. Projects and technologies for which historical technology-level costs were not available were removed from the data set. To perform a detailed analysis of individual technologies, technology-level cost estimates (as opposed to project-level estimates) are preferable. Therefore, only technologies with available historical costs were retained.

4. Since the PLM technology is calculated as a percentage of the sum of the total marked-up cost of construction-related technologies run within the same phase, an accurate historical cost comparison can only be made if each of those construction-related technologies was retained in the estimate. In projects where one or more technologies were removed, the PLM technology was not retained for comparison and analysis in RACER 2008.

5. During the upgrade to RACER 2008, RACER technologies were forced to recalculate if one of the following was true:

   - the technology was re-engineered for 2008
   - the technology contained analytical assemblies
   - the technology contained Other Direct Costs (ODCs).

   Table 2, below, lists the technologies that were forced to recalculate in RACER 2008 and identifies the reason for the upgrade requirement.

Technology Name	Re-engineered Technology	Analytical Templates	Other Direct Costs
Administrative Land Use Controls			X
Air Sparging		X	
Capping	X		
Corrective Measures Study			X
D&D, Conduit, Pipe & Ductwork			X
D&D, Contaminated Building Materials	X		
D&D, Rad Contaminated Building			X
D&D, Removal, Attached Hazardous Materials			X
D&D, Removal, Unattached Hazardous Materials			X
D&D, Site Characterization Survey			X

15 *Revised Sensitivity Analysis Report for Final Version of RACER 2008, U.S. Air Force Civil Engineer Support Agency, Technical Support Directorate, Tyndall Air Force Base, Florida, November 2007*

Technology Name	Re-engineered Technology	Analytical Templates	Other Direct Costs
D&D, Size Reduction			X
D&D, Specialty Process Equipment			X
D&D, Surface Decontamination	X		
Demolition, Underground Pipes			X
Drum Staging	X	X	
Excavation	X		
Feasibility Study	X		
Five-Year Review			X
Groundwater Monitoring Wells		X	
In Situ Biodegradation	X		
MEC Institutional Controls			X
MEC Monitoring			X
MEC Removal Action			X
MEC Sifting			X
Monitoring	X		
Natural Attenuation		X	
Off-Site Transportation & Disposal	X		
Operations and Maintenance	X		
Preliminary Assessment		X	
Professional Labor Management	X		
RCRA Facility Investigation		X	
Remedial Design (Detail)			X
Remedial Investigation	X		
Residual Waste Management	X		
Site Close-Out Documentation	X		
Site Inspection		X	
Slurry Walls	X		
Soil Vapor Extraction		X	
UST Closure & Removal	X	X	X

Table 2 – RACER 2008 Technologies Which Required Recalculation During Upgrade

6. In technologies for which required parameters were retained in the upgrade, these parameters were verified against the sources listed below and utilized (see Item #10 in this list, on the following page). In technologies for which required parameters were not retained (e.g., In-Situ Biodegradation), the technology was omitted from the data set. This is because the required parameters differed so greatly from those in 2004, and the data necessary to populate the parameters of the reengineered technology were not collected by the 2004 RACER assessment team.

7. For secondary parameters and assemblies, default selections and quantities were used, unless otherwise noted in the project documentation sources (see Item #10, below). This approach is consistent with the analysis of data newly collected in 2008—default values were only changed when known. This approach is also consistent with guidance for the preparation of Environmental Liability (EL) estimates, where RACER estimators are instructed to use default parameters unless other site or project data are available.
8. RACER default values were used for the following items, unless more specific information was available: safety levels, cost database, escalation factors, location modifiers (ACFs), professional labor rates, professional and craft labor quantities, and professional labor management. These items are described in more detail in Section 2.1.
9. A user-defined RACER markup template was applied to all projects, which zeroed out the "owner cost," as described in Section 2.1. All other markups were left as default in the template.
10. Project- and technology-level parameters were obtained from the following sources:
    - *Final Project Report (Appendix A-2, Model Analysis Report), Assessment of RACER Cost Models and Database Project, USACE Hazardous Toxic and Radioactive Waste Center of Expertise (HTRW-CX), 24 January 2005* (contains information regarding Scenario 3 assembly-level changes to each technology)
    - *RACER Assessment Database (RAD), 2004 RACER Assessment Project* (project and technology input parameters documented in a Microsoft Access database)
    - *RACER Cost Estimate Databases, 2004 RACER Assessment Project* (project and technology input parameters documented in "Comments" and "Tab Notes" fields).

2.3 PROTOCOL FOR HISTORICAL DATA COLLECTION AND ANALYSIS

During visits to six USACE District Offices and one AFCEE location as part of the RACER 2008 assessment, the data collection team followed the protocol called out in the Final Project Management Plan dated 4 November 2008. Figure 2, below, displays an overview of the step-by-step approach that Booz Allen followed in accomplishing each of five subtasks for the data collection, processing, and analysis portions of the assessment.

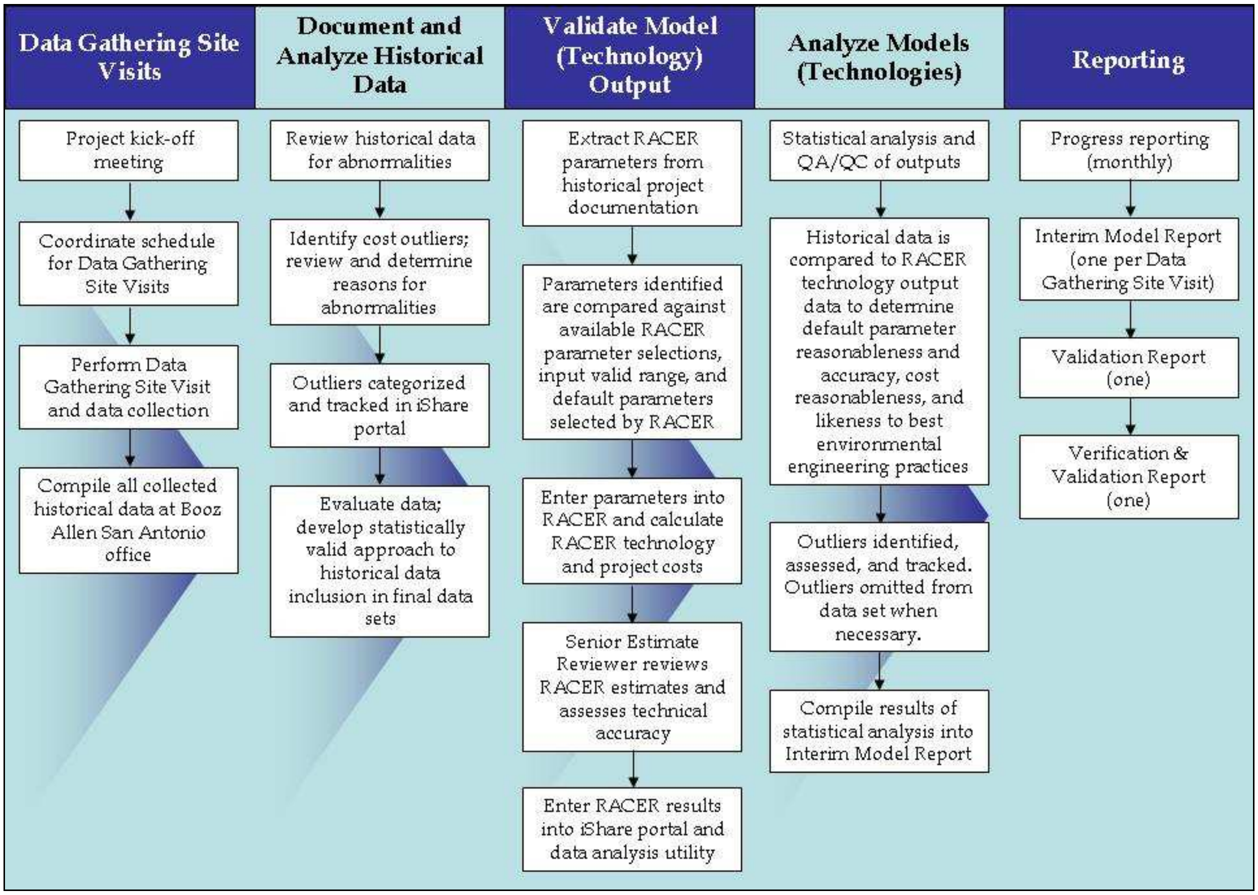


Figure 2 – RACER Assessment Project Tasks

A description of the protocol used for each of the subtasks follows:

Subtask A – Data Gathering Site Visits

The Booz Allen team followed a consistent and systematic approach for the data collection task at the USACE District and AFCEE office site visits to ensure that the amount and type of data would be sufficient for deconstruction and RACER estimate creation. Government personnel supported logistics and facilitated the gathering of all required data during the site visits.

The following is a list of protocol steps followed for each of the visits to USACE District offices and AFCEE:

1. A USACE representative for this Task Order contacted the Government POCs at each USACE District office and AFCEE to coordinate the location visits and identify participating Government project managers and contracting personnel with relevant historical project data.
2. USACE and USAEC provided a preliminary list of proposed projects to the Booz Allen team and the applicable Government POC prior to the office visit. The initial list was gathered from queries of the Formerly Used Defense Sites Management Information System (FUDSMIS), Army Environmental Database- Restoration (AEDB-R), and AEDB- Compliance-Related Cleanup (AEDB-CC) databases.
3. USACE sent out a pre-site visit information packet, prepared by Booz Allen, to the Government POCs to inform them of the purpose of the visit, the types of data needed, and the level of participation requested by the data collection team.
4. USACE, USAEC, Booz Allen, and the Government POCs participated in pre-visit teleconferences to discuss the overall objectives of the site visit, define roles and responsibilities, and begin to narrow down the initial project list.
5. Upon arrival at the Government Offices, the Booz Allen team conducted project in-briefs to discuss the overall objectives of the site visits and to confirm interview availability with the project managers associated with the projects identified on the initial project lists, as well as associated contracting personnel. Locations of project files, scanners, copiers, and other logistics were discussed during these meetings.
6. Once relevant projects were targeted and files located during the site visit, the team scanned or copied the supporting documentation and then returned the files. The team organized the copied documents and transported them to the Booz Allen office in San Antonio, Texas for processing.

Subtask B – Document and Analyze Historical Data

Upon completion of the data collection, all documents were transferred to the Booz Allen San Antonio office for deconstruction and storage. All collected data were organized and stored in a way that allows for easy access and review. To accomplish this, Booz Allen is using an internal Microsoft SharePoint service called iShare. All data collected under this TO was logged in the iShare system.

Each project was given a unique identifier consisting of an abbreviation for the site visit location and a unique digit. The identifiers for the data gathering site visits are USACE-NWK-## (Kansas City District), USACE-SWF-## (Fort Worth District), AFCEE-## (AFCEE), USACE-POA-## (Alaska District), USACE-LRL-## (Louisville District), USACE-NAB-## (Baltimore District), and USACE-SAS-## (Savannah District), where the "##" represents a unique number assigned by Booz Allen.

Booz Allen utilized Data Deconstruction templates to aid in data gathering for each project. The template captures all project and site information, cost information, and all parameters needed to complete RACER estimates. The Data Deconstruction templates, interview notes, and collected project data were then used to populate a project item in the iShare portal. Each project item contains the data fields listed in Table 3, below.

Field	Description
ID	Unique project identifier
Organization	Data gathering location (e.g. USACE District, or AFCEE)
ID Number	Unique project ID number
Estimator	Name of assigned estimator
Estimate Reviewer	Name of assigned senior reviewer
Accept/Reject?	Indicates if project was selected for inclusion in the final data set
Documentation Gathered	List of each item gathered at the data gathering site visit (e.g., SOW, Cost Estimate, Award Documentation)
Project Name	Project title, as indicated in contract award documentation
Project Date	Project award date, used as basis for escalation
Data Gatherer	Name of individual who collected project information at data gathering site visit
RACER Database Name	Filename of RACER database
Technology-level Historical Costs Available	Indicates if historical cost data can be broken out for any technologies in the estimate
Issues / Comments	Issues encountered during deconstruction and estimating; includes discrepancies with RACER technologies, bugs, inability to recreate project tasks in RACER, etc.
FFID	Federal Facility Identification Number(s) associated with the project
Funding Source:	Source of project funds, if known (e.g., BRAC, FUDS, IRP)
Data Completeness Level	High, Medium, or Low[16]
Contract Number	Contract number
Contract Type	Contract award type (e.g., FFP, CPFF) [16]

[16] *See Section 4.0 for explanation of Data Completeness Levels and Contract Types*

Field	Description
Installation	Government installation where project work was performed (used to aid selection of Location Factor)
Project Location	State and City where project work was performed (used to aid selection of Location Factor)
Site(s)	Site(s) associated with the project
Total Historical Cost	Total cost of project, as indicated in project documentation. In most cases, this is the same as the contract award amount; in cases where only a portion of the project was estimated, this cost reflects only the relevant portion of the project that was recreated for the RACER estimate
Description (for Summary)	Full project description, as shown in Project Summary (see Appendix C for Project Summaries)
RACER Technologies Used	List of all RACER technologies utilized in the RACER estimate
Attached files	Lists (and stores) scanned files of each item collected at the data gathering site visit, as well as comments generated by the senior estimate reviewer during the QC process

Table 3 – Project Information Fields in the iShare Portal

Each project item in the iShare portal was used by the RACER estimator to create the estimates, as described in Subtask C below.

Subtask C – Validate Model (Technology) Outputs

To analyze the RACER program, the deconstructed elements and costs obtained from the historical project documentation were compared against the RACER outputs under four scenarios. Actual parameters found in project documentation were entered into the RACER program using the required parameters as defined in Scenario 1 below. Three additional scenarios were also run to facilitate identification of variance parameters in the cost estimates. Subsequent estimates were generated by copying the baseline estimate (Scenario 1) and following the protocol as defined in the scenarios found in Table 4, on the following page.

Scenario Number	Description	Purpose
1	Scenario 1 consists of entering required parameters into RACER based on project documentation. No secondary parameters or assembly information is changed from the RACER default values. The location factor is location-specific dependent upon the information obtained from the historical project data.	This scenario is used to isolate and identify any issues with the RACER technology primary parameters as well as to create a basis for Scenario 2.
2	Scenario 2 consists of copying Scenario 1 and then changing the RACER default secondary parameters to specific project values derived from the historical project documentation. Assembly information is not changed from the RACER default.	This scenario is used to identify any issues with the RACER technology secondary parameters and compare it with Scenario 3 to determine outstanding issues with RACER technology assemblies. This scenario provides data to determine if a new technology is required or if existing technologies require modification.
3	Scenario 3 consists of copying Scenario 2 and making changes to the default assembly line items found within the RACER technologies. All assembly modifications are based on information specified in the project documentation but are not included within the default RACER estimate. Changes could include modifications to the assemblies in the technology by deleting/adding assemblies or by changing the quantity of an assembly.	This scenario is used to isolate and identify any issues with the RACER technology assemblies. These can include the assembly itself, as well as quantities being calculated by the technology algorithms.
4	Scenario 4 consists of copying Scenario 3 and changing the location factor to the U.S. 96 City Average; therefore specific location factors are not applied to the estimate; thus the labor, material, and equipment factors are all equal to factors used in Scenario 1.	This scenario is used as the baseline estimate to determine how location factors for each project affect the project costs variance. Its purpose is to identify any significant problems with an estimate that involves a location factor modification.

Table 4 – Scenario Description Table

The Data Deconstructor and RACER Estimator provided page-specific references within the RACER databases to all relevant sections of gathered historical project data used to determine required parameters, secondary parameters, and changes to assembly quantities. Finally, all changes to RACER secondary parameters and assemblies were captured in the “Comments” field of each relevant RACER technology. This assisted the Senior Estimate Reviewer in ensuring the estimate was accurately created and documented. Also, documenting changes in this manner allows for re-creation of estimates for future validation efforts.

Subtask D – Analyze Models (Technologies)

Based on the level of detail found in the historical cost documentation, analyses were performed at both the project and technology-level. Once project estimates were created using each of the four different scenarios for each project, the difference in cost (the percent difference between the estimated and actual cost) was analyzed to determine how RACER performed at the project level. The project-level analysis compares the total documented historical cost for the applicable piece of work being estimated against the RACER-generated cost of the aggregate RACER technologies used to model the historical cost. Technology-level analysis was conducted by isolating, where feasible, the portions of the historical costs applicable to specific RACER technologies and comparing these costs to RACER-generated costs at the technology level.

The results from each project were reviewed considering the following criteria:

- Default Parameter Reasonableness and Accuracy

This review was conducted by comparing RACER outputs in Scenarios 1 and 2. The greater the difference in estimated costs from Scenario 1 to Scenario 2, the farther from historical project data the secondary default parameters were. For all projects, Scenario 1 had an average percent difference in estimated cost of 28%; by changing default secondary parameters to include additional site- or project-specific values (Scenario 2) the difference in estimated cost was reduced to 7%. These results imply that utilizing default values for RACER secondary parameters may lead to estimates with reduced accuracy compared to estimates with changed secondary parameters.

- Best Environmental Engineering Practices

Each technology or project was evaluated to determine the reason for the cost difference (or lack thereof). This was accomplished by reviewing the assembly information to determine if the assemblies and quantities used coincided with current best environmental engineering practices. Results of this analysis are listed in Section 6.3.

- Cost Reasonableness

The project estimates and included technologies were reviewed for cost reasonableness. The statistical analysis of cost differentials between historical project costs and RACER-estimated costs was performed at both the project and technology-levels. In the cumulative analysis, once a sufficient number of project estimates were completed, the difference in cost was analyzed statistically to evaluate the standard deviation between estimated and historical project cost at the project and technology-level (referred to as average percent difference).

The team evaluated each project's RACER output against historical project cost data by comparing the ratio of the cost difference [(RACER – historical estimate) / (historical costs)]. Specifically, the team computed the average (mean) of the cost difference ratio for each of the four scenarios.

The team then aggregated project and technology outputs in appropriate data sets by scenario to produce comparable data sets for statistical analysis. This activity confirmed the utility of the modified scenario approach used to identify and isolate cost drivers.

Subtask E – Reporting

Upon completion of each site visit under this TO, Booz Allen prepared and submitted an Interim Model Report. Each Interim Model Report presented the data collection process, data analysis for the location visit, and cumulative data analysis for all the projects gathered to date. The Interim Model Reports presented detailed information on the data gathered at each specific location and also provided cumulative analyses of data gathered to date for each location visit. For the three locations visited under the AFCEE TO, this information was presented in one report titled "Final Interim Validation Report" (dated 5 December 2008).

3.0 Summary of Location Visits

The data collection team visited seven locations to gather historical data for completed environmental remediation projects. Six of the locations were USACE district offices, and one was AFCEE in San Antonio, TX. The information below lists locations, dates of visits, and project counts for analysis in RACER. Map 1, on the following page, depicts the geographical dispersion of the project locations.

Location: Kansas City, KS (USACE)
Date: November 13–15, 2007

- 24 projects were collected.
- 3 projects were selected for analysis with RACER.

Location: San Antonio, TX (AFCEE)
Date: February 19–21, 2008

- 23 projects were collected.
- 8 projects were selected for analysis with RACER.

Location: Fort Worth, TX (USACE)
Date: April 22–24, 2008

- 18 projects were collected.
- 11 projects were selected for analysis with RACER.

Location: Anchorage, AK (USACE)
Date: October 21–23, 2008

- 27 projects were collected.
- 18 projects were selected for analysis with RACER.

Location: Louisville, KY (USACE)
Date: November 18–20, 2008

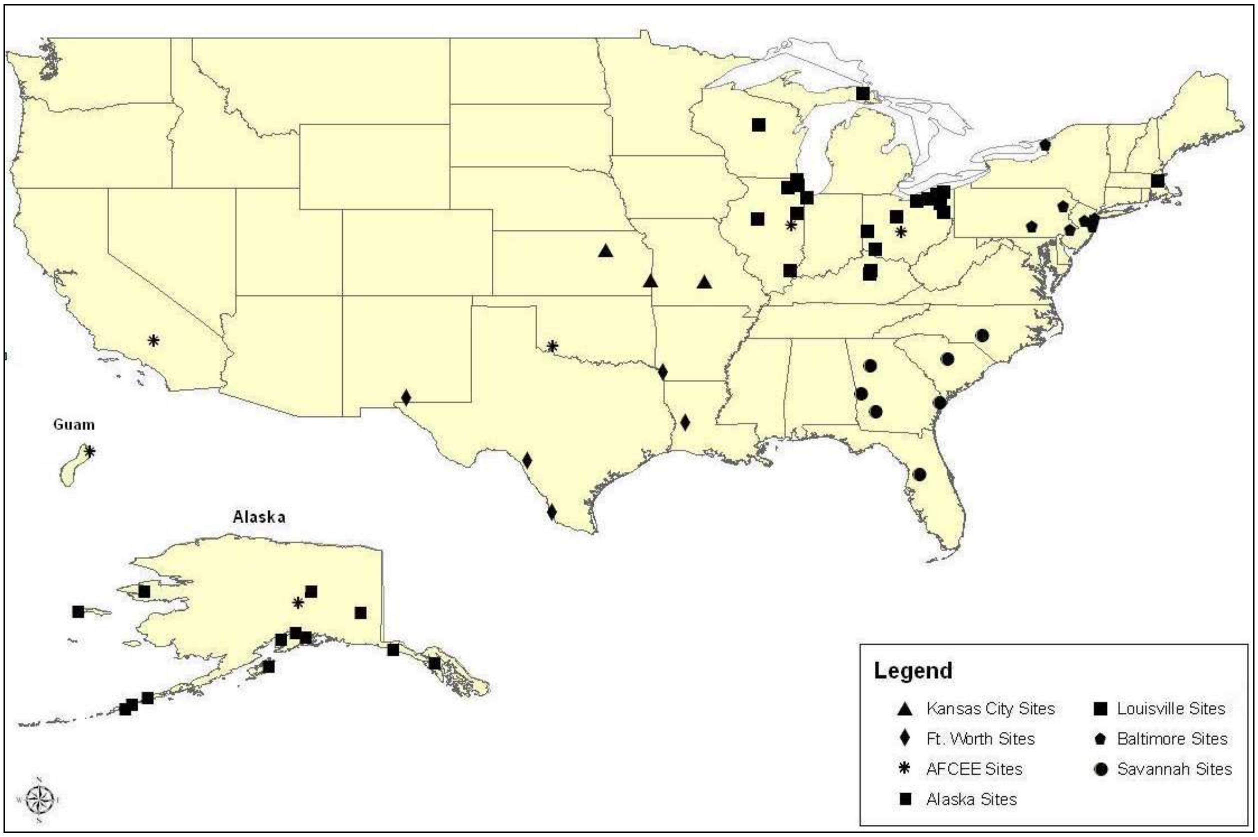
- 22 projects were collected.
- 19 projects were selected for analysis with RACER.

Location: Baltimore, MD (USACE)
Date: December 9–11, 2008

- 23 projects were collected.
- 14 projects were selected for analysis with RACER.

Location: Savannah, GA (USACE)
Date: 27-29 January, 2009

- 19 projects were collected.
- 15 projects were selected for analysis with RACER.



Map 1 – Historical Project Locations[17]

Lessons Learned From Data Collection and Site Visits

During each of the seven data gathering site visits, lessons learned were gathered and documented to improve efficiency and performance of future data gathering site visits. These lessons learned should be considered for future efforts of a similar nature. An aggregated list of lessons learned is presented in Appendix F.

17 *Note: Map is not to scale.*

4.0 Data Collection Summary

The historical project data were provided in varying types of documentation across projects. The following list is indicative of the types of documents collected:

- **Scope of Work or Statement of Work (SOW)** – The detailed description of the work to be performed at the site, produced by the Government before the project is started. This document may also be referred to as the Performance Work Statement (PWS) or Scope of Services (SOS).
- **Contractor's Technical Proposal** – A detailed description of the work to be performed at the site produced by the contractor which was submitted to the Government for review as a response to a request for proposal. Typically this document contains a detailed discussion of how the contractor proposes to accomplish the work. In some cases this includes a detailed cost estimate.
- **Contractor's Estimate (at the time of award)** – An estimate, proposal, or price from an independent contractor stating the charge for the service or product the independent contractor is offering. Typically this is the estimate, which was used to accomplish the work (the winning proposal).
- **Independent Government Estimate (IGE)** – An independent detailed estimate by the Government or a Government representative used to evaluate the winning proposal and used as a basis for negotiations. This document is often included as part of the Price Negotiation Memorandum (PNM) or Pre-Negotiation Objective Memorandum (PNOM).
- **Construction Completion Report** – The final document compiled and submitted by the contractor performing the work on a project to the Government. Typically the document summarizes the work performed during the construction phase of a project.
- **Invoice** – The document submitted to the Government during or at the end of a project summarizing the work performed for payment of work completed.
- **Order for Supplies or Services** – The contract award document. This includes the final negotiated price, lists all Contract Line Item Numbers (CLINs), and includes a copy of the contract SOW.
- **Work Plan** – The document submitted to the Government, by the contractor, post-award, which details how the work will be accomplished. This document generally elaborates on work spelled out in the SOW and includes specific approaches to successful project completion, more detailed site information, and detailed information regarding anticipated contract deliverables, such as level of report detail and frequency of reporting.

In some cases, the project data collected did not provide sufficient documentation for the purpose of assessing the RACER technologies against the historical costs. For example, the data collection team may have located a contractor's estimate and the original SOW, but neither document provided a description of the project parameters sufficient to complete a RACER estimate. The data completeness for these projects was designated as "low;" these projects were not included in the project data set. In other instances, project data were collected that provided sufficient information to create a RACER estimate; in addition the information available contained the SOW and Contractor's estimate at time of award, as well as the final project costs. In these instances, the data completeness was designated as "high." When collected data included the SOW and estimate at the time of award (or the final site report and a cost breakdown, but not both) the project data completeness was designated as "medium."

Table 5, below, describes the project-level data completion categories and the minimum types of documentation required to meet each level. Projects that fell within either the high or medium categories were included in the data analysis. Projects that fell within the low category were eliminated from the scope of the data analysis, but source data has been retained for possible future analysis and reference.

Level of Project Data Completeness	Information Type	Document Types
High	Scope, design, and detailed cost information available from the time of award to the project closeout stage, including scope or design modifications made during the life of the project.	• Scope of Work • Contractor's estimate at time of award • Contractor's Technical Proposal • Construction and Completion Report • Final Invoice/Cost Breakdown • Project Modification Details • Contract Execution Summary
Medium	Scope, design, and cost information available at the time of award, or final project closeout information including cost and scope is available.	• Scope of Work • Contractor's Technical Proposal • Contractor's Estimate at time of award OR • Construction and Completion Report • Final Invoice/Cost Breakdown
Low	Scope, design, and partial cost information available for the project, no final project information found, and incomplete/no project data.	• Scope of Work • Partial Technical Proposal • Partial Contractor's Estimate • Various Reports • Independent Government Estimates

Table 5 – Project Data Completeness Levels

Appendix C provides selected project summary information from each of the seven location visits. A total of 156 total projects were collected, with 88 projects selected for RACER modeling and analyses.

Contract award type was noted when collected and assessing the historical project data. Table 6, on the following page, shows the number of projects for each contract award type. The most common award type at every location visited was FFP; 83% of the estimated projects were awarded under FFP contracts.

Contract Award Type	Number of Projects
Firm, Fixed-Price	73
Time and Materials	6
Cost Plus Fixed-Fee	5
Cost Plus Award Fee	2
Indeterminate ("unknown")	2
Total	**88**

Table 6 – Project Data Completeness Levels

4.1 TECHNOLOGY INFORMATION

During the historical data deconstruction process, phases and associated technologies were identified specific to each of the projects selected and reviewed. Parameters associated with each technology were extracted from the historical project documentation and then ultimately entered into the associated RACER technology. The estimated project costs produced by RACER were then compared with the historical cost for each project using the scenario approach described in Section 2. When possible, line items and quantities from the historical project cost were compared against the RACER assemblies and quantities from the RACER technology.

A total of 40 RACER technologies were utilized when completing the RACER estimates using historical project costs. There were 425 total technology occurrences within the selected projects based on the number of times a technology was used in different projects. The list of technologies that were utilized and the number of instances of each are presented below in Table 7.

Project Type (RACER Phase Type)	RACER Technology (Model)	Number of Instances, 2008 Data Set
Study	Feasibility Study	8
	Remedial Investigation	18
	Site Inspection	6
	Preliminary Assessment	9
	RCRA Facility Investigation	2
Remedial Design	Remedial Design	2
Removal or Remedial Action	Administrative Land Use Controls	2
	Asbestos Removal	1
	Bioslurping	1
	Bulk Material Storage	1
	Buried Drum Recovery	1
	Cleanup and Landscaping	5
	Clear and Grub	2
	Decontamination Facilities	5
	Demolition, Underground Pipes	1
	Demolition, Pavements	7
	Drum Staging	2
	Excavation	39

	Ex Situ Solidification/Stabilization	1
	Fencing	4
	Groundwater Monitoring Well	19
	In Situ Biodegradation	9
	Load and Haul	8
	MEC Removal Action	2
	Monitoring	63
	Off Site Transportation and Waste Disposal	20
	Professional Labor Management	43
	Restoration Advisory Board	1
	Resurfacing Roadways/Parking Lots	2
	Residual Waste Management	56
	Sanitary Sewer	1
	Site Close-Out Documentation	29
	Soil Vapor Extraction	1
	Special Well Drilling & Installation	3
	Storage Tank Installation	4
	Transportation	1
	Trenching/Piping	6
	Underground Storage Tank Closure/Removal	18
	Well Abandonment	12
Operations and Maintenance	Operations & Maintenance	10
	Total	**425**

Table 7 – Number of Instances of Each RACER Technology (All Locations)

4.2 PROJECT IDENTIFICATION

This section lists and describes the types of project information that were gathered during location visits and is the basis for the organizing and accessing the historical data collected. Refer to Appendix C for tables listing the following information for all estimated projects.

- **Project ID –** The project's unique identifier, assigned by Booz Allen. This is the Level 1 and 2 name entered into RACER.
- **Installation Name –** The installation for which the project was completed. The installation name corresponds to the folder level within the RACER estimate.
- **Federal Facility Identification Number (FFID) –** The Federal Facility Identification Data Standard provides a consistent means of identifying facilities that are owned or operated by the federal Government. The data standard consists of data elements and their permissible values that indicate a facility (or the land it occupies) is owned or operated by the federal Government. Also included is information about the federal agency or organization that is responsible for the facility or land. The role or management relationship of the responsible party to the facility or land may also be specified.

- **Project Name –** The project name is the name identified in the historical data collected. Note that in some cases this name differs slightly from the name found in the Government database systems.
- **Project Date –** The project date is the date of project execution found on the project documentation from which the data was derived. This date may not be the same as when the project was actually completed or called out in the client database systems.
- **Contract Number –** The contract and task order number are defined in the historical data collected.
- **Funding Source –** Indicates the funding mechanism for the project, if known. Examples include Installation Restoration Program (IRP), Formerly Used Defense Sites (FUDS), and Base Realignment and Closure (BRAC).
- **Project Location –** The project location is the city or state where the work was performed. This location parameter may be different from the location where the data was collected or the project was managed.
- **Site(s) –** This refers to the site(s) on the installation which the project is intended to address.
- **Documents Collected –** This includes all project documentation collected during the data collection effort.
- **Project Description –** This is a brief description of the project components.
- **Total Project Cost –** This is the actual cost of the project taken from the historical documentation.
- **RACER Technologies Used –** This includes all RACER technologies used to estimate the project.

5.0 Limitations of RACER Validation

The accuracies of the validation project protocol, data collection, and resulting data analysis are limited by the capabilities of the RACER technologies themselves. Since the technologies are populated with information (parameters) gathered by the users, the quality of the RACER technology outputs is constrained by the following:

- The amount and accuracy of project data available to populate each of the technologies in the software
- The methodology employed by the user to segregate project components and correlate those components to individual RACER technologies
- Whether the remediation technologies employed in the actual project are available for cost modeling in the RACER software
- The accuracy of the unit prices employed in the RACER assemblies
- The accuracy of the algorithms employed in each RACER model
- The accuracy of the Area Cost Factors employed in the RACER software
- The accuracy of the values for Markups (including General Conditions, Overhead, Profit, Prime Markup on Subcontractor, Risk, and Owner Cost) employed in the RACER software.

The quality of the data analysis described in following Section 6.0 is limited by the quality of the data gathered during the data collection effort, and the ability of the Booz Allen team to break out those costs into segments that correlate to RACER technologies. It is important to note that the data trends identified during the RACER validation effort apply only to the project data gathered. The amount of usable data gathered in support of RACER validation posed perhaps the greatest challenge. The segregation of project components into useable pieces correlating with RACER technologies is dependent on the level of detail present in the contract documents (SOW/PWS), contractor's proposal, IGE, etc.). The trend of Government contracting towards Performance-Based Contracting (PBC) and FFP awards results in contract documents which provide very little project-specific detail, as the emphasis is on overall project performance. Time and Materials (T&M), Cost Plus Fixed-Fee (CPFF), Cost Plus Award Fee (CPAF), and Cost Reimbursable contract documentation, on the contrary, typically provide more specific detail regarding project parameters and costs.

Table 8, on the following page, displays the trend of Government contracting away from cost-type contracts and toward FFP contracts. Note that during the 2004 RACER assessment effort, only 41% of the gathered project data were FFP contracts; during the 2008 effort, 83% of the gathered project data were FFP contracts, representing a 103% increase in this contract type.

Contract Award Type	2004 Projects		2008 Projects		Percent Change
	Number	Percent	Number	Percent	
Firm, Fixed-Price	49	41%	73	83%	**103%**
Time and Materials	9	8%	6	7%	**-9%**
Cost Plus Fixed-Fee	30	25%	5	6%	**-77%**
Cost Plus Award Fee	9	8%	2	2%	**-70%**
Cost Reimbursable	12	10%	0	0%	**-100%**
Indeterminate (“unknown”)	11	9%	2	2%	**-75%**
Total	**120**	**-**	**88**	**-**	**-**

Table 8 – Comparison of 2004 and 2008 Contract Types

The FFP contract type posed difficulties for extracting cost, parameter, and assembly quantity information. This created a challenge to obtaining “apples to apples” comparisons between the contract documents and the RACER technology outputs.

Other common difficulties in data deconstruction included:

- The presence of “lump sum” items in contract documentation
- An actual task (project) could have a range of reasonable costs
- An actual task (project) cost could be skewed for reasons not apparent in the documentation (e.g., part of an installation wide effort that contributed economies of scale).

In addition, data gathered during the Alaska site visit had unique problems attributed to the remote location of these sites as well as the necessity to ship supplies and wastes via barges. The true mean cost difference for the subset of project data excluding the Alaska projects was only 19% at Scenario 1 vs. 28% average for the entire data set. Specific problems with the project data collected in Alaska are discussed in *Final Alaska District Interim Model Report*, dated 5 February 2009.[18] Individual technologies whose performance was affected by these problems are discussed in further detail in Section 6.5.

At the technology level, the cost analysis was limited by small data sets for specific technologies due to the prevalence of FFP contracting in the project data, resulting in

[18] *Final Alaska District Interim Model Report, Booz Allen Hamilton, San Antonio, TX, 5 February 2009.*

the inability of the data collection and analysis team to break out historical project costs into distinct task-related costs that can be compared to a RACER technology cost.

6.0 Cumulative Analysis of Data and Cost Differentials

6.1 MULTI-FACETED APPROACH TO DATA ANALYSIS

This section of the report is divided into three different subsections to holistically evaluate the current performance of RACER. The first subsection compares historical costs and RACER-estimated costs at the project-level, providing high level insight into the overall performance of the RACER software. The second subsection compares historical costs and RACER-estimated costs for 14 different frequency-used technologies to evaluate the accuracy of individual RACER technology models. The third subsection evaluates RACER model engineering to determine if the RACER program, technologies, algorithms, assemblies, and unit costs reflect current best practices in environmental restoration.

For the project-level cost analyses, actual historical costs and RACER-estimated costs were compared to determine relevant differences under each scenario. Each project-level cost is a roll-up of the specific technologies used in RACER to capture the historical contract activities. The purpose of the project-level analysis is to evaluate the accuracy of the cost generated by a grouping of RACER technologies (for example, Excavation together with Professional Labor Management and Residual Waste Management) as compared to actual cost incurred for those activities. Data from all seven site visit locations are presented as a percent difference (ratio) between the RACER estimates and identifiable historical project costs. This assessment pertains to the 88 selected projects (for all locations) and demonstrates the cost differential trends and data fit between identifiable historical data and RACER estimates.

This cost-based analysis was also performed at the technology-level, where actual costs relevant to the RACER technologies could be logically isolated from the rest of the historical cost estimate.[19] This technology-level cost analysis provides insight into how well each RACER technology estimates costs for specific environmental restoration activities. It measures the soundness of the algorithms employed in RACER models one piece at a time. However, due to data collection limitations,[20] the data sets for technology-level cost analysis were small. In addition, sufficient data were not available for technology-level cost analysis of each of the 113 standard RACER cost models.

Enough historical data are available to statistically evaluate RACER at the project-level; however, some technologies do not have enough data points for a highly confident statistical analysis. Therefore, the additional engineering analysis of the technologies was performed. Analyzing RACER at both the project-level and technology-level, as

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[19] *For the technology-level assessment, historical contract data collected during the RACER 2004 Assessment were also included; this increased the number of technology-level data points so that a technology-level statistical analysis could be performed. The inclusion of these data was not necessary at the project level, as the 88 historical projects utilized were enough to provide a sample size with high confidence.*

[20] *See Section 5.0 for a detailed discussion of project limitations.*

well as from both statistical and engineering viewpoints, measures the soundness of RACER estimates while compensating for data limitations for any one approach to analysis.

This three pronged analysis approach will assist the Government in gaining a better understanding of the current performance of RACER as well as provide suggestions on how to best update the program. It helps overcome data limitations at both the project and technology levels, and includes an analysis of the engineering reasoning that makes up the technology models. By itself, each analytical approach is limited; in order to form a qualified judgment, all three of these analyses are needed.

6.2 UNDERSTANDING OF STATISTICAL ANALYSES USED IN THIS REPORT

At the project level, although there are a total of 88 selected projects, the number of projects analyzed for each scenario varies. To prevent mean analyses from giving misleading descriptions of the central tendencies of the data for each scenario analysis, projects and technologies with differences between RACER-estimated costs and actual historical costs greater than 200% were omitted as outliers.[21] Scenario 1 has three outliers, Scenario 2 has four outliers, Scenario 3 has two outliers, and Scenario 4 has no outliers. Omitting the outliers brings the number of selected projects analyzed for each scenario to:

- Scenario 1 — 85 projects
- Scenario 2 — 84 projects
- Scenario 3 — 86 projects
- Scenario 4 — 88 projects

Appendix E provides a rationale for the large discrepancy between RACER-estimated cost and actual historical cost for each project- and technology-level outlier.

The analysis consists of an evaluation of the difference between the RACER estimates and the actual historical project costs. An example of sample project cost data and how cost differences were calculated for each scenario is shown in Table 9, on the following page.

[21] *It was determined that sample projects with cost differences greater than 200% were not understood well enough to explain the considerable difference between the RACER estimated cost and the actual historical project cost. Thus, these projects were omitted from the sample analysis for that scenario and identified as outliers.*

Scenario	Historical Project Cost (1)	RACER Estimated Project Cost (Marked-Up) (2)	Difference ($) (3)=(2)-(1)	Percent Difference (4)=(3)/(1)
Scenario 1	$ 427,063	$ 722,388	$ 295,325	69%
Scenario 2	$ 427,063	$ 375,378	(51,685)	-12%
Scenario 3	$ 427,063	$ 386,437	(40,626)	-10%
Scenario 4	$ 427,063	$ 394,121	(32,942)	-8%

Table 9 – Sample Project Cost Difference

Five measures of the percent difference are used for analyses:

- True mean cost difference
- Absolute value of mean cost difference
- Standard deviation of each mean cost difference
- Correlation coefficient
- Regression analysis

The true mean cost difference provides a metric to evaluate the accuracy of RACER on a software-wide basis to predict average project cost. This measure is used to assess RACER against the Tri-Service Parametric Model Specification Standard[22] which states the ranges of accuracy acceptable for various categories of cost estimates. The true mean difference in cost accounts for both the positive and negative values of the difference between the RACER-estimated cost and the actual historical project cost, so that the positive and negative values cancel out. The true mean cost difference is computed using the following formula:

$$(1)\quad \mu = \frac{1}{M}\sum_{i=1}^{M}\left(\frac{RACER - Historical}{Historical}\right)_i$$

Where: RACER = RACER-estimated cost
Historical = Actual historical cost
M = Total number of projects for each scenario (excluding outliers)

The absolute value of mean cost difference is computed using the following formula:

22 *Tri-Service Parametric Model Specification Standard, Project Time & Cost, Inc., April 1999*

$$(2)\quad ABS(\mu) = \frac{1}{M}\sum_{i=1}^{M}\left|\left(\frac{RACER - Historical}{Historical}\right)_i\right|$$

Where: RACER = RACER-estimated cost
Historical = Actual historical cost
M = Total number of projects for each scenario (excluding outliers)

Using the absolute value of mean cost difference provides a significant comparison between scenarios. The absolute value of mean cost difference converts the negative difference values between RACER estimates and historical project costs into positive values. Thus, this measure only evaluates the positive percent difference between RACER-estimated costs and actual historical costs. This provides a comparative basis to evaluate the relative accuracy of the RACER tool at different levels of use (default, secondary, and assembly levels).

The third cost difference measure evaluated is the standard deviation of each mean cost difference. The standard deviations for the true mean cost difference and the absolute value of mean cost difference are computed using the following formulas, respectively.

$$(3)\quad \sigma_{PercentDifference} = \sqrt{\frac{1}{M}\sum_{i=1}^{M}\left[\left(\frac{RACER - Historical}{Historical}\right)_i - \mu_{PercentDifference}\right]^2}$$

$$(4)\quad ABS\left(\sigma_{PercentDifference}\right) = \sqrt{\frac{1}{M}\sum_{i=1}^{M}\left[\left|\left(\frac{RACER - Historical}{Historical}\right)_i\right| - ABS\left(\mu_{PercentDifference}\right)\right]^2}$$

Where: RACER = RACER-estimated cost
Historical = Actual historical cost
M = Total number of projects for each scenario (excluding outliers)
$\mu_{\text{Percent Difference}}$ = True mean
ABS ($\mu_{\text{Percent Difference}}$) = Absolute value of the mean

The standard deviation is a measure of the dispersion of the data from the mean. A smaller standard deviation indicates less variation in the difference between RACER-estimate cost and the actual historical costs from the mean. Figure 3, on the following page, illustrates the concept of the standard deviation of a normal distribution. Standard deviation values are an important factor in considering how well RACER produces cost estimates in comparison with historical projects. Hypothetically, a mean of 50% with a standard deviation of 50% across all selected projects would imply that RACER could produce estimates within a range of +/- 100% of the average expected cost.

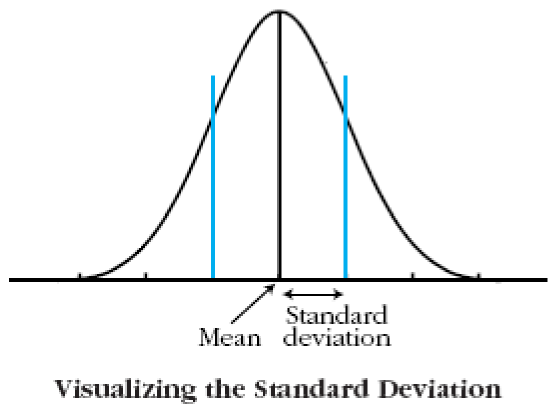

Figure 3 – Normal Curve Distribution and Standard Deviation

The correlation coefficient is also used to analyze the percent difference between RACER estimates and identified historical costs. The correlation coefficient measures the linear relationship between the RACER–estimated cost and the actual historical costs on a scale from –1 to 1. If the actual historical cost is high and the correlation coefficient is close to 1, the RACER-estimated cost will also be high. Thus, the correlation coefficient provides a predictive value of the RACER-estimated cost based on the actual historical cost. The correlation coefficient is computed using the following formula:

$$\rho = \frac{\operatorname{cov}(Historical, RACER)}{\sigma_{Historical}\,\sigma_{RACER}} \quad (5)$$

Where: cov(*Historical,RACER)*= E(Historical, RACER) – E(Historical)E(RACER)

E is the expected value of the particular function of Historical and RACER

$\sigma_{Historical}$ = Standard deviation of the identified historical costs

σ_{RACER} = Standard deviation of the RACER estimate costs

Racer = RACER-estimated cost

Historical = Actual historical cost.

The final measure used to evaluate cost differentials is a regression analysis between the RACER-estimated cost and the actual historical costs. The regression analysis is computed using the following equation:

$$(6)\ \text{RACER-estimated cost} = \alpha + \beta\ (\text{identified historical cost}) + \varepsilon$$

Where: α = Intercept parameter
β = Slope parameter
ε = Standard error parameter.

The R^2 value from the regression analysis provides a measure of fit for the RACER-estimated cost from the actual historical cost on a scale from 0 to 1. The closer the R^2 value is to 1, the closer the RACER–estimated cost will be to the actual historical cost. Hypothetically, if the R^2 value were 1, then the RACER estimated-cost would be the *same* as the actual historical cost.

6.3 STATISTICAL COST ANALYSIS AT THE PROJECT-LEVEL[23]

Mean Cost Differential

Figure 4, on the following page, presents the true value of mean cost difference between RACER-estimated costs and historical project costs for each scenario. The results include data for all seven location visits for the selected projects, excluding outliers. The true value of mean cost difference between RACER-estimated cost and historical cost was computed for each scenario (1–4) using Equation 1, while the standard deviation was calculated using Equation 3.

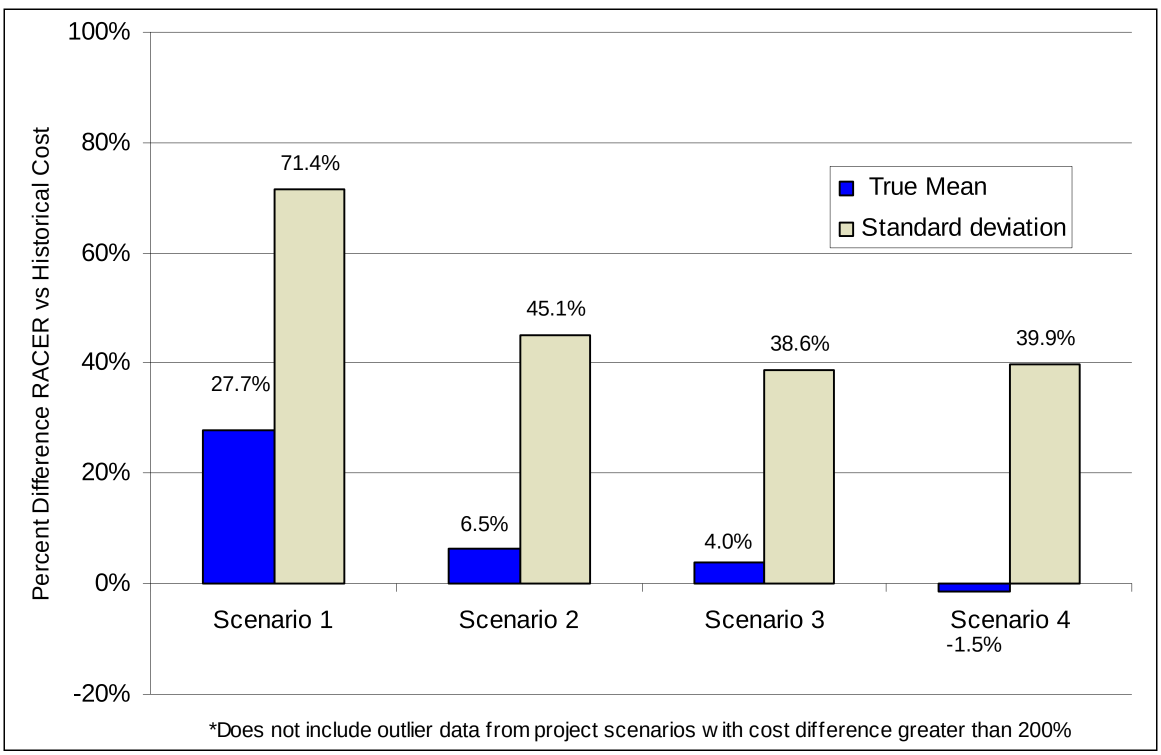

Figure 4 – True Mean Cost Difference by Scenario, All Locations

23 *Raw data used for the project-level statistical analysis are presented in Appendix B. This appendix shows the historical cost, scenario costs, and scenario percent differences for each of the 88 projects in the data set.*

As shown in Figure 4, above, there is significant improvement from Scenario 1 to 2, and then a flattening out from Scenarios 2 through 4 for the average cost difference, with the standard deviations decreasing in lockstep. The improvement between Scenarios 1 and 2 is logical, as Scenario 2 allows changes to secondary parameters which incorporates more project-specific information into the estimates. The leveling off from Scenarios 2 to 4 indicates that modifications to assemblies for these projects did not produce a significant improvement, and that the use of specific location modifiers as opposed to the US average did not produce significantly different results. This lack of improvement from Scenario 2 to 3 can be partially attributed to one of several facts: that the level of detail required for assembly-level modifications was not available for some projects; that LOE for labor categories was not modified; and that although assembly-level modifications were made in some instances, associated assembly-level costs were not comparable to the proposed costs.

In Scenario 1, the mean cost difference between RACER-estimated costs and historical costs is 27.7% with a standard deviation of 71.4%. In Scenario 2, by modifying important secondary parameters in the technology, the mean cost difference is reduced to 6.5% with a standard deviation of 45.1%. The analysis of the mean cost difference presented in Figure 4 reveals a considerable difference between historical costs and RACER-estimated costs under Scenarios 1 and 2. This difference in mean cost under Scenario 1 is exacerbated by large standard deviations that depict broad distribution from the mean cost difference. In Scenario 3, the advanced user can modify specific assemblies that form the basis for the cost estimate, and the mean cost difference is slightly reduced to 4.0% with a standard deviation of 38.6%.

In Scenario 4, the mean cost difference decreases to negative 1.5%, but the standard deviation slightly increases to 39.9%. Scenario 4 utilizes the same parameters for the RACER estimate as Scenario 3 but selects the 96 city-average location modifier, which sets labor, equipment, and material location modifiers equal to "1". The labor, equipment, and material modifiers are varied up or down by the different location modifiers for each specific location. When the location modifiers were set to "1", as in Scenario 4, the analysis yielded no considerable difference when comparing Scenario 4 to Scenario 3.

The true mean cost difference provides insight on the overall effect (software-wide) of using RACER for multiple project estimates. A closer look at the dispersion (standard deviation) from the true mean cost difference also provides information on the expected range of outcomes for the RACER estimate relative to the historical costs. The standard deviations for Scenarios 1–4 in Figure 4 show relatively high levels of uncertainty in the accuracy and predictability of any given RACER estimate when compared to the historical cost.

Figure 5 presents the absolute value of mean cost difference between RACER-estimated cost and actual historical project cost for each scenario. This measure provides a comparative basis to evaluate the relative accuracy of RACER at different levels of use (default, secondary, and assembly levels).

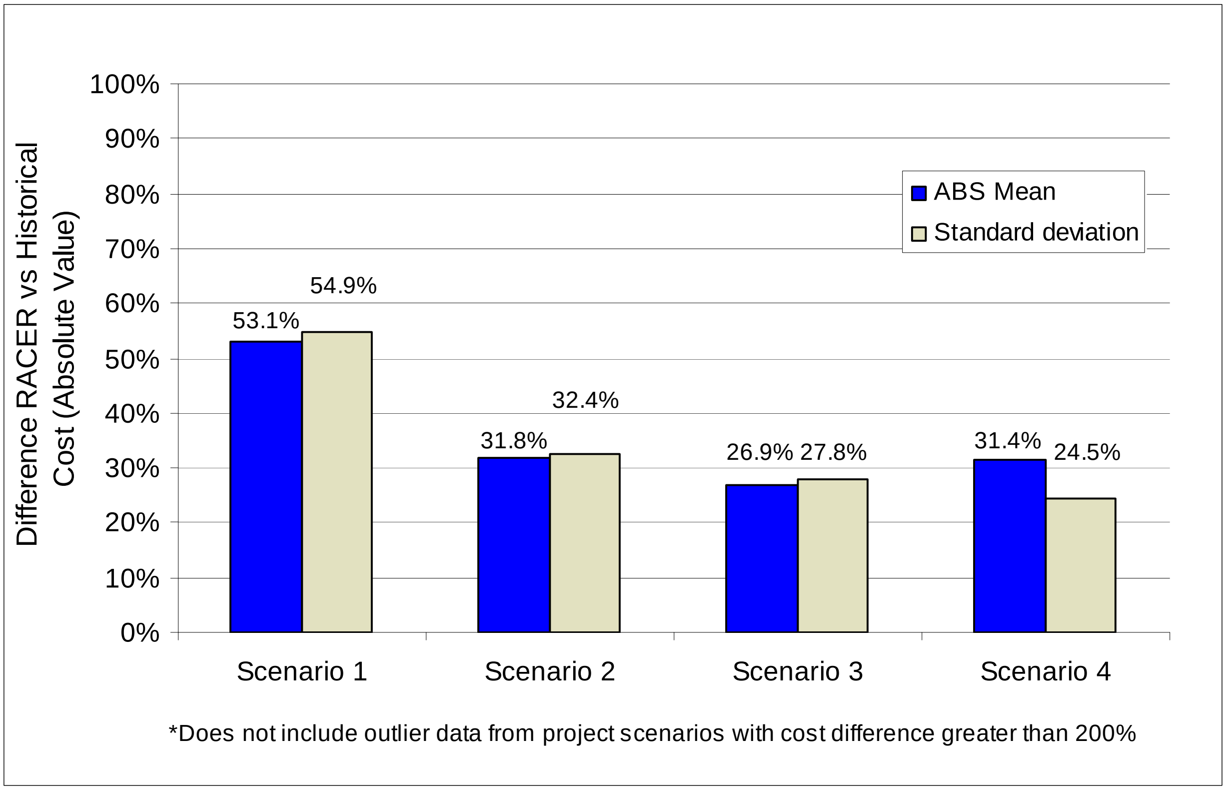

Figure 5 – Absolute Value of Mean Cost Difference in RACER Estimate and Historical Project Cost by Scenario, All Locations

Figure 5 shows that the absolute value of mean cost difference is much higher than the true mean cost difference presented in Figure 4 for each scenario. This is due to the exclusion of both positive and negative cost differences that tend to cancel each other out. However, the standard deviation is much lower for the absolute value of mean cost difference because the data dispersion considers only the positive side of the expected zero mean.

A scatter plot of the cost difference data points provides greater insight into how well RACER estimates cost in comparison with the historical project cost. In Figure 6, on the following page, the cost difference between the RACER-estimated cost and the corresponding actual historical project cost for Scenario 3 (the most detailed comparison) is shown. The percent cost difference in positive and negative terms for 86 projects are displayed. As shown in Figure 6, on the following page, the scatter plot begins to resemble the normal distribution with the true mean cost difference at approximately 0%. The difference in cost generally falls within the 50% cost differential range for most projects. Based on identified historical project cost data, there appears to be no clear trend whether RACER estimates are "low" or "high" for remediation projects, and that the data collected from the seven site visits resemble a normal distribution.

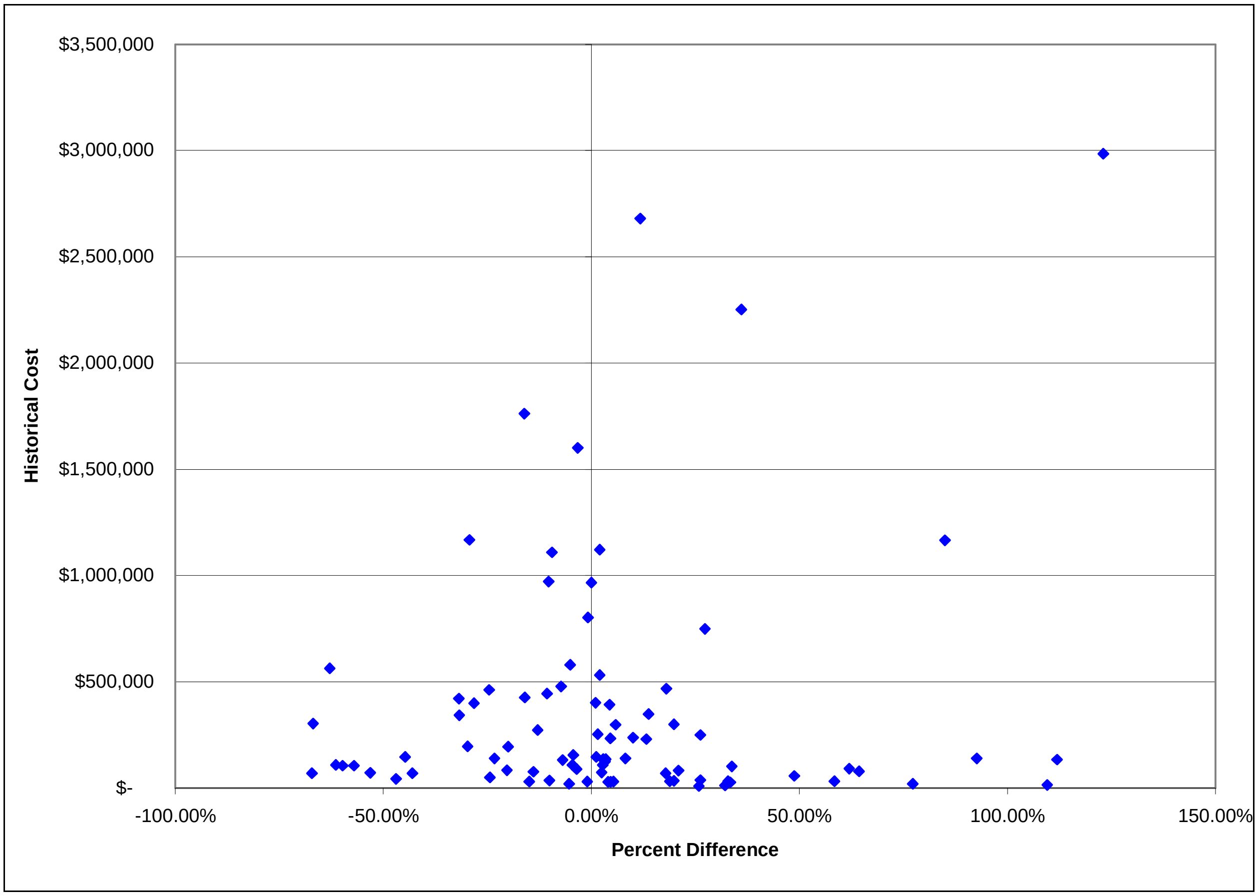

Figure 6 – Scatter Plot of Percent Cost Difference Between RACER Estimate and Historical Cost

Correlation Index

The next statistical measure pertains to the correlation of the RACER–estimated cost to the actual historical cost data. As shown in Table 10 below, the correlation of the RACER-estimated cost and actual historical cost data improves slightly from Scenarios 1 to 2. There is not, however, a marked change in correlation from Scenario 2 to Scenario 3 or the 96 City Average applied in Scenario 4 based on cumulative data from the four locations. These are high correlation values (approaching "1").

Correlation Coefficient Historical Marked-up Project Cost: RACER, All Locations	
Scenario 1	90%
Scenario 2	93%
Scenario 3	92%
Scenario 4	94%

Table 10 – Correlation of RACER Estimate to Historical Cost, by Scenario

Regression Analysis

The least-squares regression analysis result is presented in Figure 7.

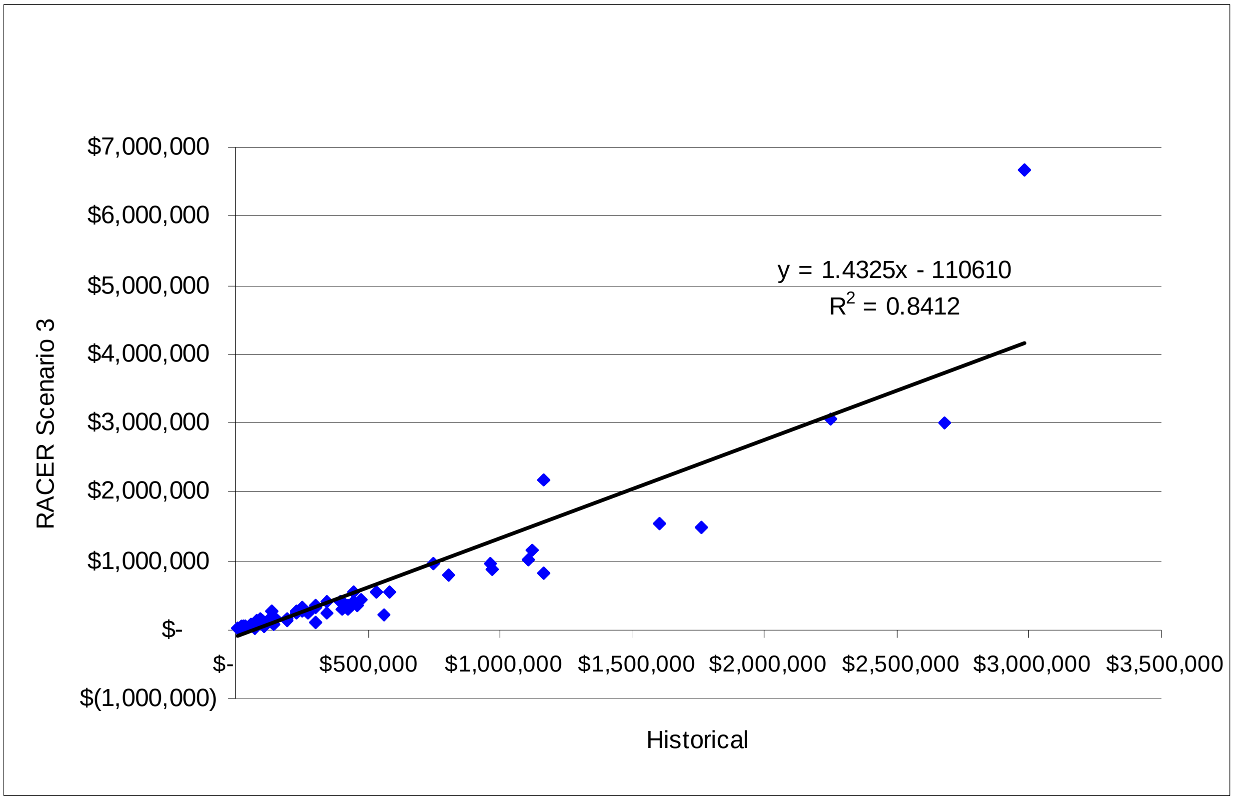

Figure 7 – Linear Regression Analysis Scatter Plot, Scenario 3, All Locations

The value of R^2 is most useful as a relative measure across similar data sets, and although a fit above 0.9 usually indicates a "good fit", this qualitative assessment varies significantly depending on the application. In this analysis, a fit of 0.84 still represents a good R^2 for Scenario 3.

The slope of the least-squares regression trend line (Scenario 3) is 1.4. A 1:1 slope (slope of 1.0) would describe a 45-degree line and indicate that the best fit trend (straight line) tracks consistently from low- to high-cost projects. The reported value of 1.4 is a good fit under Scenario 3.

Table 11, on the following page, presents conclusive narrowing of the "fit" from Scenario 1 to 2. The slopes of the best-fit lines move towards 1.0 from Scenario 1 to 2, slightly decreases from Scenario 2 to 3, then moves back towards 1.0 from Scenario 3 to 4 indicating that the RACER technology results' predictive capability improves from Scenario 1 to 2 and then from Scenario 3 to 4. There is not, however, a marked change in correlation from Scenarios 2 to 4.

R-Squared Historical Cost vs. RACER	
Scenario 1	80%
Scenario 2	86%
Scenario 3	84%
Scenario 4	88%

Table 11 – R² Results by Scenario (All Locations)

Low- Versus High–Cost Project Analysis

The team performed additional regression analyses, separating the 88 projects into two data sets: historical projects with a cost less than $500,000 and those with a cost greater than $500,000 (roughly splitting the total number of projects into two data sets).

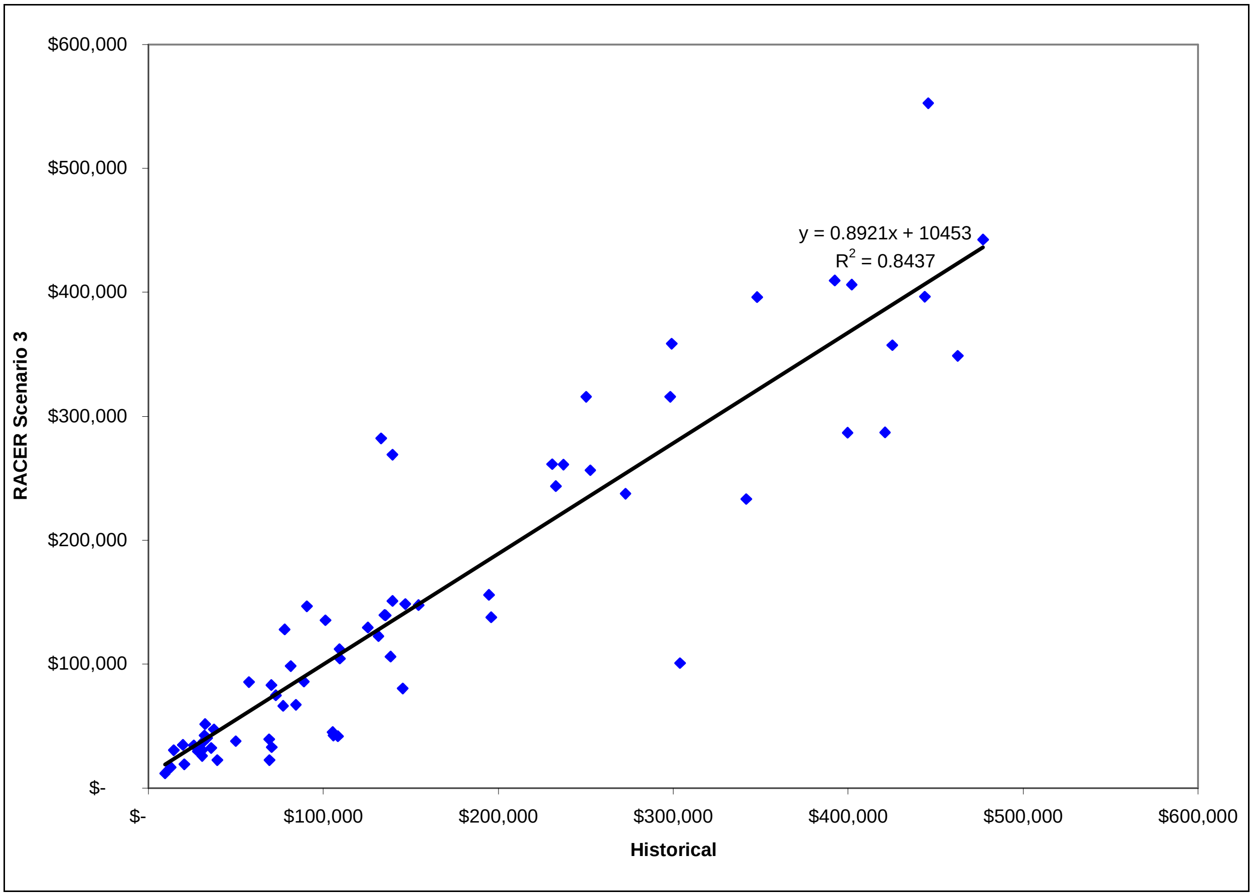

Figure 8 – Regression Analysis Scenario 3 Scatter Plot, Projects < $500,000 (historical cost), All Locations

Results of this analysis for locations 1-7, displayed in Figures 8 and 9, indicate that with this data set there are no significant statistical differences in the predictability of RACER for low- versus high-cost projects. The R^2 (0.84 for projects less than \$500K, 0.79 for projects greater than \$500K) indicates a slightly greater predictive power for the low-cost projects' regression, and the line slopes (0.89 for <\$500K, 1.86 for >\$500K) also indicate a slightly tighter fit (closer to 1:1) for the low-cost projects' regression model. Nonetheless, the analysis presents findings that indicate no comparative advantage to RACER project cost-estimating capability for either low- or high-cost (\$500K threshold) projects.

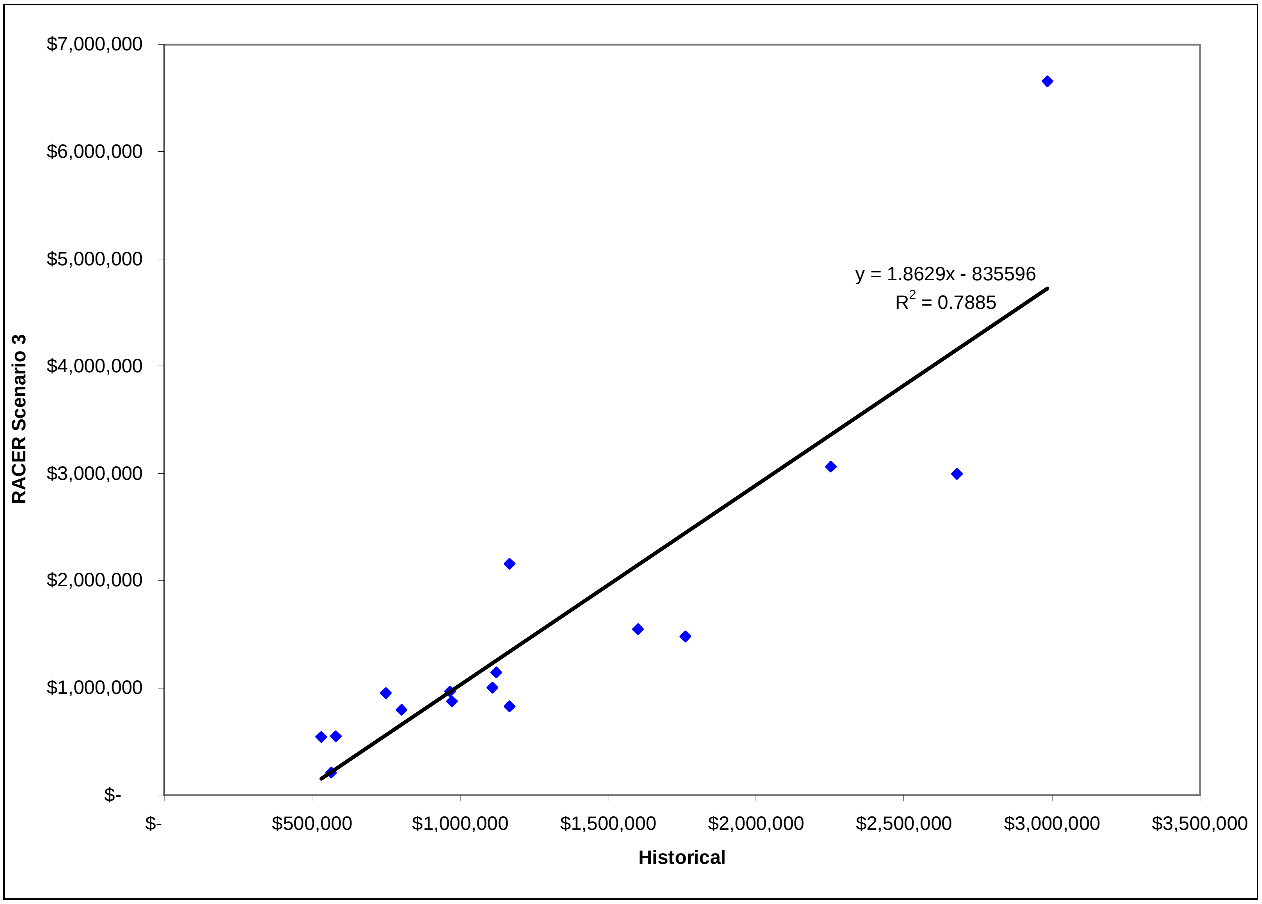

Figure 9 –Regression Analysis, Scenario 3, Projects > \$500,000 (historical cost), Locations 1-12

Comparative Analysis between the RACER 2008 software and benchmark 2004 RACER software

The collection of historical data for completed remediation projects in 2008 builds upon the previous 2004 RACER benchmark data. The additional data aids in evaluating and improving the RACER parametric model by allowing for comparative analysis between the re-engineered 2008 RACER software against the benchmark 2004 RACER software. Figure 10, below compares the historical data collected from seven site visits in 2008 with the benchmark historical data collected from the eleven site visits and internet data in 2004.

One way to compare the two versions of the RACER software data is to simultaneously evaluate the true mean and standard deviation for each software version by scenario. The true mean cost difference comparison provides insight on the overall effect (software-wide) between each version of the RACER software for multiple project estimates. A closer look at the dispersion (standard deviation) from the true mean cost difference also provides information on the expected range of outcomes for each version of the RACER-estimated costs relative to the actual historical costs.

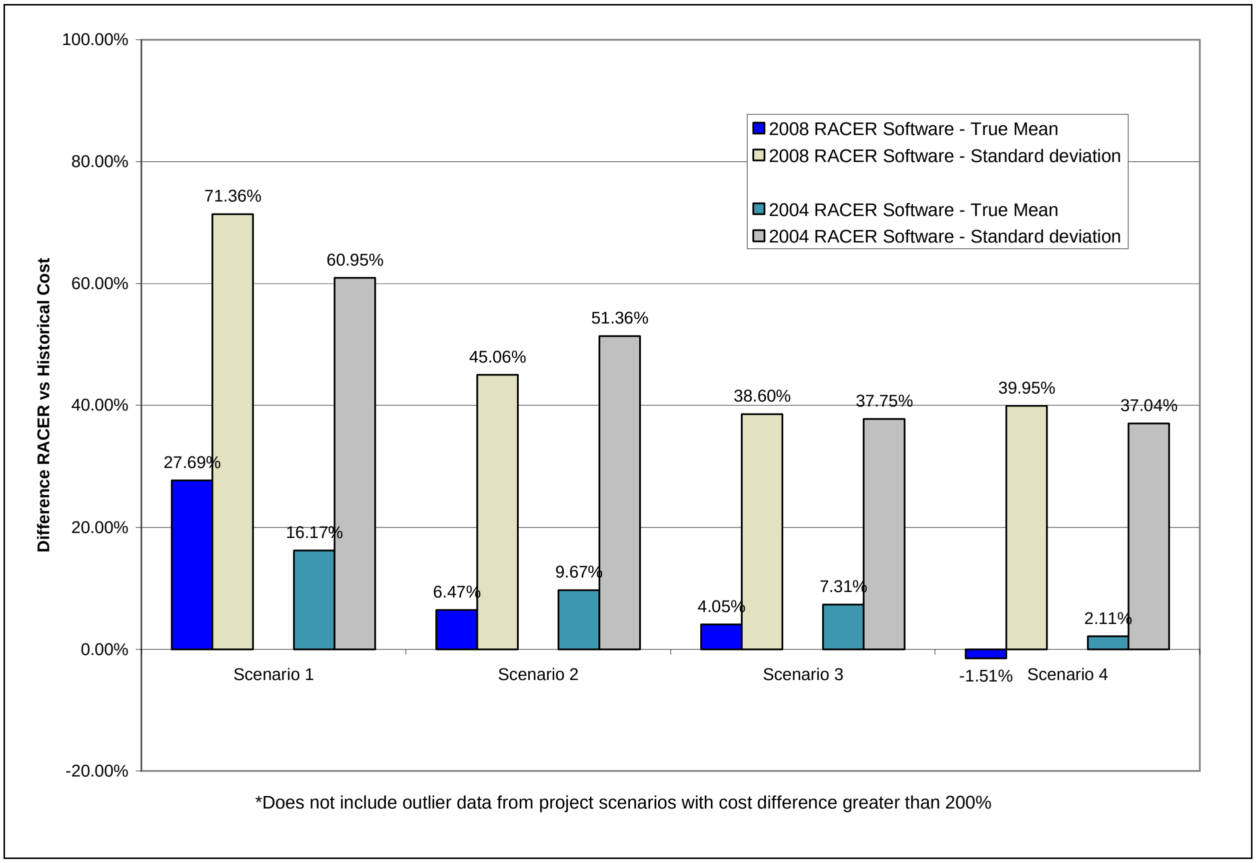

Figure 10: True Mean Cost Difference Comparison Between RACER 2008 Software and RACER 2004 Software by Scenario, All Locations

Figure 10 depicts summary results for both the RACER 2008 software version and 2004 RACER software version for all site locations, excluding outliers. The data show that RACER 2008 has a higher true mean and standard deviation than RACER 2004 for Scenario 1. However, the true mean cost difference for RACER 2008 is slightly lower than RACER 2004 for Scenarios 2 – 4. The standard deviation is similar between the RACER software versions for Scenarios 2 - 4. The standard deviations for Scenarios 1–4 in Figure 10, above, show relatively high levels of uncertainty in the accuracy and predictability of any given RACER estimate when compared to the actual historical project cost.

Summary of Project-level Statistical Analysis

Table 12, below, summarizes each of the five measures used to evaluate the difference between the RACER-estimated cost and the actual historical project costs by scenario. There is significant improvement from Scenario 1 to 2, and then a flattening out from Scenarios 2 through 4 for both the true mean and absolute value of mean cost difference, with the standard deviations decreasing in lockstep. The standard deviations for both the true mean and absolute value of mean cost difference show relatively high levels of uncertainty in the accuracy and predictability of any given RACER estimate when compared to the historical project cost. Both the correlation coefficient and R-Squared show there is high correlation between the RACER estimates and historical costs for all the scenarios. The R-squared measure presents conclusive narrowing of the fit from Scenario 1 to 2, but not a marked change in fit from Scenario 2 through 4.

Summary Results for RACER 2008 Software by Scenario				
	Scenario 1	Scenario 2	Scenario 3	Scenario 4
True Mean	28%	7%	4%	-2%
Absolute Mean	53%	32%	27%	31%
True Standard Deviation	71%	45%	39%	40%
Absolute Standard Deviation	55%	32%	28%	25%
Correlation Coefficient	90%	93%	92%	94%
R-Squared	80%	86%	84%	88%

Table 12 – Project-level Summary of Each Statistical Measure Results by Scenario for RACER 2008 Software (All Locations)

6.4 STATISTICAL COST ANALYSIS OF TECHNOLOGIES

This second subsection compares historical costs and RACER-estimated costs for 14 frequently-used technologies to evaluate the accuracy of these RACER technology models. This second prong of the three pronged analysis looks at the performance of some of the more frequently used technologies generally included in environmental restoration projects rather than looking at the entire project (collection of technologies). The technology and project level cost analyses work together to form the total cost analysis. Engineering analyses of the algorithms that make up the technology models follow this section to provide a more complete understanding of the current performance of RACER as well as provide suggestions on how to best update the software.

The approach developed for evaluating technologies in RACER was based on three major factors:

- Technologies most frequently used in DoD program experience;
- Most frequently occurring technologies within the historical project database; and
- Technologies that were re-engineered for RACER 2008.

In combination, these three factors effectively identified the most important technologies for evaluation. Forty technologies were applied as RACER technologies in the 88 historical projects. These 40 technologies were applied as RACER technologies in 425 instances. Table 7 in Section 4.1 of this document describes these technologies and frequency of use in RACER cost estimating during this project.

Due to data limitations at the technology-level,[24] sufficient data are available for only a subset (14 technologies) of these 40 technologies to make comparisons between RACER estimates and historical technology-level costs. This analysis of the subset of technologies measures the accuracy of RACER with more granularity than at the project-level. However, as described in Section 5.0 above, due to the limitations of the data collection and analysis process, data sets for the individual 14 technologies are small; therefore, only preliminary conclusions should be drawn from the technology-level cost analysis.

Figure 11, on the following page, depicts the Top 25 technologies encountered during the data collection effort for the 2008 validation project. This set of 25 RACER technologies represents those most frequently encountered within the 88 historical projects.

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24 *See Section 5.0 for a detailed discussion of project limitations.*

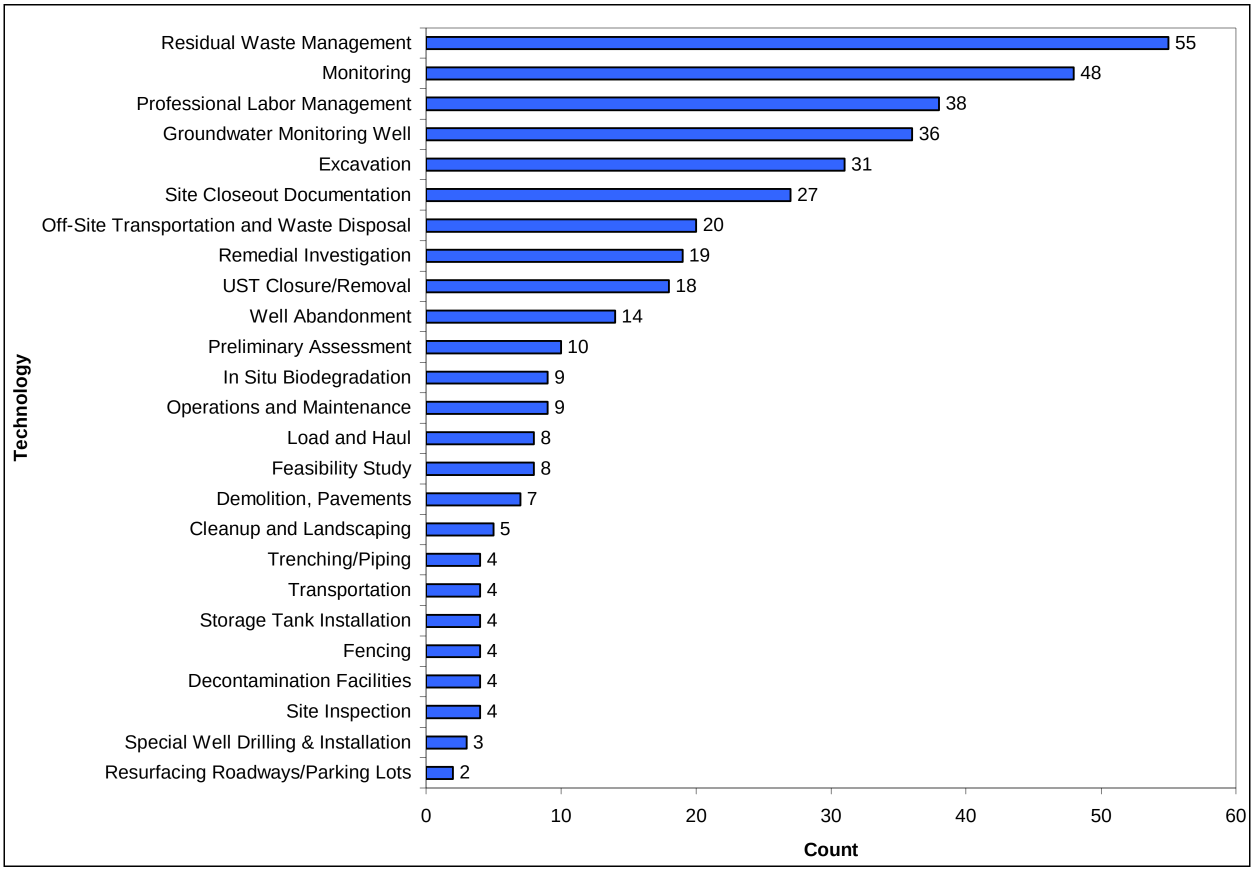

Figure 11 - "Top 25" Technologies Identified in Historical Projects

In an effort to develop a viable benchmark for comparison, the USAEC provided a list of the agency's most frequently used technologies based on their user community and program experience; this list is displayed in Figure 12, on the following page, along with their frequency of use in the 88 validation projects gathered for the 2008 validation project. A comparison of the technologies most frequently identified in the validation projects (as presented in Figure 11) with the USAEC list (as presented in Figure 12) provides credibility to the top 25 technologies identified during this analysis due to the overlap. The reader should note that 4 of the 25 most common technologies identified by USAEC are Munitions and Explosives of Concern (MEC) technologies (MEC Removal Action, MEC Monitoring, MEC Institutional Controls and MEC Site Characterization and Removal Assessment) that were not covered by this project, as a sufficient number of historical projects was not available. Therefore, those technologies are not included in Figure 12.

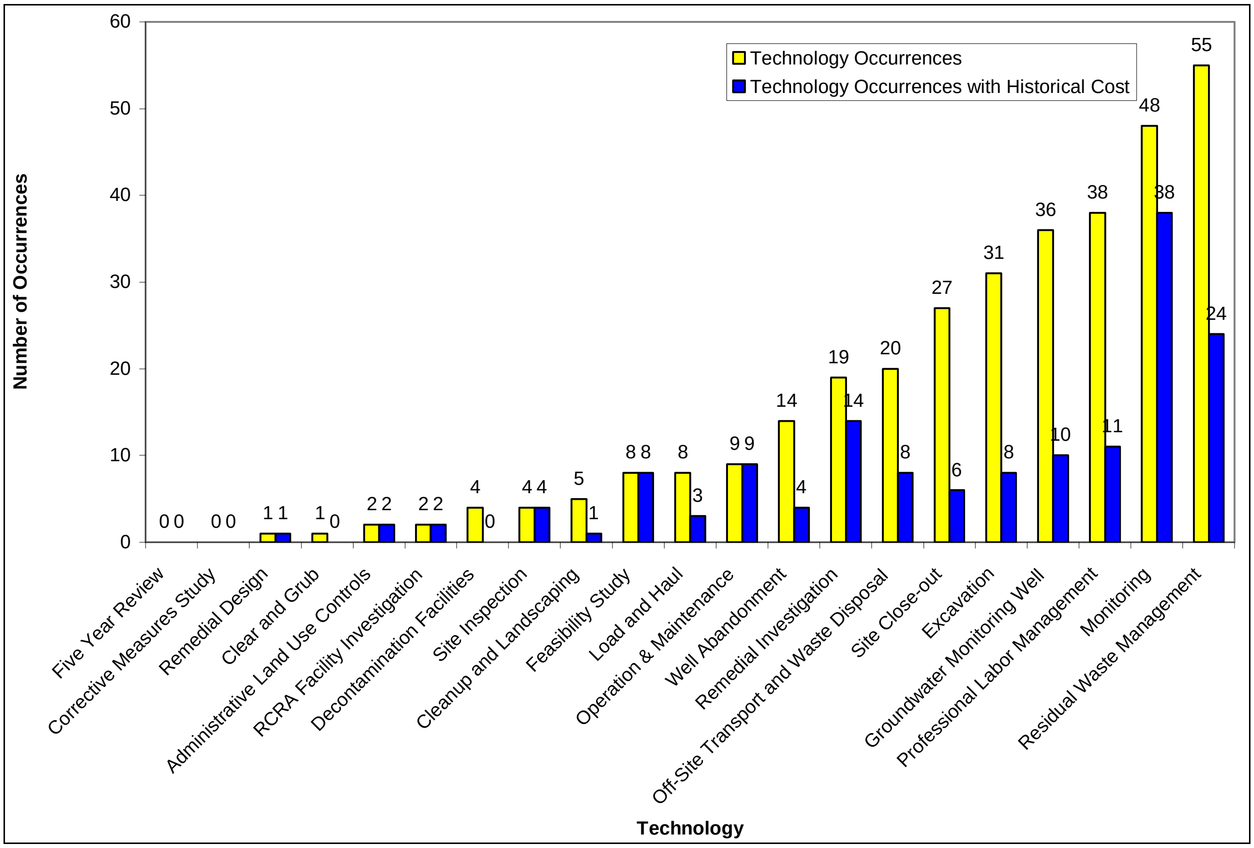

Figure 12 – The 21 Most Commonly Used Technologies by USAEC[25]

Analysis of Fourteen Most Frequently Occurring Technologies

This section evaluates the performance of a subset of the "Top 25" technologies most frequently occurring within the historical data set. The subset of the 14 most frequently occurring technologies was evaluated using the same statistical cost differentials presented in the project-level discussion under Section 6.1. This analysis provides a more specific cost differential evaluation between RACER-estimated cost and historical cost at the technology-level. This is especially relevant as the cost difference at the project-level is the result of multiple technologies being employed. The examination of the cost difference at the technology-level reveals how well specific and frequently used RACER technologies are performing in isolation.

Figures 13 – 16 depict the cost differentials of the 14 most frequently occurring technologies under each scenario. These technologies identify relative trends in cost performance. The technologies are arrayed from low to high frequency of identified historical cost occurrence per technology beginning with "Site Close-Out Documentation" and ending with "Monitoring." In addition to the 88 projects collected

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25 *"Technology Occurrences" counts the number of technologies identified in the historical projects that could be cross-walked into a RACER estimate. The technology occurrences with historical costs are the number of technologies identified in the historical projects for which specific technology costs could be isolated for comparison with the RACER estimate.*

as part of this effort, Booz Allen also utilized assessment data collected from the previous RACER 2004 software assessment to increase the number of RACER technology occurrences for this analysis. The 2004 technology-level assessment data were run through the 2008 RACER software following the same methodology described in Section 2.3.

Figure 13, below, depicts the 14 most frequently occurring technologies for Scenario 1. The true mean cost difference and standard deviation are shown for each technology.

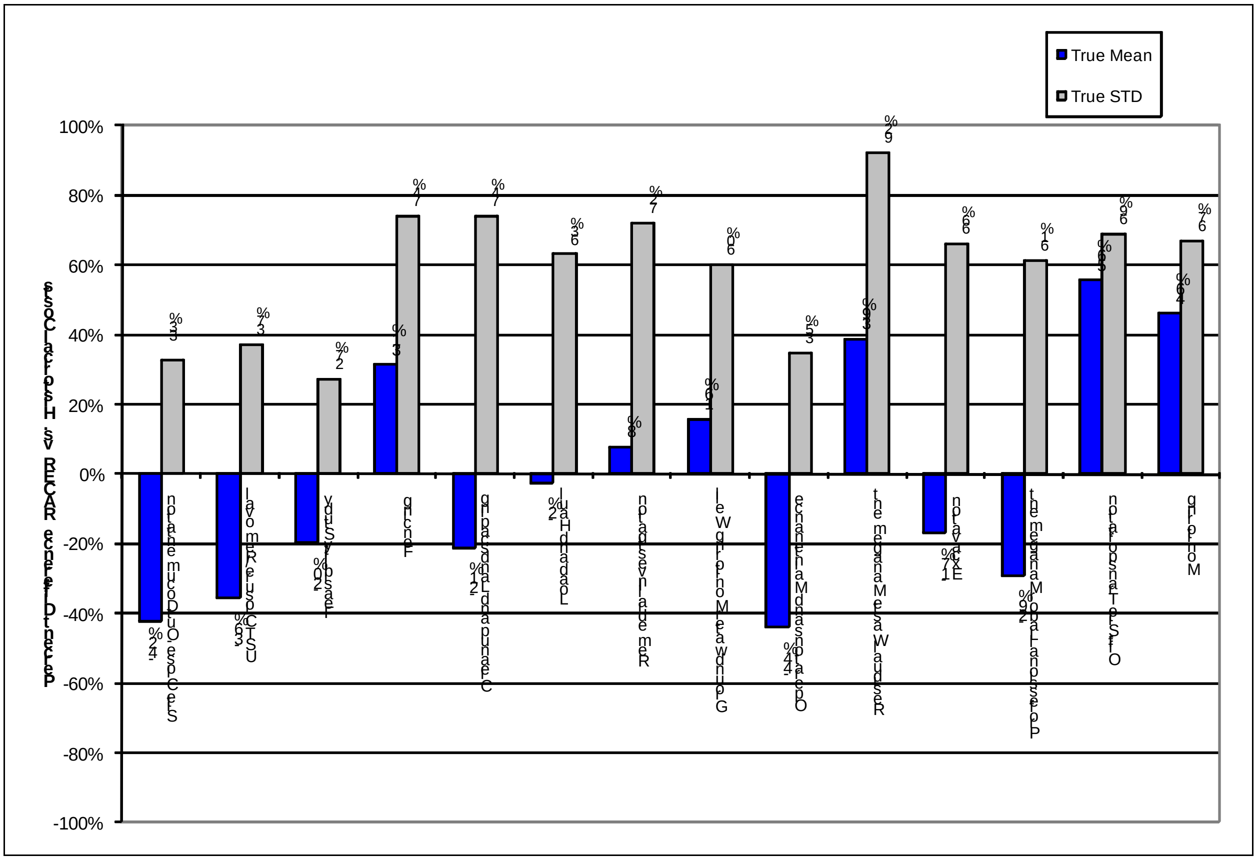

Figure 13 – Fourteen Most Frequently Occurring Technologies – Scenario 1 Percent Difference in Cost[26]

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26 *Scenario 1: Site Close-Out Documentation has 8 historical occurrences with no outliers.*
UST Closure/Removal has 11 historical occurrences, but 1 was omitted as an outlier.
Feasibility Study has 11 historical occurrences with no outliers.
Fencing has 13 historical occurrences, but 4 were omitted as outliers.
Cleanup and Landscaping has 14 historical occurrences, but 1 was omitted as an outlier.
Load and Haul has 16 historical occurrences with no outliers.
Remedial Investigation has 18 historical occurrences, but 2 were omitted as outliers.
Groundwater Monitoring Wells has 18 historical occurrences with no outliers.
Operations and Maintenance has 22 historical occurrences, but 1 was omitted as an outlier.
Residual Waste Management has 26 historical occurrences, but 4 were omitted as outliers.
Excavation has 39 historical occurrences, but 3 were omitted as outliers.
Professional Labor Management has 42 historical occurrences, but 2 were omitted as outliers.
Off-Site Transportation and Waste Disposal has 47 historical occurrences, but 5 were omitted as outliers.
Monitoring has 68 historical occurrences, but 20 were omitted as outliers.

Figure 14, below, depicts the 14 most frequently occurring technologies for Scenario 2. The true mean cost difference and standard deviation are shown for each technology. With the modification of secondary parameters in Scenario 1, the mean difference in cost is reduced compared to Scenario 1. The standard deviation is also improved for the technologies with higher numbers of occurrences. Monitoring, the technology with the highest number of occurrences, has similar means and standard deviations for both Scenarios 1 and 2. However, eight occurrences were omitted as outliers in Scenario 2 while yielding similar results to Scenario 1.

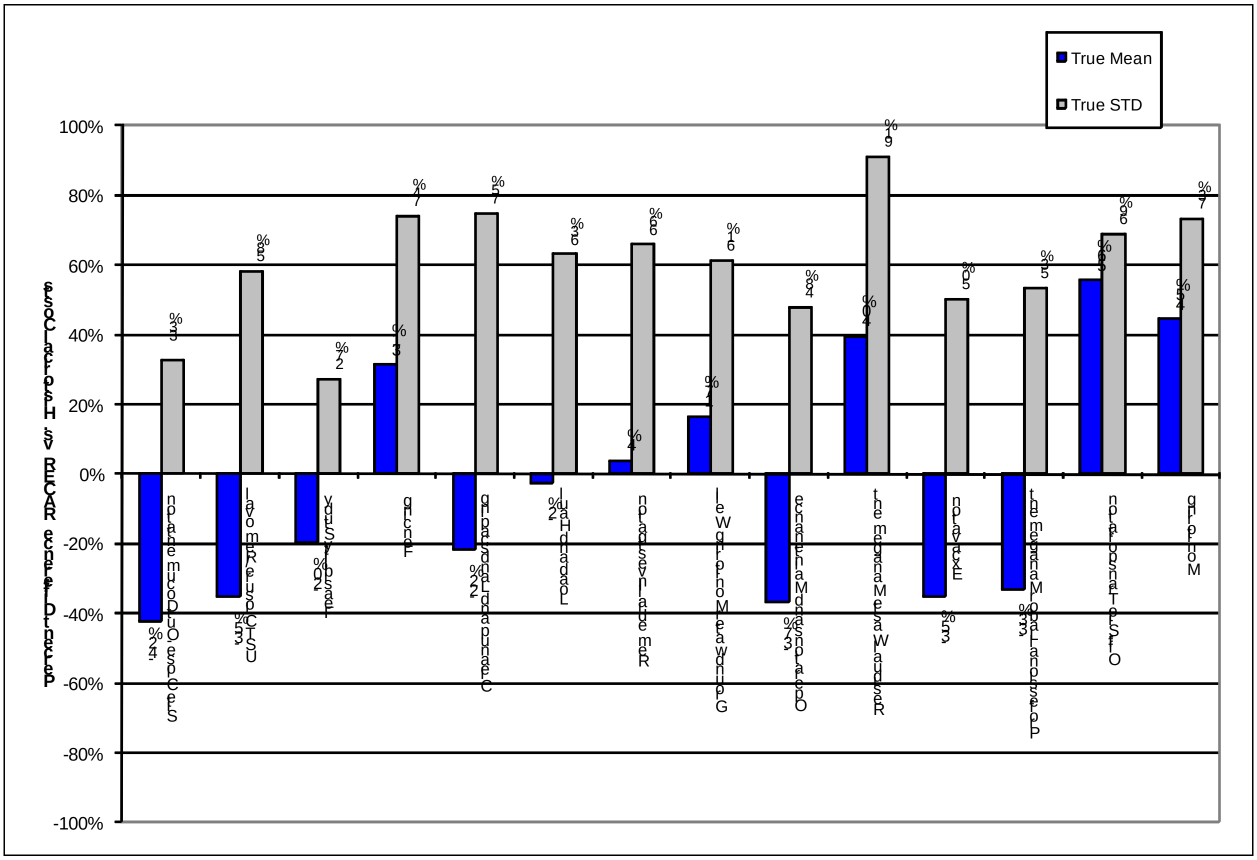

Figure 14 – Fourteen Most Frequently Occurring Technologies – Scenario 2 Percent Difference in Cost[27]

[27] *Scenario 2: Site Close-Out Documentation has 8 historical occurrences with no outliers.*
UST Closure/Removal has 11 historical occurrences, but 1 was omitted as an outlier.
Feasibility Study has 11 historical occurrences with no outliers.
Fencing has 13 historical occurrences, but 4 were omitted as outliers.
Cleanup and Landscaping has 14 historical occurrences, but 1 was omitted as an outlier.
Load and Haul has 16 historical occurrences with no outliers.
Remedial Investigation has 18 historical occurrences, but 2 were omitted as outliers.
Groundwater Monitoring Wells has 18 historical occurrences with no outliers.
Operations and Maintenance has 22 historical occurrences, but 1 was omitted as an outlier.
Residual Waste Management has 26 historical occurrences, but 5 were omitted as outliers.
Excavation has 39 historical occurrences, but 2 were omitted as outliers.
Professional Labor Management has 42 historical occurrences, but 2 were omitted as outliers.
Off-site Transportation and Waste Disposal has 47 historical occurrences, but 5 were omitted as outliers.
Monitoring has 68 historical occurrences, but 12 were omitted as outliers.

Figure 15, below, depicts the 14 most frequently occurring technologies for Scenario 3. The true mean cost difference and standard deviation are shown for each technology. The mean difference in cost is more consistently shown to fall within the 25–50% category with the user's ability to specifically modify parameters and technology assemblies.

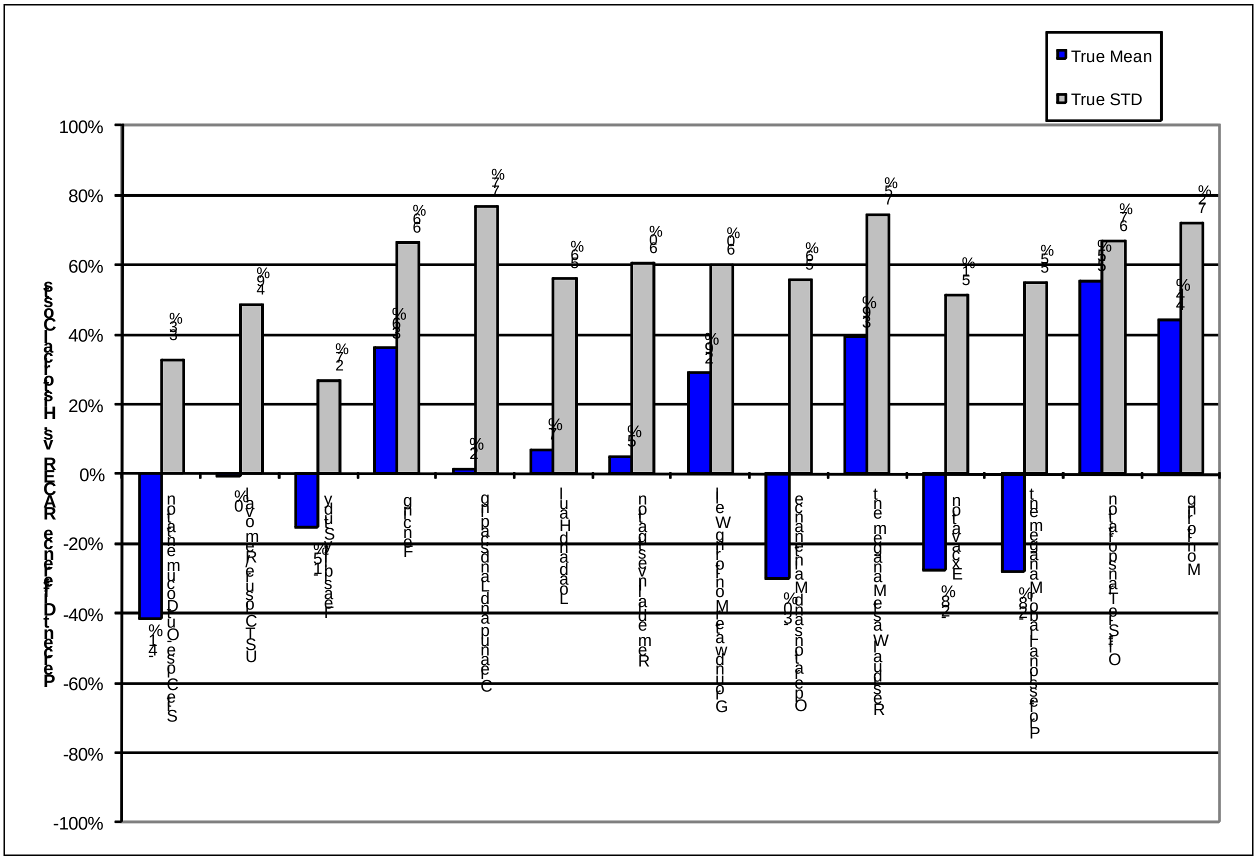

Figure 15 – Fourteen Most Frequently Occurring Technologies – Scenario 3 Mean Difference in Cost[28]

Figure 16, on the following page, depicts the 14 most frequently occurring technologies for Scenario 4. The true mean cost difference and standard deviation are shown for

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[28] *Scenario 3: Site Close-Out Documentation has 8 historical occurrences with no outliers.*
UST Closure/Removal has 11 historical occurrences, but 1 was omitted as an outlier.
Feasibility Study has 11 historical occurrences with no outliers.
Fencing has 13 historical occurrences, but 3 were omitted as outliers.
Cleanup and Landscaping has 14 historical occurrences with no outliers.
Load and Haul has 16 historical occurrences with no outliers.
Remedial Investigation has 18 historical occurrences, but 2 were omitted as outliers.
Groundwater Monitoring Wells has 18 historical occurrences with no outliers.
Operations and Maintenance has 22 historical occurrences, but 1 was omitted as an outlier.
Residual Waste Management has 26 historical occurrences, but 2 were omitted as outliers.
Excavation has 39 historical occurrences, but 1 was omitted as an outlier.
Professional Labor Management has 42 historical occurrences, but 2 were omitted as outliers.
Off-Site Transportation and Waste Disposal has 47 historical occurrences, but 5 were omitted as outliers.
Monitoring has 68 historical occurrences, but 13 were omitted as outliers.

each technology. Consistent with the analysis of Scenario 4 at the project-level in Section 6.1, it does not appear that a considerable difference in the accuracy of estimates is occurring with the use of either area cost factors (Scenario 3) or the 96-City Average (Scenario 4).

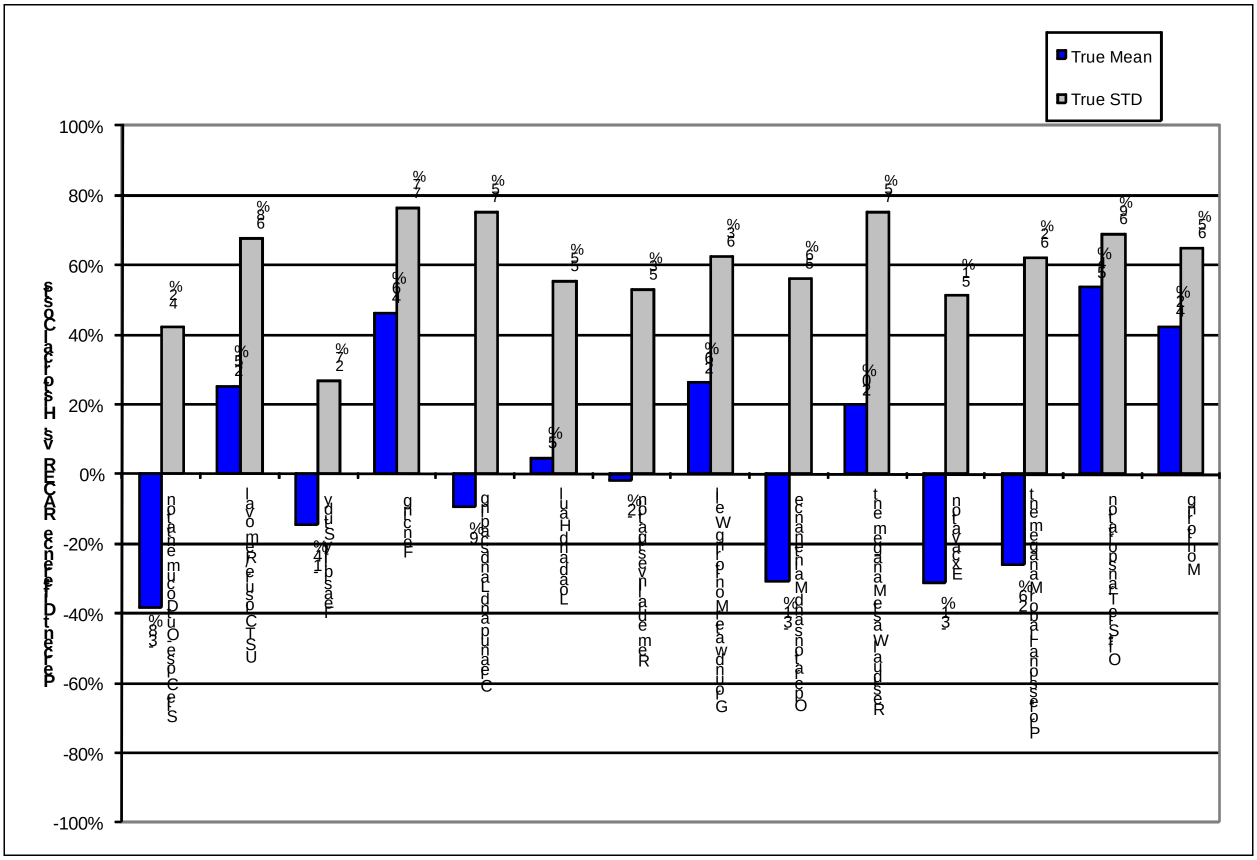

Figure 16 – Fourteen Most Frequently Occurring Technologies – Scenario 4 Mean Difference in Cost[29]

[29] ***Scenario 4:*** *Site Close-Out Documentation has 8 historical occurrences with no outliers.*
UST Closure/Removal has 11 historical occurrences with no outliers.
Feasibility Study has 11 historical occurrences with no outliers.
Fencing has 13 historical occurrences, but 2 were omitted as outliers.
Cleanup and Landscaping has 14 historical occurrences, but 1 was omitted as an outlier.
Load and Haul has 16 historical occurrences with no outliers.
Remedial Investigation has 18 historical occurrences, but 2 were omitted as outliers.
Groundwater Monitoring Wells has 18 historical occurrences with no outliers.
Operations and Maintenance has 22 historical occurrences, but 1 was omitted as an outlier.
Residual Waste Management has 26 historical occurrences, but 2 were omitted as outliers.
Excavation has 39 historical occurrences, but 1 was omitted as an outlier.
Professional Labor Management has 42 historical occurrences, but 1 was omitted as an outlier.
Off-Site Transportation and Waste Disposal has 47 historical occurrences, but 5 were omitted as outliers.
Monitoring has 68 historical occurrences, but 12 were omitted as outliers.

Comparative Technology Analysis between the RACER 2008 software and benchmark 2004 RACER software

This section evaluates the performance of the "Top 10" technologies that most frequently occurred within the 2004 benchmark historical cost dataset. This subset of the 10 most frequently occurring technologies is evaluated using the same statistical cost differentials presented in the project-level discussion under Section 6.1.

This analysis provides more specific cost differential evaluation between RACER estimates and historical cost at the technology-level. Furthermore the analysis provides a comparison of the RACER 2008 software against the benchmark RACER 2004 software. This is especially relevant for analyzing changes in the estimation performance of the re-engineered RACER 2008 software. The examination of the cost difference at the technology-level reveals how well specific and frequently-used RACER 2008 technologies are performing.

For this comparison, benchmark 2004 historical technologies costs were re-estimated using the RACER 2008 software.[30] Only true mean and standard deviation technology cost differences that were not omitted as outliers and were able to be estimated by both the RACER 2008 software and the benchmark RACER 2004 software were utilized in the analysis.

Figure 17, on the following page, depicts a comparison between the RACER 2008 software and RACER 2004 software by cost differentials of the most frequently occurring technologies under Scenario 2. These technologies identify change in estimation performance with the re-engineered RACER 2008 software. The technologies are arrayed from low to high frequency of historical cost occurrences per technology beginning with "Capping" and ending with "Professional Labor Management."

[30] *See Section 2.2 of this document for a detailed discussion of the re-estimation / upgrade process.*

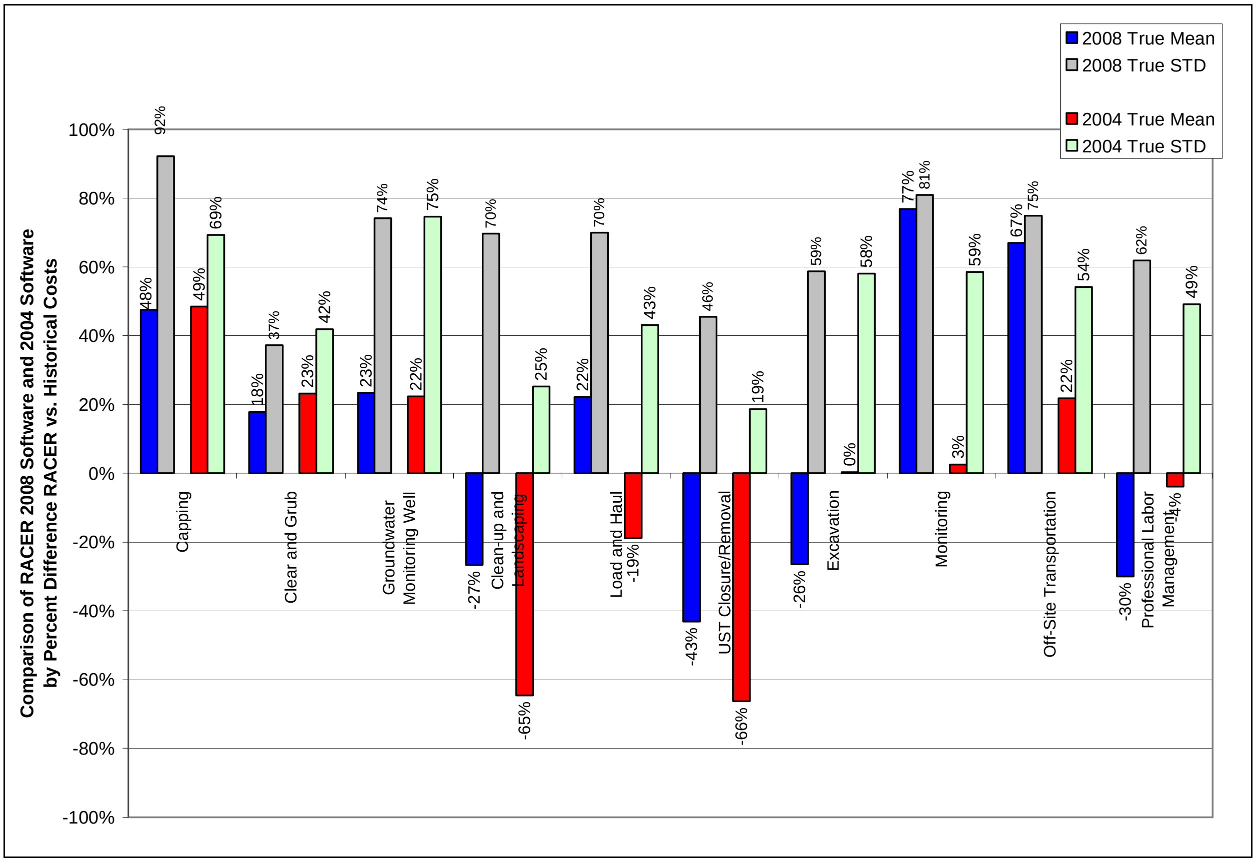

Figure 17 – Comparison of RACER 2008 Software and RACER 2004 Software by Top Ten Technology Occurrences

Four of these technologies, including Capping, Clear and Grub, Cleanup and Landscaping, UST Closure/Removal, have a lower percentage difference in RACER 2008 than in RACER 2004, indicating improved performance. Six of these technologies have a higher percentage difference in RACER 2008 than in RACER 2004. These are Groundwater Monitoring Well, Load and Haul, Excavation, Monitoring, Off-Site Transportation and Waste Disposal, and Professional Labor Management. A discussion of the possible reasons for this greater difference follows below; these issues are discussed in detail in Section 6.3.

Monitoring

The following issues may play a large role in why the RACER 2008 Monitoring technology shows a greater deviation from historical costs than in 2004.

1. Travel (incorrectly calculating travel to and from the site for each day of sampling)
2. Plans and Reports (overestimation of costs, particularly at the comprehensive selection)
3. Purge water calculations (calculating purge water volumes from ground surface to average sample depth).

Off-Site Transportation and Waste Disposal (Off-Site T&D)

The prominent issue with the Off-Site T&D technology appears to be that the technology separately accounts for loading, transport, analysis, and disposal of waste (via separate assemblies). Project documentation reviewed as part of this project indicates that most often waste disposal costs are charged as a lump sum cost (all inclusive cost for pickup, transport, and disposal). In most instances the RACER-estimated cost was elevated relative to the actual cost, indicating the combination of assemblies employed in this technology are overstating the typical costs for these services. A second, smaller issue is utilizing hazardous waste assemblies for waste transport, where non-hazardous assemblies should be used.[31] The use of the correct non-hazardous assemblies should result in a more accurate estimation of actual costs. This issue was also identified in the 2004 report.

Load and Haul

Although the percent cost difference between RACER 2004 and RACER 2008 is 41%, Load and Haul now shows a positive deviation (22%) from historical costs where it showed a moderate negative deviation (-19%) in RACER 2004. Of the three assemblies utilized in this technology, one is calculated by user input (*17020401, Dump Charge*); therefore, the discrepancy is either in the number of hours calculated for equipment use (e.g., wheel loader) or the number of hours calculated for the travel distance to the dump site (e.g., dump truck or semi-dump).

Excavation

The Excavation technology exhibits a negative deviation from historical project costs. We have identified several requirements not found in RACER that are common to excavation projects: mobilization, per diem, and surveying. A discussion of each of these is found in Section 6.3 below. This issue was not identified in the 2004 report.

Professional Labor Management (PLM)

Since PLM is calculated in RACER via a default percentage, the reason for the deviation of PLM from the historical project costs must lie in the calculation of this percentage or the technologies which are included in the total "Marked Up Construction Cost" calculation.

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31 *Two examples of this issue are when non-hazardous, bulk solid waste is selected, the assembly is "33190205 Transport Bulk Solid Hazardous Waste, Maximum 20 CY (per Mile)"; and when non-hazardous liquid waste in drums is selected, the assembly is "33190204 Transport 55 Gallon Drums of Hazardous Waste, Max 80 drums (per Mile)".*

6.5 TECHNOLOGY ENGINEERING ANALYSIS

The last prong of the three pronged analysis is the engineering analysis. The combination of the project-level cost analysis, technology-level cost analysis, and technology engineering analysis form the total analysis of the RACER software performed as part of the software validation. This three pronged approach helps to compensate for data and analytic limitations, previously mentioned in Sections 5 and 6, that each analytical approach has when used separately.

This section discusses the engineering analysis of the RACER technologies as it pertains to the list of projects deconstructed for all seven site locations. As part of the critical review of the RACER program, technologies, assemblies, and unit costs were analyzed to determine if they reflect best practices in environmental restoration. The assemblies were reviewed to see if they need to be changed or updated, if default parameters need to be changed, and to identify if new technologies need to be developed. This section will assist the Government in gaining a better understanding of the current performance of RACER as well as provide suggestions on how to best update the program.

The following observations were gathered during the deconstruction and development of the four RACER scenarios for the 88 selected projects used for comparison against the historical project costs. As part of the analysis, the technologies were reviewed for Cost Reasonableness, Current Technology Methodology, and General Technology Functionality. The complete list of RACER observations and recommendations is presented in Appendix D.

The RACER software is based on engineering logic for environmental restoration treatment trains. Because environmental technologies are continuously evolving, the RACER software must be periodically assessed and updated as well. As a result, it is necessary that ongoing annual RACER training be provided for estimators to maintain their proficiency in and knowledge of the software.

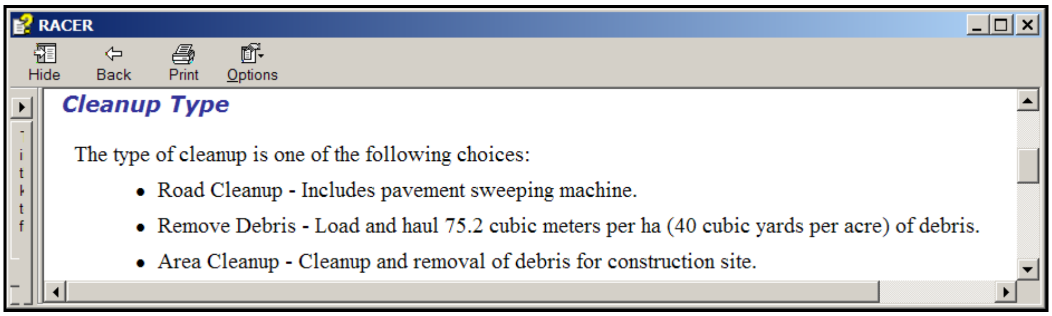
<u>Suggested Improvements to the Most Frequently Observed Technologies</u>

A detailed analysis was performed on the “Top 14” technologies to identify deficiencies and suggest improvements to each. The results of this analysis are presented below for the following technologies (listed alphabetically): Cleanup and Landscaping, Excavation, Feasibility Study, Fencing, Groundwater Monitoring Well, Load and Haul, Monitoring, Off-Site Transportation and Waste Disposal, Operations and Maintenance, Professional Labor Management, Remedial Investigation, Residual Waste Management, Site Close-Out Documentation, and Underground Storage Tank Closure/Removal. In addition, a discussion on Well Abandonment is included, as it is a new technology to the RACER 2008 software.

Technology #1: Cleanup & Landscaping

The Cleanup & Landscaping technology was observed five times throughout the seven location visits; only one instance was available for comparison at the technology-level. Combined with technology-level data from the 2004 effort, there are a total of 14 instances of the technology that can be compared at the technology level. The most frequent observations and suggested solutions are listed below.

- Issue: There is not sufficient information in the Help Topic to determine the difference between the options for "Remove Debris" and "Area Cleanup."



- Recommended Solution: To aid the user in selecting the option most appropriate to their estimate, revise the description of the options for "Remove Debris" and "Area Cleanup" so that the difference between the options is clear.
- Issue: Each selection for cleanup type (Road Cleanup, Remove Debris, and Area Cleanup) has only one assembly item associated with it. Unlike other RACER technologies, there are not different assemblies based on material volumes, hauling distances, and other parameters which affect project cost.
  - 17040102 *Pavement Sweeping, Machine*, for Road Cleanup, at a cost of $0.04/SY
  - 17040103 *Load & Haul Debris, 5 Miles, Dumptruck*, for Remove Debris, at a cost of $7.46/CY
  - 17040101 *Cleaning Up, site debris clean up and removal*, for Area Cleanup, at a cost of $624.14/ACR
- Recommended Solution: Review algorithm to ensure the equipment assemblies used in the technology are appropriate for all possible combinations of parameter inputs.

Technology #2: Excavation

The excavation technology (EXC) was observed 39 times throughout the seven location visits; seven instances were able to be compared at the technology level. Combined with technology-level data from the 2004 effort, there are a total of 38 instances of EXC available for technology-level analysis. The most frequent observations and suggested solutions are listed below.

- Issue: The backfill hauling distance is limited to 20 miles. RACER should allow longer distances for the transportation of backfill to the site. While this applies especially to remote sites, it may impact major CONUS installations as well.
- Recommended Solution: Increase the maximum valid range to match that of hauling distances used throughout the RACER system. These should be consistent throughout.

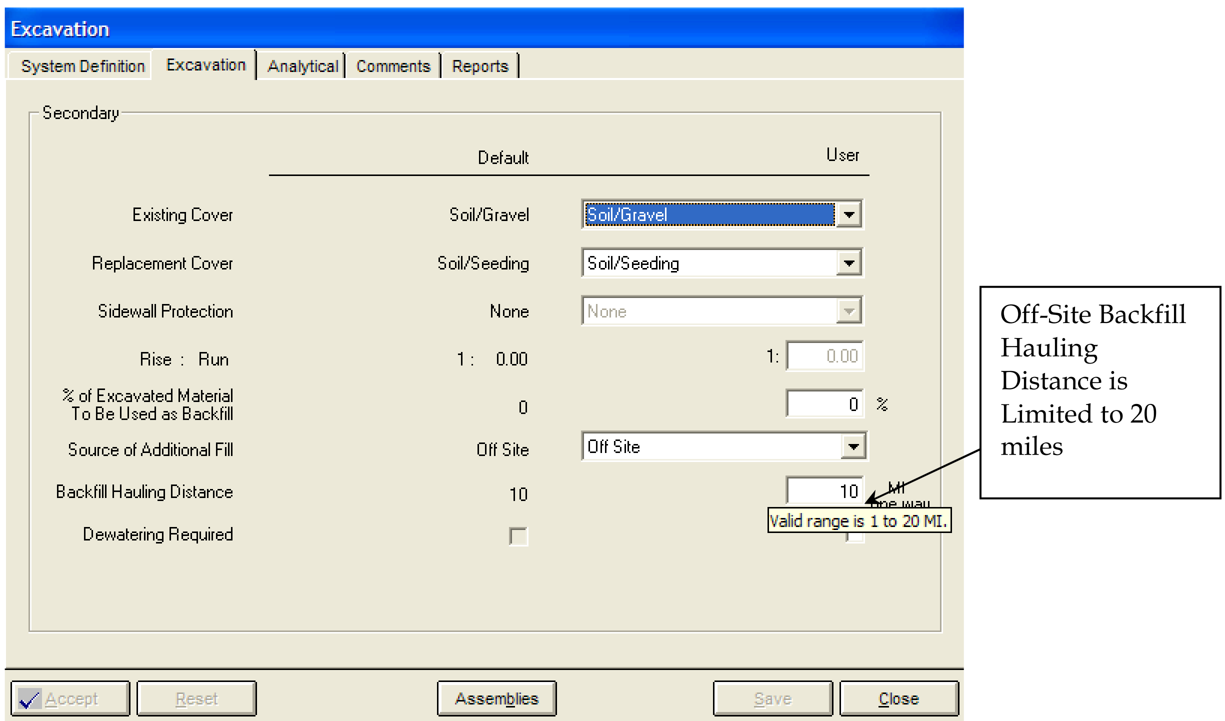


Figure 18

- Issue: Several Alaska District projects involved transporting workers and material to and from the site via helicopter. There are no options available for selecting different modes of transporting excavated materials or fill. Trucks are assumed.
- Recommended Solution: Provide a "remote" option to better estimate projects in remote locations. When selected, other options or combinations of options would be available for selection (similar to the list provided under Residual Waste Management but revised to include helicopter usage).

- Issue: The technology cannot account for surveying requirements.
- Recommended Solution: Create a surveying mini-model to address surveying requirements identified in several RACER technologies (e.g., Excavation, Groundwater Monitoring Well, MEC Site Characterization, Monitoring, Remedial Investigation).

- Issue: The technology cannot account for travel requirements/per diem.
- Recommended Solution: Provide a per diem option in the technology. The per diem duration could be defaulted based on the excavation duration calculation; number of travelers could be based on the quantities of labor categories.

- Issue: The assembly for a scraper ("22 CY Scraper by BCY") is brought in for situations that normally would not require a scraper but, rather, an excavator. RACER selects the scraper based on excavation volume (between 13,000 and 999,999 BCY), width of excavation (greater than 15 feet), and whether dewatering is required (no dewatering required). Use of a scraper is based on excavation depth, and the RACER calculation should reflect that.

  In addition, using width as a part of the calculation presents an issue. For area/depth and volume/depth methods, width is calculated by RACER by using the square root of the excavation footprint (this method assumes the excavated area is a square). However, for the length/width/depth method, RACER uses the user input values for length and width. The RACER scenario in Table 13, on the following page, illustrates this issue. Both input combinations result in the same excavation volume; however, combination 1 results in the use of a scraper whereas combination 2 results in an excavator for the exact same excavation volume. (It is also worth noting that using the appropriate conversions for the volume/depth and area/depth methods results in the use of the scraper assembly.) The resulting cost difference between the two input combinations is $31,684.68, or 51%.

Input Combination 1	Input Combination 2
User Input Values	**User Input Values**
Length 14 ft	Length 10,000 ft
Width 10,000 ft	Width 14 ft
Depth 4 ft	Depth 4 ft
RACER Assembly-Level Output	**RACER Assembly-Level Output**

Input Combination 1:

Assembly Number	Description	QTY	UOM	Extended Cost
17030242	22 CY Scraper by BCY	20741	BCY	$62,633.14

Input Combination 2:

Assembly Number	Description	QTY	UOM	Extended Cost
17030278	Excavate and load, bank measure, medium material, 3-1/2 C.Y. bucket, hydraulic excavator	20741	BCY	$30,948.46

Note: comparison assumes all other input parameters are set equally; assembly costs calculated using US 96-city average. All other assembly outputs are the same, except the assembly listed.

Table 13 – Assembly-level discrepancy in excavation equipment.

- Recommended Solution: Reevaluate equipment algorithms so that the use of the scraper is based on the volume and depth of the excavation, not the volume and width. Further, for any algorithms based on excavation width, it is recommended that the approach to user-input width values for non-square excavation footprints be re-evaluated to avoid discrepancies as shown above in Table 10.

- Issue: Volume of dewatering passed to Residual Waste Management (WMS) is incorrect for small excavation volumes. The quantity of dewatering passed to WMS is 4800 gallons for several scenarios of small-volume excavations. The algorithm is based on soil type and equipment duration, but equipment durations are stepped values in RACER, not linear calculations. This approach is not inappropriate for equipment duration, but results in highly inflated values for several dewatering scenarios.
- Recommended Solution: Revise algorithm so that the calculated volume of dewatering liquid passed to Residual Waste Management more closely matches the amount of water at the base of the excavated area.

- Issue: Mobilization/Demobilization costs are not included in the technology. The Help Topic for Field Office Overhead/G&A states:

  > *"Field Office Overhead/G&A costs in RACER include all indirect costs to the general contractor(s) performing the construction work; including job overhead costs associated with field-related tasks that are required to execute a contract, as well as non project-specific costs that are required to support labor and general operations of the general contractors' business. Field Office Overhead/G&A costs may include the items listed above, as well as the following job-related overhead items:*
  >
  > - *Taxes;*
  > - *Project-specific insurance;*
  > - *Bonds;*
  > - *Permits and licenses;*
  > - *General supervision;*
  > - *Temporary office personnel;*
  > - *Schedules;*
  > - *Preparatory work and testing services;*
  > - *Temporary project facilities;*
  > - *Temporary utilities (e.g. phone, electrical);*
  > - *Operations and maintenance of temporary project-site facilities;*
  > - *Project vehicles;*
  > - *Personal protective equipment and Occupational Health and Safety (OSHA) requirements;*
  > - *Quality controls;*
  > - *Mobilization and demobilization; and*
  > - *Site security."*

  It is unclear whether these costs are accounted for in the EXC technology since several other technologies do include mobilization/demobilization assemblies.

- Recommended Solution: Reevaluate mobilization/demobilization costs in the EXC technology as well as throughout the RACER system. Ensure mobilization/demobilization costs are accounted for consistently and accurately; revise Help Topics accordingly.

Technology #3: Feasibility Study

Throughout the seven location visits, this technology had two observations called out in Appendix D. Feasibility Study was observed eight times, and each of the eight instances was able to be compared at the technology level. Combined with data from 2004, there are 11 instances of the Feasibility Study technology available for technology-level comparison. The most frequent observations and suggested solutions are listed below.

Treatability Study Tab (Figure 19, on the following page)

- Issue: RACER only provides a default cost for bench-scale and pilot-scale treatability studies (TS) without modifiers that could increase or decrease the default costs. It might be more accurate not to use the TS option but to cost out all TS tasks individually using applicable technologies.

- Recommended Solution: Compile average actual costs for various types of bench-scale treatability tests and pilot-scale tests from various environmental projects. RACER would then provide options for selecting the types of tests such as chemical in-situ tests. The cost estimate would be determined by RACER by multiplying the average actual costs with a multiplier determined from the site complexity and level of study chosen by the user in the System Definition tab. The option for the user to input a cost can be provided by including a "user-defined" option in the types of tests option.

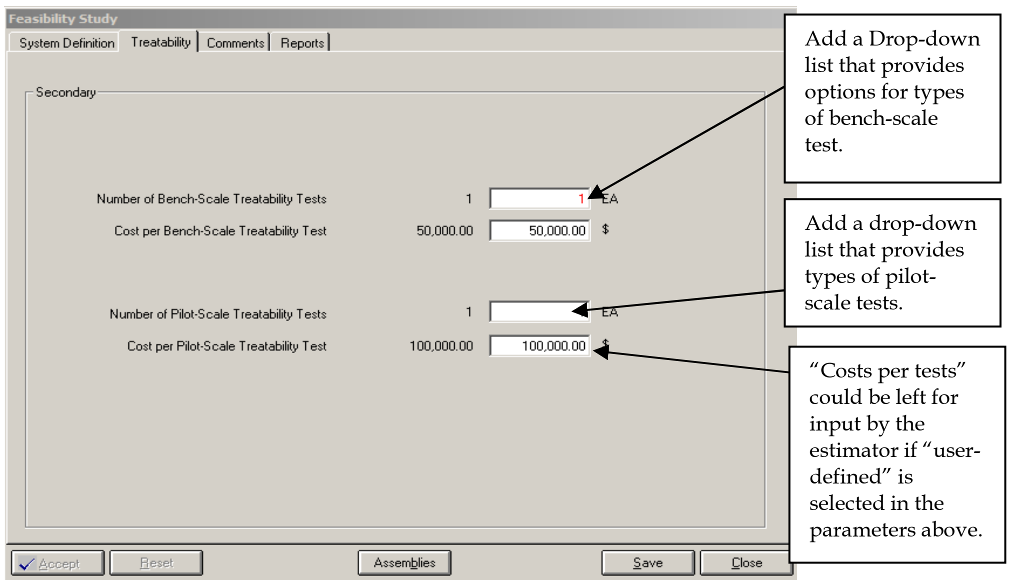
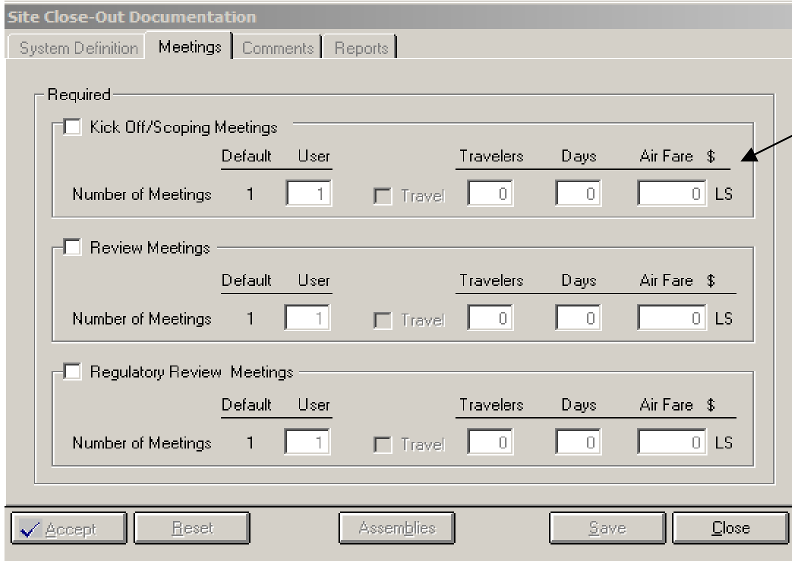


Figure 19

- Issue: There is no option for additional meetings.
- Recommended Solution: Amend the technology by adding a Meetings tab similar to that of the Site Close-Out Documentation technology as shown in Figure 20. The estimator would input the number of meetings, distance, airfare, and number of travelers. RACER would calculate per diem, labor, and other travel costs using the inputs.



Add a mileage box for occasions when travel is by car. When mileage is inputted, then the Air Fare box will not allow inputting a cost for airfare.

Figure 20

Scoping Tab

- Issue: There are no travel costs for site visits under the Scoping tab.
- Recommended Solution: Provide inputs for mileage or site distance in this tab or include site visits for scoping in the proposed tab shown above in Figure 20.

Feasibility Report Tab (Figure 21)

- Issue: There is no Draft Final version for the Feasibility Study report. There are no Draft and Draft Final versions for the Proposed Plan and Record of Decisions.
- Recommended Solution: Provide additional tabs for selection of the noted document versions.

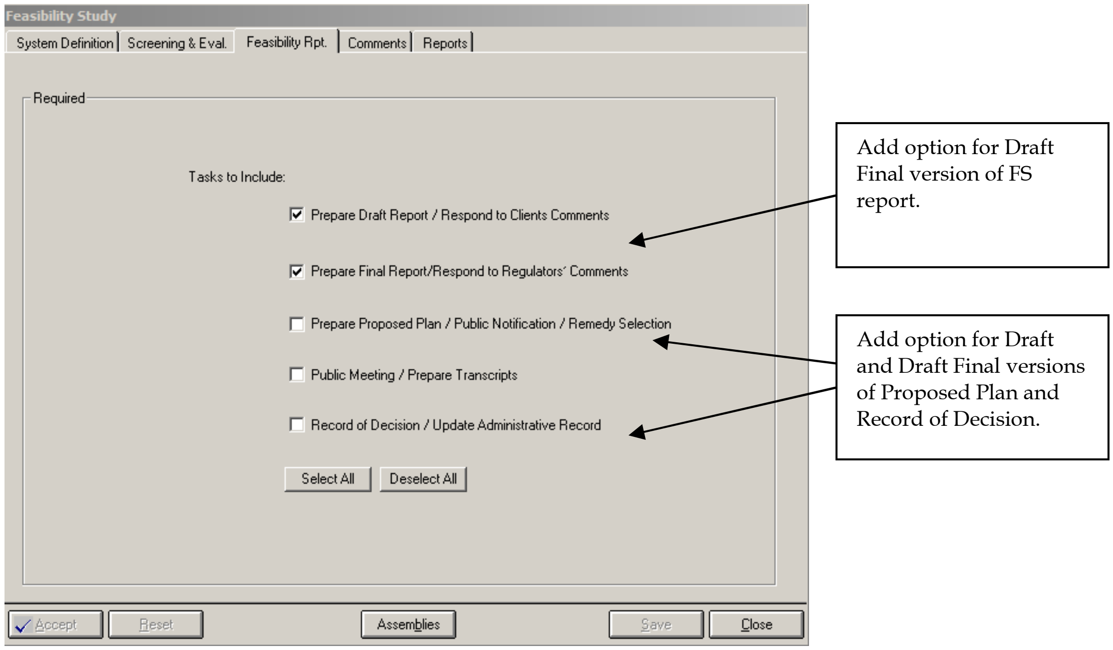


Figure 21

- Issue: The hours allocated for preparation of the Proposed Plans and Record of Decisions are very low compared to actual experience.
- Recommended Solution: Provide additional hours for the various versions of these two documents.

Technology #4: Fencing

The fencing technology (FEN) was observed four times throughout the seven location visits; two instances were able to be compared at the technology level. Combined with technology-level data from the 2004 effort, there are a total of 12 technology-level instances of FEN available for technology-level analysis. The most frequent observations and suggested solutions are listed below.

FEN was observed in the 2004 assessment project, but was not re-engineered for RACER 2008. Issues identified in 2004 are listed below along with new observations.

- Issue: The current parameters within the fencing technology do not allow an accurate estimate within RACER for the fencing task.
- Recommended Solution: Add additional secondary parameters that would refine the estimate based on known site requirements, as shown in Figure 22. Examples of types of parameters needed based on historical project data are as follows:
  - Height of fence
  - Fence Material (chain link, plastic, etc)

– Number and types of gates for entry
– Post type and spacing
– Permanent or Temporary Fencing
– Type of signage (in-ground installation vs. signage installed on fencing)

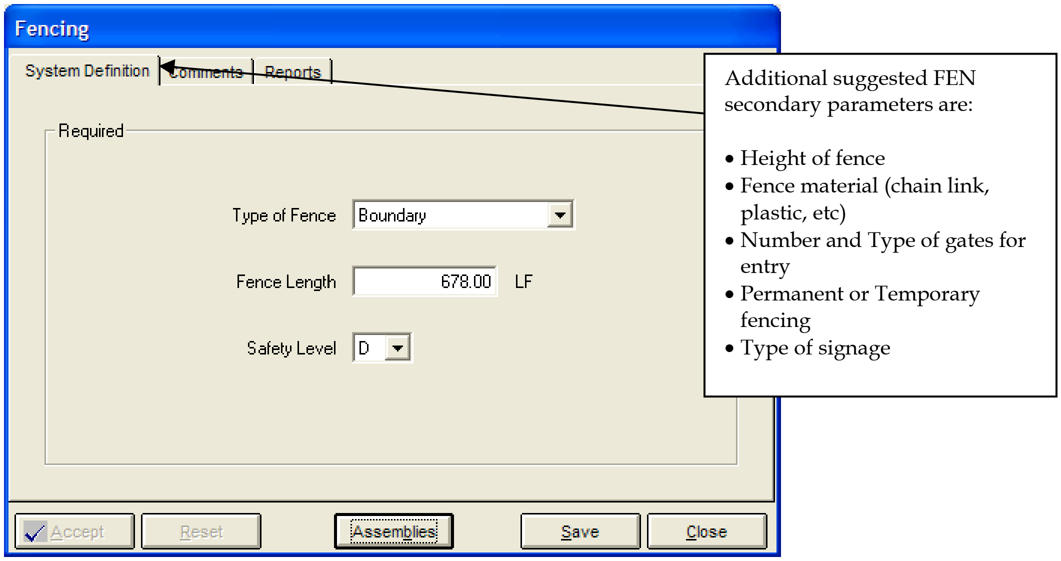


Figure 22

- Issue: The FEN Help Topic does not reveal that signage is included in the estimate.
- Recommended Solution: Add language to the Help Topic explaining the inclusion of signage costs at the assembly level.

- Issue: Cost of signage ($59.44 EA, using US 96-City Average) implies signage is of a simple, fence-mounted type. However, the line items associated with signage indicate several hours of semi-skilled laborers for installation of signs.
- Recommended Solution: Add signage type as a secondary parameter; ensure line items associated with fence-mounted are appropriate. For in-ground signage, line items should include necessary labor, and cost (expected to be $400-$500 range) should be based on historical documentation.

Technology #5: Groundwater Monitoring Well

The Groundwater Monitoring Well technology (GWM) was observed 19 times throughout the seven location visits; 10 instances were able to be compared at the technology level. Combined with technology-level data from the 2004 effort, there are a total of 18 instances of GWM that can be compared at the technology-level. The most frequent observations and suggested solutions are listed below.

Assemblies

- Issue:. Analytical assembly quantities do not account for Quality Assurance Quality Control (QA/QC) analysis.
- Recommended Solution:. Update this technology to include the monitoring mini-model that is now used in many of the technologies that were reengineered in RACER 2008 (e.g. Monitoring, Remedial Investigation, Feasibility Study). When utilizing Soil Analytical Template under the Aquifer Tab (Figure 23), add an optional check box or secondary requirements tab to enable the user to define QA/QC sample quantities.

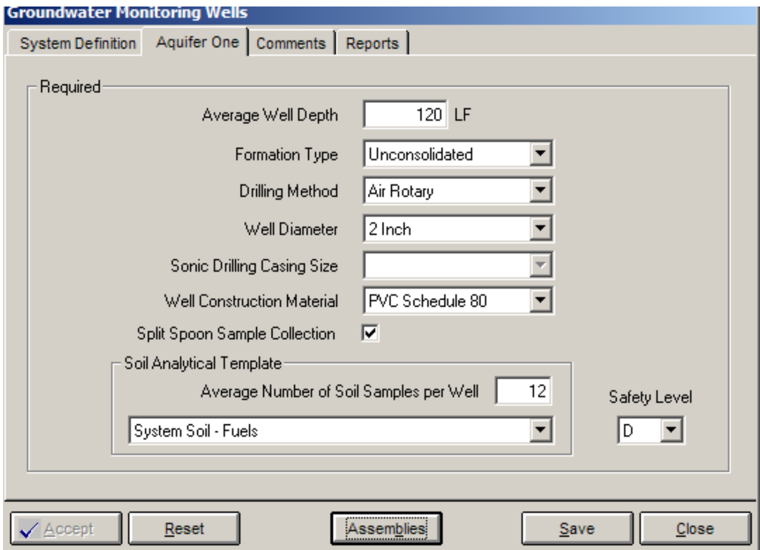


Figure 23

- Issue: There are no assemblies to account for the cost of disposable materials per sample or decontamination materials per sample collected (see Figure 24).
- Solution: Add requisite assemblies to cover the cost for disposable sample collection equipment and decontamination equipment.

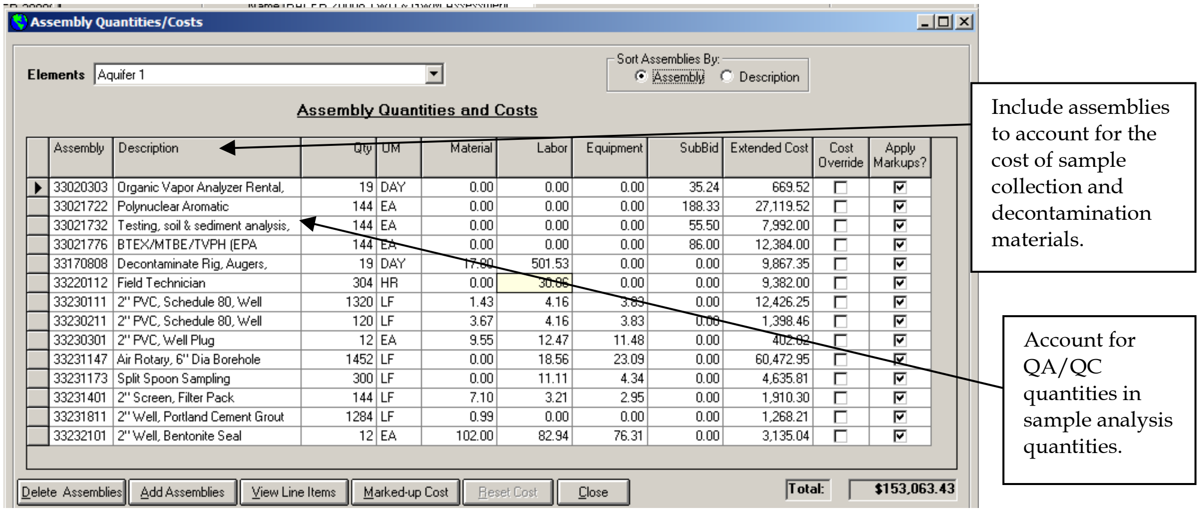


Figure 24

- Issue: LOE for the Field Technicians does not change when the split spoon sample collection option (Figure 25) is selected. With the addition of a sample collection, the LOE should increase for the technicians (Figure 26).
- Recommended Solution: Modify algorithms to account for additional labor when split-spoon sample collection is specified under the Aquifer Tab.

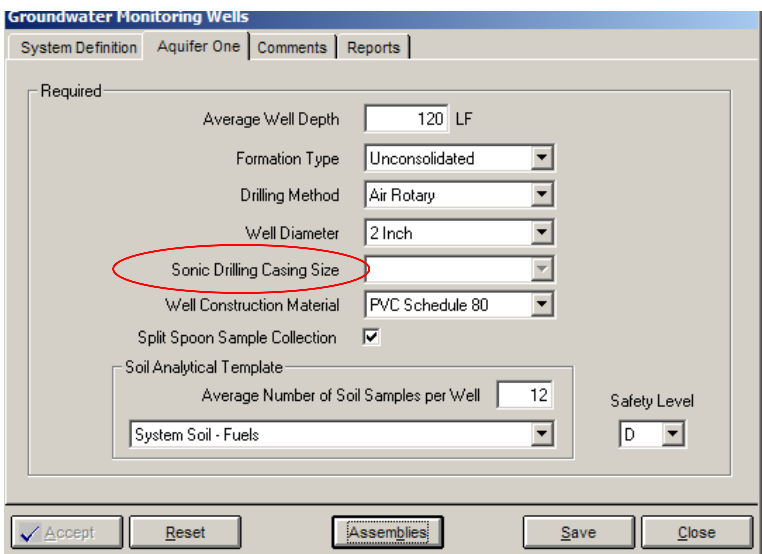
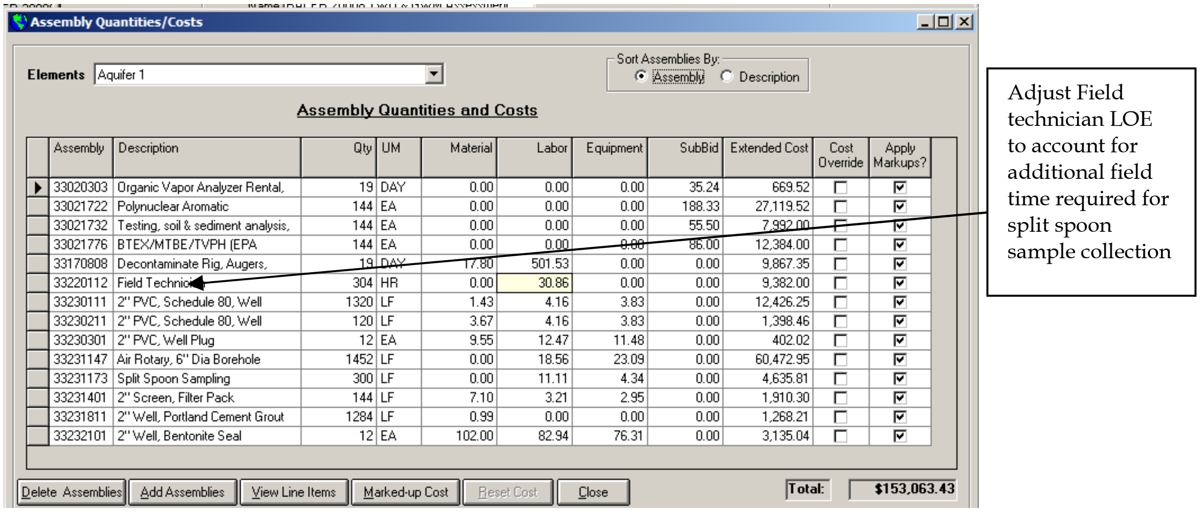


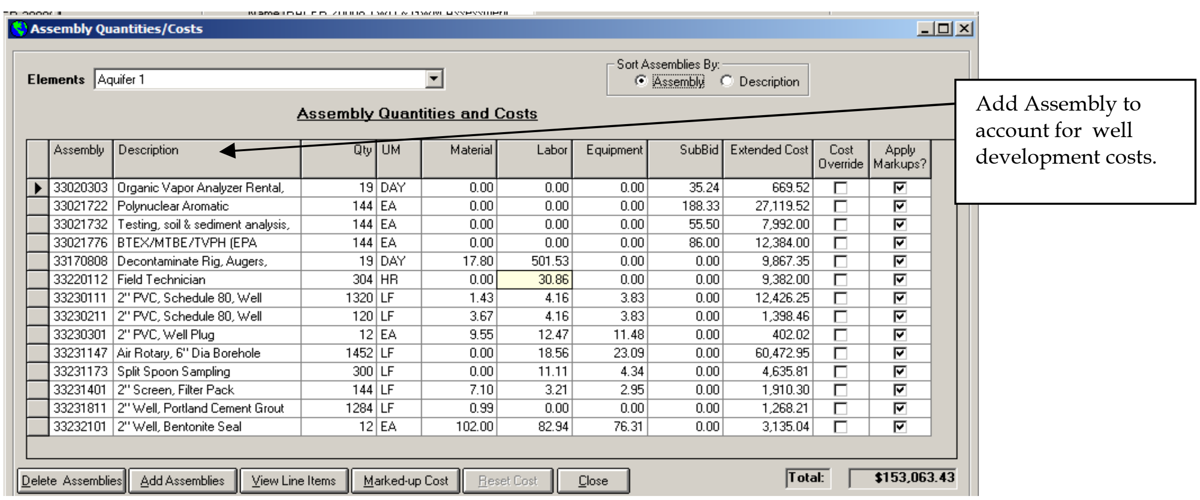
Figure 25



Assembly	Description	Qty	UM	Material	Labor	Equipment	SubBid	Extended Cost	Cost Override	Apply Markups?
33020303	Organic Vapor Analyzer Rental,	19	DAY	0.00	0.00	0.00	35.24	669.52	☐	☑
33021722	Polynuclear Aromatic	144	EA	0.00	0.00	0.00	188.33	27,119.52	☐	☑
33021732	Testing, soil & sediment analysis,	144	EA	0.00	0.00	0.00	55.50	7,992.00	☐	☑
33021776	BTEX/MTBE/TVPH (EPA	144	EA	0.00	0.00	0.00	86.00	12,384.00	☐	☑
33170808	Decontaminate Rig, Augers,	19	DAY	17.80	501.53	0.00	0.00	9,867.35	☐	☑
33220112	Field Technician	304	HR	0.00	30.86	0.00	0.00	9,382.00	☐	☑
33230111	2" PVC, Schedule 80, Well	1320	LF	1.43	4.16	3.83	0.00	12,426.25	☐	☑
33230211	2" PVC, Schedule 80, Well	120	LF	3.67	4.16	3.83	0.00	1,398.46	☐	☑
33230301	2" PVC, Well Plug	12	EA	9.55	12.47	11.48	0.00	402.02	☐	☑
33231147	Air Rotary, 6" Dia Borehole	1452	LF	0.00	18.56	23.09	0.00	60,472.95	☐	☑
33231173	Split Spoon Sampling	300	LF	0.00	11.11	4.34	0.00	4,635.81	☐	☑
33231401	2" Screen, Filter Pack	144	LF	7.10	3.21	2.95	0.00	1,910.30	☐	☑
33231811	2" Well, Portland Cement Grout	1284	LF	0.99	0.00	0.00	0.00	1,268.21	☐	☑
33232101	2" Well, Bentonite Seal	12	EA	102.00	82.94	76.31	0.00	3,135.04	☐	☑

Figure 26

- Issue:. Well development Assemblies 33231186 (weekly rental) and 33231193 (daily rental) are not default assemblies in this technology; therefore, they must be added manually (Figure 27). Well development is an integral part of groundwater well installation and should be included in this technology as part of the cost of well installation.
- Recommended Solution:. Modify algorithms to provide for the cost of well development in the assemblies for the Groundwater Monitoring Well technology. The LOE for the field technicians will require an increase as well to ensure adequate labor for performing the well development tasks.



Assembly	Description	Qty	UM	Material	Labor	Equipment	SubBid	Extended Cost	Cost Override	Apply Markups?
33020303	Organic Vapor Analyzer Rental,	19	DAY	0.00	0.00	0.00	35.24	669.52	☐	☑
33021722	Polynuclear Aromatic	144	EA	0.00	0.00	0.00	188.33	27,119.52	☐	☑
33021732	Testing, soil & sediment analysis,	144	EA	0.00	0.00	0.00	55.50	7,992.00	☐	☑
33021776	BTEX/MTBE/TVPH (EPA	144	EA	0.00	0.00	0.00	86.00	12,384.00	☐	☑
33170808	Decontaminate Rig, Augers,	19	DAY	17.80	501.53	0.00	0.00	9,867.35	☐	☑
33220112	Field Technician	304	HR	0.00	30.86	0.00	0.00	9,382.00	☐	☑
33230111	2" PVC, Schedule 80, Well	1320	LF	1.43	4.16	3.83	0.00	12,426.25	☐	☑
33230211	2" PVC, Schedule 80, Well	120	LF	3.67	4.16	3.83	0.00	1,398.46	☐	☑
33230301	2" PVC, Well Plug	12	EA	9.55	12.47	11.48	0.00	402.02	☐	☑
33231147	Air Rotary, 6" Dia Borehole	1452	LF	0.00	18.56	23.09	0.00	60,472.95	☐	☑
33231173	Split Spoon Sampling	300	LF	0.00	11.11	4.34	0.00	4,635.81	☐	☑
33231401	2" Screen, Filter Pack	144	LF	7.10	3.21	2.95	0.00	1,910.30	☐	☑
33231811	2" Well, Portland Cement Grout	1284	LF	0.99	0.00	0.00	0.00	1,268.21	☐	☑
33232101	2" Well, Bentonite Seal	12	EA	102.00	82.94	76.31	0.00	3,135.04	☐	☑

Figure 27

Technology #6: Load and Haul

The Load and Haul technology was observed eight times throughout the seven location visits; three instances were able to be compared at the technology level. Combined with technology-level data from the 2004 effort, there are a total of 16 instances of Load and Haul that can be compared at the technology-level. The most frequent observations and suggested solutions are listed below.

Assemblies (Figure 28)

- <u>Issue:</u> Assembly 17020401 “Dump Charges” is associated with the unit of measure “Each.”
- <u>Recommended Solution:</u> Change the unit of measure for this assembly to Cubic Yards (CY) to match the unit of measure under the system definition tab (Figure 29).

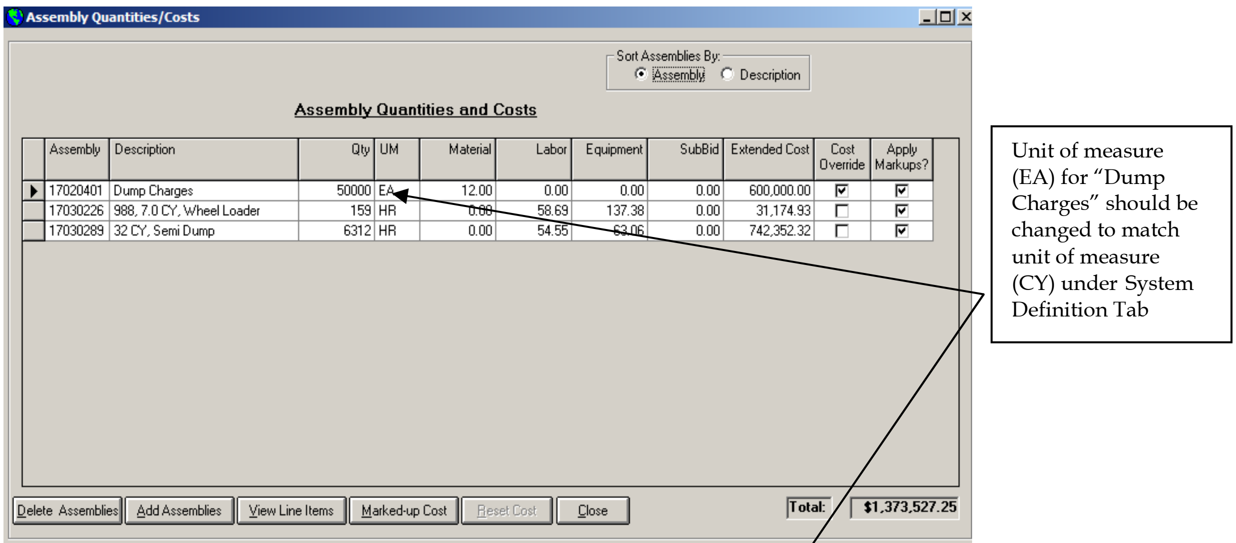


Figure 28

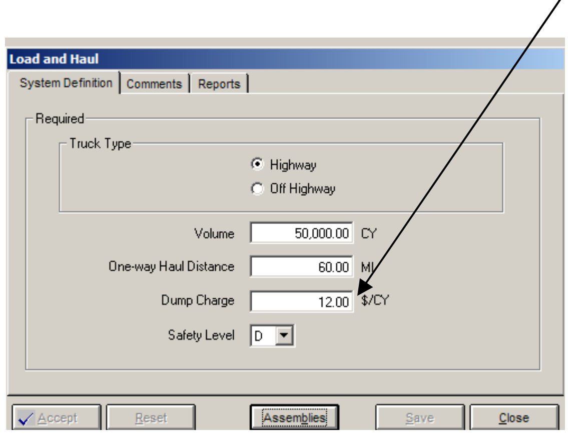


Figure 29

Technology #7: Monitoring

The Monitoring technology was observed 63 times throughout the seven location visits; 38 instances were able to be compared at the technology level. Combined with technology-level data from the 2004 effort, there are a total of 68 instances of Monitoring that can be compared at the technology level. While the Monitoring technology has been re-engineered since the 2004 report, there are still numerous problems and inconsistencies with the technology. More detail on these issues is provided below.

General

- Issue: The Monitoring technology was re-engineered but the Natural Attenuation Technology (MNA) was not. This has resulted in very different costs for similar work depending on which technology is used. For example, cost for collection/analysis of 400 groundwater samples assuming default parameters is ~$700,000 in the Monitoring module (with MNA Analytical Template used) and ~$1,000,000 in the Natural Attenuation module with the same parameters selected.
- Recommended Solution: Reevaluate Natural Attenuation and update it to be more in sync with the re-engineered Monitoring technology.

- Issue: The Monitoring technology does not properly account for travel (either mileage or travel time) when sampling over several days. For example: when site distance is 200 miles, number of wells sampled is 24 wells at 15 ft average sample depth, assuming a single sampling event, RACER calculates that six wells will be sampled per day (four total days of sampling). RACER calculates travel as if the contractor is traveling 200 miles each way for each of the four days of sampling, resulting in the following quantities:

Assembly	Description	Quantity
33010104	Sample collection, vehicle mileage charge, car or van	1,720 Mi
33010202	Per Diem (per person)	8 Day
33022043	Overnight delivery service, 51 to 70 lb packages	480 Lb
33220112	Field Technician	101 Hr

The quantities for Assemblies 33010104 and 33220112 are excessive when compared to historical data.

- The quantity for assembly 33010104 should be 400 miles plus onsite mileage

- The quantity for assembly 33010202 appears to be accurate (4 days for each of 2 field techs)
- The quantity for 33022043 appears to be accurate
- The quantity for assembly 33220112 should be approximately 16 hours for travel time (4 hours each way for each of 2 technicians). For comparison, the quantity of hours for a site with a 10 mile site distance is 18 hours compared to the example shown above, with a 200 mile site distance, is 101 hours.

- Recommended Solution: Reevaluate quantities for assemblies listed above. Additionally, RACER should calculate travel for the sampling technicians by car up to a reasonable number of miles and by air for greater distances.

Groundwater Tab

- Issue: Projects frequently include requirements for measuring groundwater depths at certain wells or checking for free product with no corresponding sample collection. Additionally, RACER does not provide the ability to measure for depth- to-water or presence of free product when samples are not also collected. The only option in RACER is to sample. RACER does not have an assembly for rental of oil/water interface probe.
- Recommended Solution: Include an option in the Groundwater tab for depth to water measurements only, and/or free product presence/absence at a user-provided number of wells. This should result in assemblies for rental of a well depth indicator or oils/water interface probe, as well as an increased LOE for a field technician.

- Issue: The technology does not properly capture purge water volume. In order to properly calculate purge water, the following well parameters must be obtained: depth to groundwater (DTW), average sample depth, total depth (TD), and well diameter. The only input in RACER is average sample depth. The following is from the Monitoring Addendum dated 5/25/07:

GWPV1 = Groundwater Purge Volume in Year 1

Note: the calculations presented below assume 4-inch diameter well casings, and 80% of GWD.

If GWMETH = PMP or BLR (assume 5 purge volumes per well)
= 5 * (pi * R^2 * well depth) * GWSPE1 * GWEV1 * (7.48 gallons per cubic foot)
= 5 * pi * (2/12)^2 * GWD * GWSPE1 * GWEV1 * 7.48 * 0.8

<u>If GWMETH = LFP (assume 2.0 purge volume per well)</u> = 2 * (pi * R^2 * well depth) * GWSPE1 * GWEV1 * (7.48 gallons per cubic foot) = 2 * pi * (2/12)^2 * GWD * GWSPE1 * GWEV1 * 7.48 * 0.8

The problems with these calculations are as follows:

1. Purge volumes for bailers and pumps are inconsistent with standard sampling procedures. It is recommended that the five purge volumes be changed to a minimum of three volumes based on the *HQ AFCEE Model Field Sampling Plan*[32] and the *US Environmental Protection Agency (EPA) Groundwater Sampling for Superfund and RCRA Projects.*[33]

2. The formula specifies use of the average DTW and an average well diameter of four inches in the purge volume calculation; however, the actual model input is the average sample depth, not average depth to groundwater. Regardless of this discrepancy, this parameter does not provide the most accurate calculation. The section of casing between the depth to groundwater and the total well depth should be used for this calculation.

- <u>Recommended Solution:</u> Adjust technology to require depth to water and total well depth parameters; use these parameters to calculate purge water volume. In addition, reduce purge volumes per well for pump and bailer methods.

Surface Water tab

- <u>Issue</u>: The average sample depth for surface water samples does not impact cost as much as it should; only values at the extremes of the valid range affect costs.
- <u>Recommended Solution</u>: Check the technology algorithm to ensure this functionality is working as intended; consider revising. The Monitoring Addendum dated 25 May 2007 does not discuss sample depth.

Subsurface Soil tab

- <u>Issue</u>: RACER appears to assign a maximum of eight hand auger borings/day, even if these borings are only 2-ft. deep.
- <u>Recommended Solution</u>: Check the technology algorithm to ensure this functionality is working as intended; consider revising.

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32 *HQ AFCEE Model Field sampling Plan, Final Version 1.2, September 2002*

33 *Yeskis, Douglas and Bernard Zavala. Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers, Ground-Water Forum Issue Paper. US EPA, Washington DC, May 2002*

Data Management tab

- Issue: The Help Topic does not adequately define the terms for selection of the various options for Monitoring Plan (Abbreviated, Standard, and Comprehensive). It only lists the options with no corresponding definitions.
- Recommended Solution: Add more detail to the Monitoring Plan section of the Help Topic.

- Issue: There is a problem/inaccuracy with the LOE associated with the Monitoring Plan options. In one example involving collection of only one groundwater sample, when "None" is selected for Monitoring Plan, the marked up project cost is $8,177; when "Abbreviated" plan is selected, marked up cost goes up to $20,167 ($11,990 increase), when "Standard" plan is selected, marked up cost is $30,381 ($22,204 increase), and when "Comprehensive" plan is selected, marked up cost is $49,993 ($41,816 increase). These cost increases do not seem realistic for a monitoring plan associated with a sampling event involving only one sample. For examples with larger numbers of samples, cost again seem unrealistically high.
- Recommended Solution: Reevaluate the algorithms and assumed LOE associated with this parameter.

- Issue: The Monitoring Report algorithm appears to be incorrect. In one example, changing from "Abbreviated" report to "Standard" to "Comprehensive" increased the marked up total project cost from $104,787 (for Abbreviated Report) to $109,776 (for Standard Report) to $209,782 (for Comprehensive Report). The jump of $100K from Standard Report to Comprehensive does not appear reasonable.
- Recommended Solution: Review the Monitoring Report LOE and associated algorithm to determine if this is an error; if so, revise software code accordingly. If not, consider review and revision of the Model Addendum to ensure these cost increases are reasonable.

- Issue: Default values for Monitoring Report (Data Management tab) are not functioning in accordance with the Help Topic. For example, in one estimate the number of samples in the first year is 53. According to the Help Topic, the default for Report should be Comprehensive, but it is Abbreviated. The Help Topic does not correspond to the Monitoring Addendum dated 5/25/07. The addendum states that QA must be a selection higher than 1 to trigger automatic adjustment of the report, however the Help Topic does not mention this.
- Recommended Solution: Ensure Help Screen for Monitoring Report options are correct.

- Issue: The Monitoring technology does not contain options for preparation of quarterly reports, and the Help Topic does not indicate whether changing the "number of events per year" changes the number of reports prepared for each year; resulting assembly quantity changes are not indicative of this.
- Recommended Solution: For each type of sampling, ensure Help Topic indicates how many reports per year are accounted for.

- Issue: RACER does not provide an option for no data validation.
- Recommended Solution: An option could be provided for rare cases when no validation is required. Alternatively, the Help Topic could be revised to describe what assemblies are affected, so that the user could make informed assembly changes should they choose to remove the LOE associated with data validation.

Assemblies

- Issue: There appears to be many discrepancies of both cost and types of analyses available within RACER. Some of the more frequently encountered issues related to analyses are listed below.
  1. Metals. Metals analyses are frequently run for single elements (manganese, cadmium, chromium, nickel) and are approximately $10-20/ea. While there is also an extraction that is necessary, this type of individual analysis is not an available option in RACER (except for chromium) so total metals must be used as a substitution but the cost is much greater ($332/sample). Consider adding assemblies for single element analyses.
  2. RACER does not provide analyses for DRO and GRO. The user has to approximate using TPH.
  3. RACER does not include an assembly for the SW 9056 analysis.

- Recommended Solution: Revise assembly cost database to include above-listed assemblies.

Technology #8: Off-Site Transportation and Waste Disposal

The Off-Site Transportation and Waste Disposal (Off-Site T&D) technology was observed 20 times throughout the seven location visits; eight instances were able to be compared at the technology level. Combined with technology-level data from the 2004 effort, there are a total of 47 instances of Off-Site T&D that can be compared at the technology level. The most frequent observations and suggested solutions are listed below.

System Definition/Assemblies (Figures 30 through 33)

- Issue: When utilizing the Off-site Transportation and Waste Disposal Technology to account for transporting via truck, rail, or truck/rail and disposing of a **non-hazardous liquid waste**, this technology will add an assembly for transporting radioactive waste by rail. The additional assembly will result in over-estimated site costs.
- Recommended Solution: Review the algorithms and make requisite corrections to incorporate nonhazardous waste transport via truck and rail.

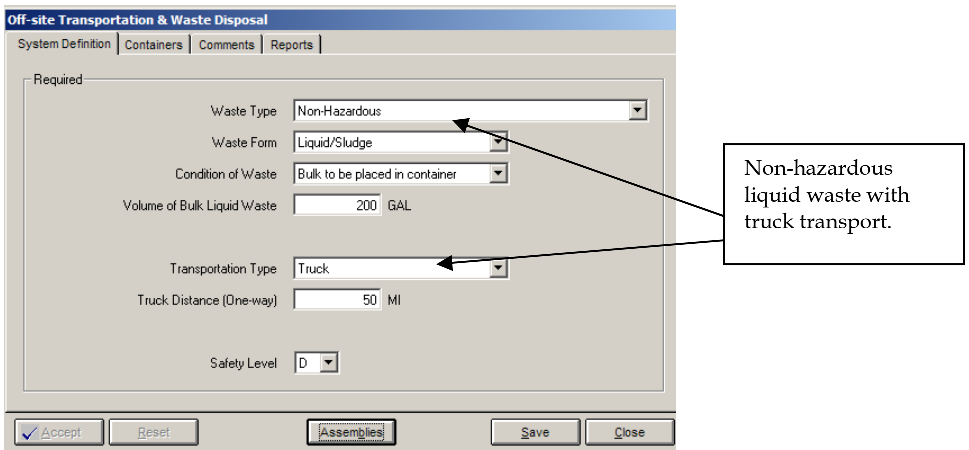


Figure 30

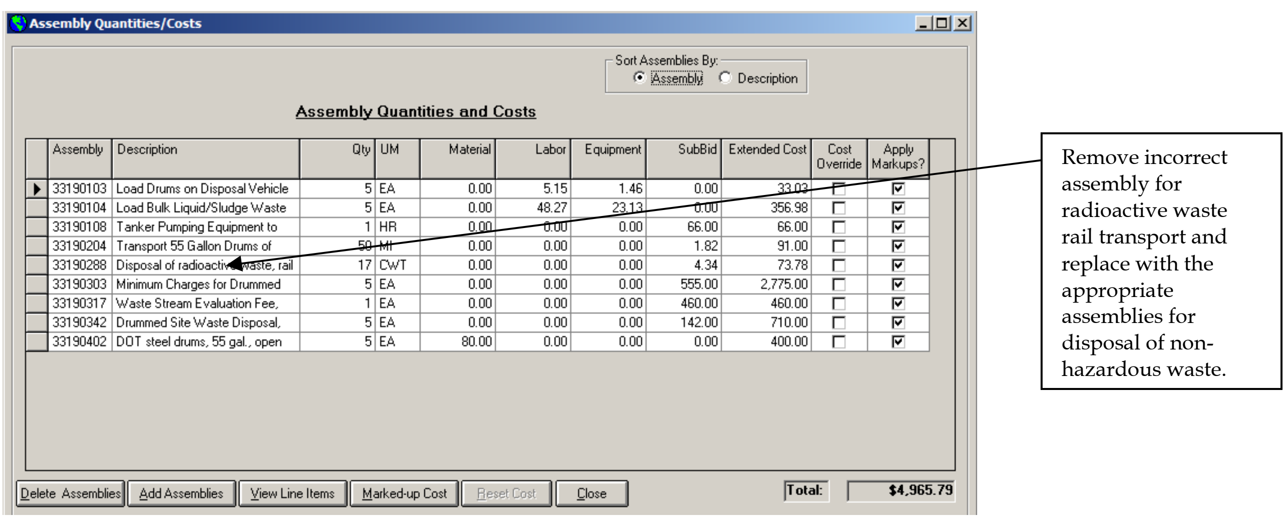


Figure 31

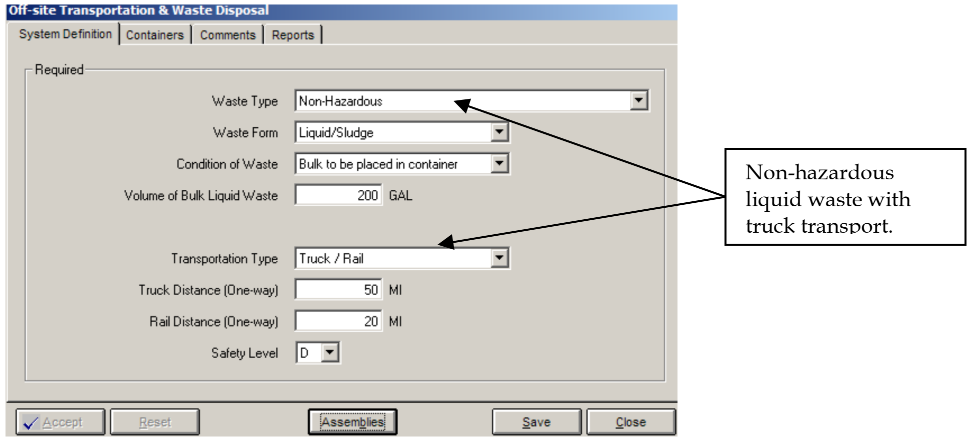


Figure 32

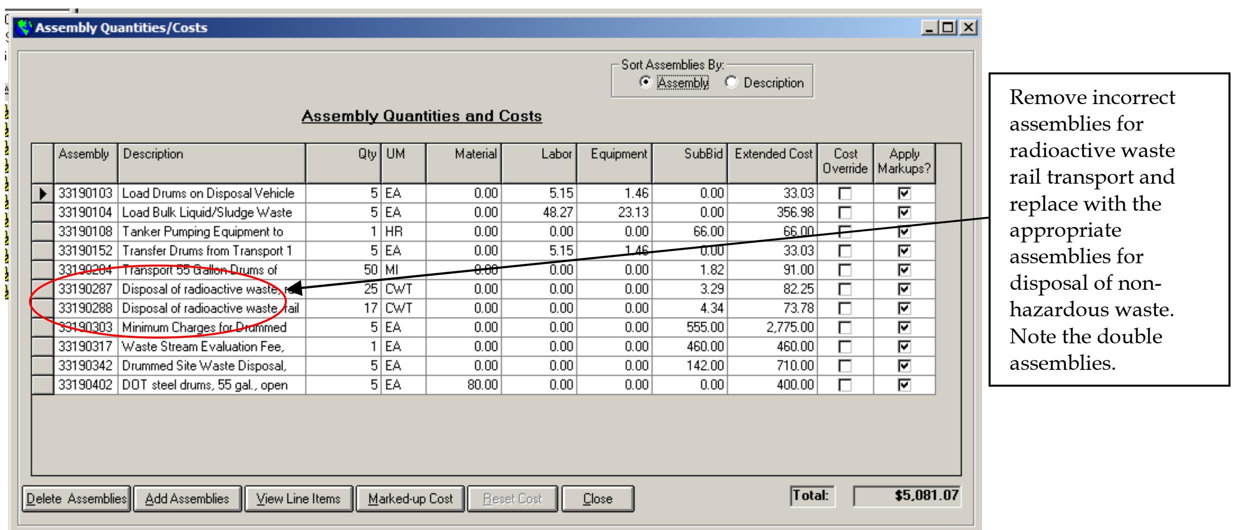


Figure 33

System Definition/Assemblies (Figure 34 and 35)

- <u>Issue:</u> When utilizing the Off-Site Transportation and Waste Disposal Technology to account for transporting via rail or truck/rail combination and disposing of **a non-hazardous <u>solid</u> waste**, this technology will add an assembly for transporting radioactive waste by rail. The additional assembly will result in over-estimating site costs.
- <u>Recommended Solution:</u> Review the algorithms and make requisite corrections to incorporate nonhazardous waste transport via rail.

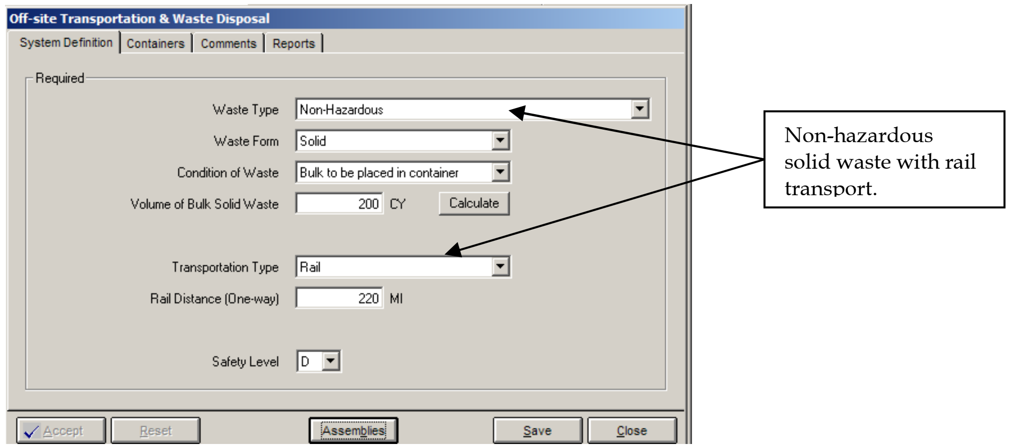


Figure 34

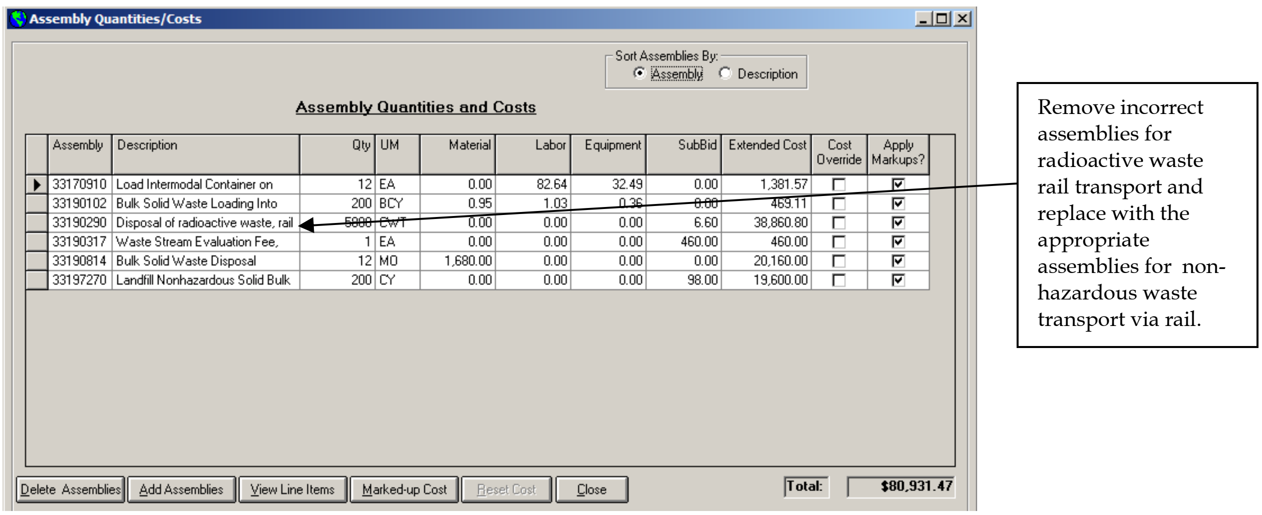


Figure 35

System Definition/Assemblies (Figures 36 and 37)

- Issue:. When Non-Hazardous waste type is selected under the System definition Tab, the Transport Bulk Solid Hazardous Waste Assembly is loaded to cover transport cost.
- Recommended Solution:. Replace Transport Bulk Solid Hazardous Waste Assembly 33109215 with an assembly for transporting non-hazardous waste such as Assembly 17030289 – "32 CY Semi Dump.

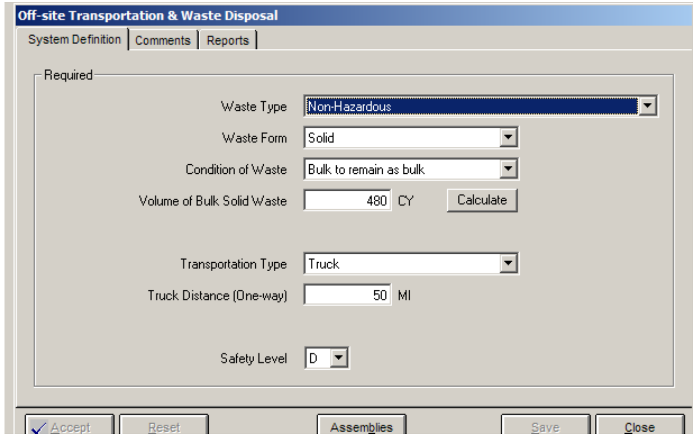


Figure 36

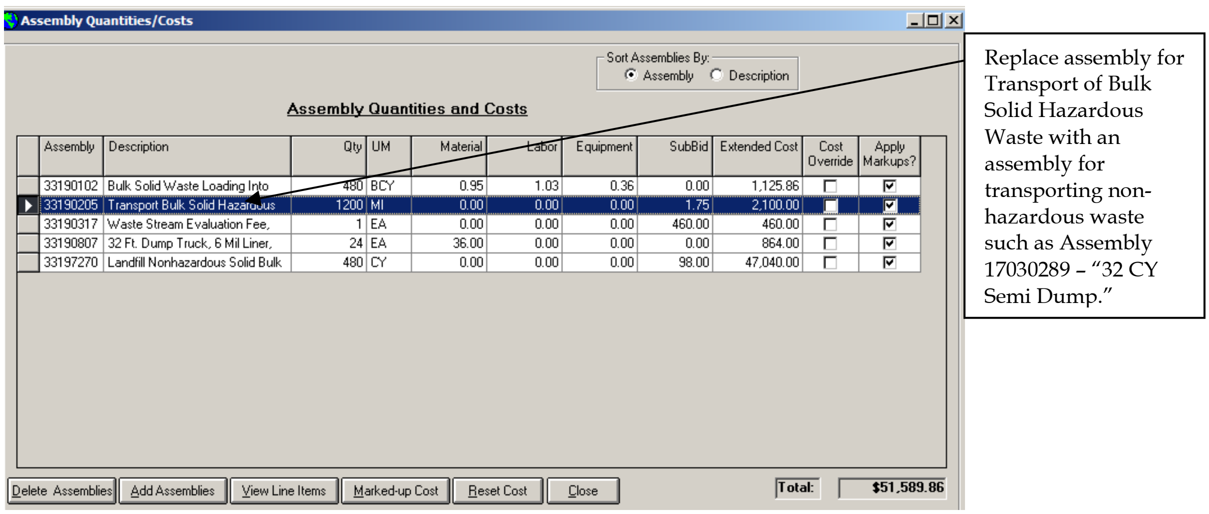


Figure 37

Technology #9: Operations and Maintenance (O&M)

Throughout the seven location visits, the O&M technology was observed ten times. Nine of these instances were relevant for comparison at the technology level; combined with the 2004 data, there are 22 total instances in the data set. O&M had three observations called out in Appendix D. The most frequent observations and suggested solutions are listed below.

- Issue: The values for the Professional Labor assemblies were all the same, regardless of whether "Moderate," "Minimum," or "Exclude from Estimate" was selected.
- Recommended Solution: Check technology algorithm to ensure this functionality is working as intended; consider revision.

- <u>Issue</u>: RACER does not provide Professional Labor hours when "Minimum" is selected. The algorithm for Staff Engineer Labor Hours for Inspection and Certification of Active Treatment Systems (SEHRTS) in the Operations and Maintenance (O&M) Model Addendum Report shows it as zero. Need to revise algorithm.
- <u>Recommended Solution:</u> Check technology algorithm to ensure this functionality is working as intended; consider revision.

- <u>Issue</u>: RACER does not provide the option of using a vacuum truck for free product removal. Many contractors supply a vacuum truck to perform this service.
- <u>Recommended Solution:</u> Provide an option in the Free Product Removal or O&M technology to perform removal work using a vacuum truck.

- <u>Issue</u>: RACER does not provide the option of on-site disposal such as water generated from oil/water separators and SVE knockout drums. These only require loading/transportation and/or direct disposal to a POTW by pipeline.
- <u>Recommended Solution:</u> Add an additional tab within the O&M technology that would provide an extensive list of on-site and off-site options for all wastes generated during O&M activities.

- <u>Issue</u>: RACER does not provide the option of renting equipment such as Granular Activated Carbon (GAC) modules. Many contractors provide treatment equipment at a per month rental rate.
- <u>Recommended Solution:</u> Provide an option in the applicable tab for treatment technologies process equipment rental of systems such as GAC modules, thermal & catalytic oxidation, and in-situ treatment systems. Rental costs would be based on average industry costs. RACER already offers some assemblies with rental rates. See Figure 38.

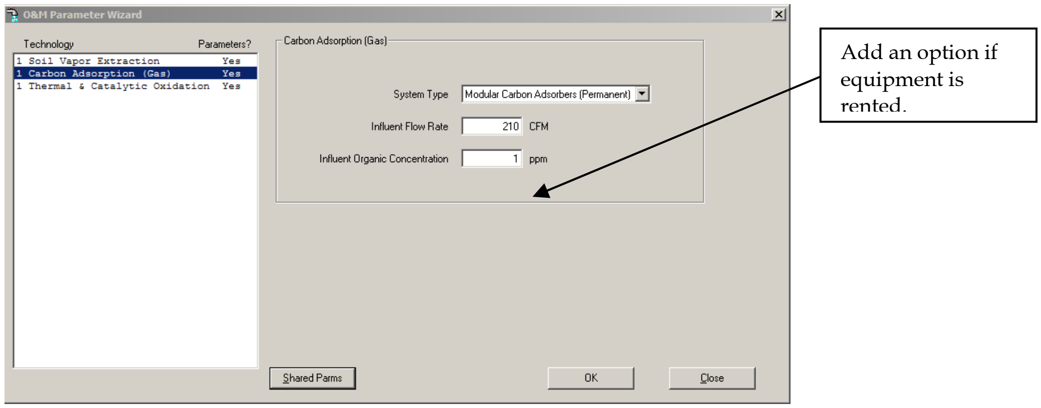


Figure 38

- Issue: The algorithms for Field Technician Labor Hours for Inspection and Certification of Active Treatment Systems (FTHRTS) and Staff Engineer Labor Hours for Inspection and Certification of Active Treatment Systems (SEHRTS) in the O&M Model Addendum Report go to zero whenever there is an in situ biodegradation technology even though there might be other active systems.
- Recommended Solution: Check technology algorithm to ensure this functionality is working as intended; consider revision.

- Issue: The algorithms for Project Engineer Labor Hours for Inspection and Certification of Active Treatment Systems (PEHRTS) in the O&M Model Addendum Report require that there be an In-Situ Biodegradation component present in the O&M technology for hours to be added for minimum and moderate scenarios.
- Recommended Solution: Check technology algorithm to ensure this functionality is working as intended; consider revision.

- Issue: The summations for Field Technician Labor Hours in Year 1 (FTHR1), Staff Engineer Labor Hours in Year 1 (SEHR1), and Project Engineer Total Hours in Year 1 (PEHR1) in the O&M Model Addendum Report should include hours for an in situ biodegradation technology. It is also noted that there are no labor algorithms for Staff Engineer when there is a biodegradation technology.
- Recommended Solution: Check technology algorithm to ensure this functionality is working as intended; consider revision.

- Issue: Need to be consistent when determining professional labor in the algorithms for other staff such as project manager and QC. In some cases, some labor categories are considered professional labor and in other cases they are not.

- Recommended Solution: Check technology algorithm to ensure this functionality is working as intended; consider revision.

- Issue: The algorithms for the rental of a portable air sampler (page 36 of the O&M Technology Addendum) seem to be reversed. The daily rental assembly is attached to the long-term rental algorithm, while the weekly assembly is attached to the daily algorithm.
- Recommended Solution: Check technology algorithm to ensure this functionality is working as intended; consider revision.

- Issue: The duration equations used for the O&M technology seem to shorten the duration of operations more than what one would expect. For example, if one starts on day 1 of the 1st month and ends on day 31 of the 2nd month, then there would be two months of operations. The algorithm calculates only one month: End Point (EP) – Start Point (SP) = 2 – 1 = 1.
- Recommended Solution: Check technology algorithm to ensure this functionality is working as intended; consider revision.

- Issue: The list of chemicals for in situ biodegradation should be upgraded to include commonly used injectants such as persulfate, Regenesis compounds, and EOS (emulsified edible oil substrate). A search of commercially available applications will provide commonly used chemicals.
- Recommended Solution: Consider revision to include additional injectants.

- Issue: On page 110 of the O&M Technology Addendum, the table heading indicates that Start-up Duration for Technology (SUDUR) values are months but the algorithms assume that SUDUR values are weeks.
- Recommended Solution: Check technology algorithm to ensure this functionality is working as intended; consider revision.

- Issue: Four assemblies related to the handling of spent activated carbon within RACER have incorrect unit costs. RACER assigns a unit cost of $0.02 per pound of carbon to each of these assemblies. During each annual update to the RACER cost database, most RACER assemblies, including these, are obtained from the same source as the assemblies used in an RS Means catalog. The RS Means catalog was checked to confirm whether the RACER unit costs were valid and it was found that they were incorrect (too low). The assemblies and their respective unit costs as defined in the RS Means catalog are as follows:

Assembly Number	Assembly Description	RS Means Assembly Unit Cost
33132065	Removal, Transport, Regeneration of Spent Carbon, < 2k lb	$0.61
33132066	Removal, Transport, Regeneration of Spent Carbon, < 2k to 10k lb	$0.28
33132073	Remove and dispose of Spent Carbon from Water Treatment	$0.30
33132074	Remove and dispose of Spent Carbon from Offgas Treatment	$0.30

- <u>Recommended Solution:</u> Incorporate correct costs into the correct cost database for these assemblies.

- <u>Issue</u>: When modeling the operations and maintenance of a bioslurping system using the O&M technology in RACER, the technology assumes the system will be continuously pumping 90% of the time. In reality, the pumps in a bioslurping system cycle on and off regularly and are actually not running the majority of the time. The method used by RACER to model this operation results in an extremely high quantity of waste water generated, resulting in excessive waste disposal costs. The Total Quantity of Liquids Removed (gallons / year) (SLPTQLR) algorithm contains a runtime factor (SRTF) but the O&M technology does not provide the option of changing the default SRTF.
- <u>Recommended Solution:</u> Incorporate an option that will allow the user to change the SRTF. See Figure 39. Check technology algorithm to ensure this functionality is working as intended; consider revision.

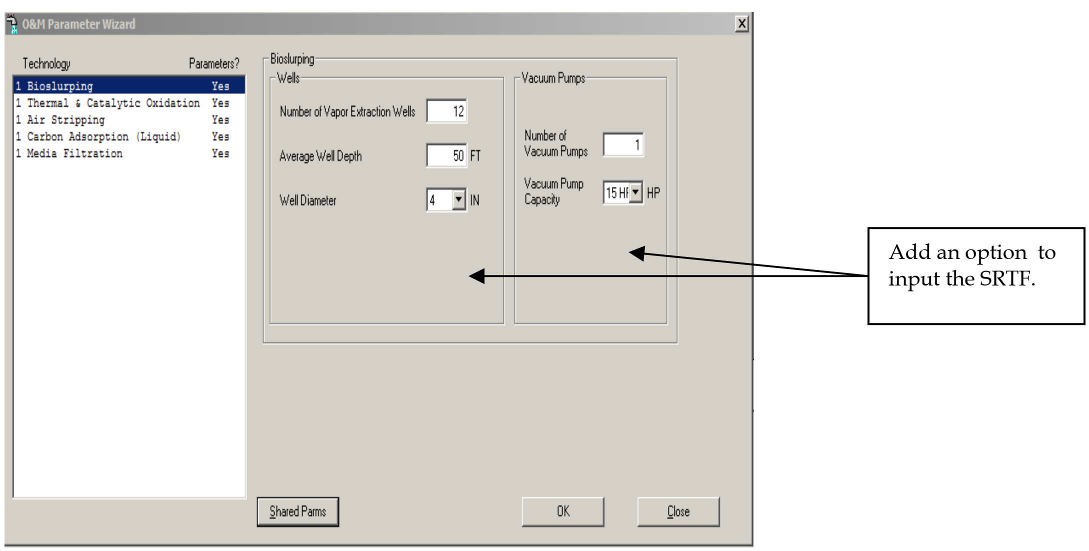


Figure 39

Technology #10: Professional Labor Management

The Professional Labor Management (PLM) technology was observed 43 times throughout the seven location visits; 11 instances were able to be compared at the technology level. Combined with technology-level data from the 2004 effort, there are a total of 42 instances of PLM that can be compared at the technology level. While PLM applies a percentage to the remedial action work performed, there are several changes or enhancements that would make the technology perform better. More detail on these suggestions is provided below.

General

- Issue: PLM should be applied the same whether a technology is performed as part of a remedial action or investigation phase. Example: Groundwater Monitoring Well – if this technology is used under an RA phase, RACER applies PLM to the technology. However, this same technology can be used under a study or LTM phase. When this is the case, no PLM can be applied resulting in a different cost for the same work simply by choosing a different phase.
- Recommended Solution: Allow PLM to be selected in more phases and constrain over-estimating by excluding non-relevant technologies from the capital construction cost calculation from which the PLM cost is calculated.

- Issue: RACER does not provide sufficient options for reports such as Remedial Action Report or Treatability Study reports. The Help Topic for PLM states that PLM is designed to capture costs performed by a specific list of activities, one of which is "prepare and submit contract-required deliverables."
- Recommended Solution: Clarification should be provided for exactly what PLM is intended to cover concerning reporting. (This comment overlaps with Site Closeout.) If not covered by PLM, technologies could be developed for preparation of a wide range of reports.

Technology #11: Remedial Investigation

Throughout the seven location visits, this technology had five observations identified in Appendix D. Eighteen instances of Remedial Investigation were observed, and 14 were relevant for comparison at the technology level. Combined with the 2004 data set, there are 18 total instances of this technology. The most frequent observations and suggested solutions are listed below.

- Issue: There is no option for additional meetings.

- Recommended Solution: The technology could be amended by adding a Meetings tab similar to that of the Site Close-Out Documentation technology as shown in Figure 40. The estimator would input the number of meetings, distance, airfare, and number of travelers. RACER would calculate per diem, labor, and other travel costs using the inputs.

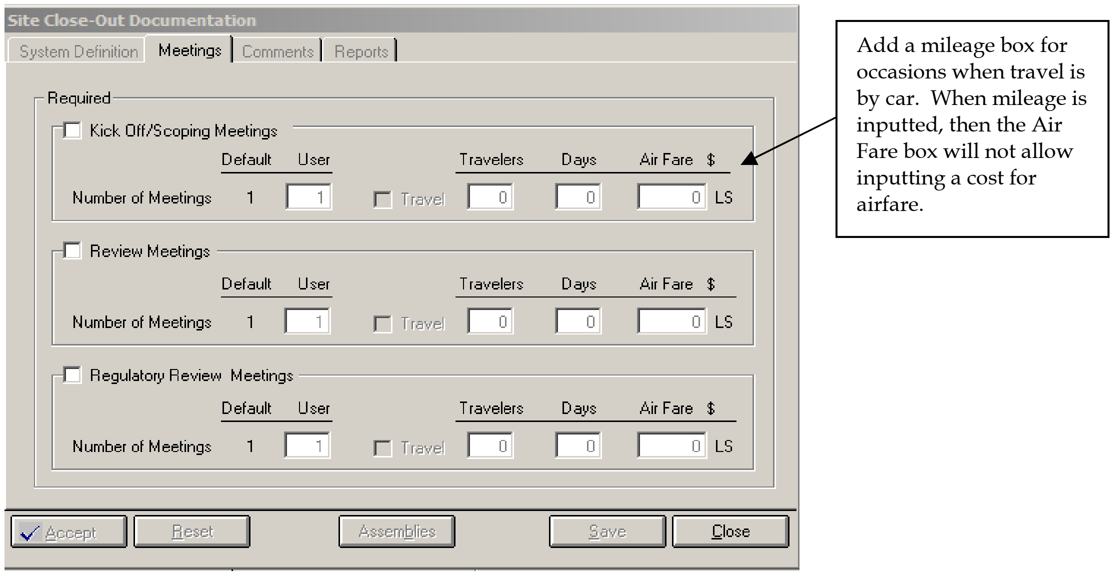


Figure 40

- Issue: There is no option for travel via airlines. RACER assumes travel by truck even for long distances.
- Recommended Solution: Revise this technology to default to air travel when a certain mileage is surpassed such as 150 miles or an industry accepted standard. For remote sites, the system would benefit from the addition of additional transportation options for personnel and equipment such as barge, helicopter, and rail.

- Issue: There are no costs in the assemblies when selecting slug tests or one of the two pump tests under the Other Investigations tab. The algorithms in the Monitoring Model Addendum Report are just for the mileage. Dye Tracer Tests do show up in the assemblies. It is suggested that material costs be added to these four tests.
- Recommended Solution: Provide appropriate assemblies when the user has selected these options. Revise accordingly.

- Issue: The algorithm for geophysical surveys in the Monitoring Model Addendum Report indicates hours for oversight should be calculated but these do not show up. Mileage does show up but there is no algorithm in the Monitoring Model Addendum Report.

- Recommended Solution: Revise accordingly.

- Issue: See applicable issues for the Monitoring technology and apply to the S&A tabs.

Technology #12: Residual Waste Management

Throughout the seven locations visits, this technology was observed a total of 56 times. This high number can be attributed to Residual Waste Management (WMS) being a "companion technology;" that is, it is utilized in conjunction with all technologies for activities which generate IDW. In 24 instances, this technology was able to be compared at the technology level. Combined with the 2004 data set, there are a total of 26 instances of WMS available for technology-level comparison. Thirteen observations were made in Appendix D. The most frequent observations and with suggested solutions are listed below. The technology was found to estimate high most of the time. There are a number of reasons for this, such as:

- Actual cost of disposal fees are generally lower than RACER assembly costs
- Loading and transport costs are typically rolled into the disposal cost, rather than broken out as separate costs
- Actual cost of barging is lower than RACER costs.

More detail is provided below on these issues.

General

- Issue: This technology does not distribute cost over time. Therefore, when used in conjunction with cost-over-time technologies, such as Monitoring, Natural Attenuation, or Operations and Maintenance, the costs for all years of waste management and disposal are concentrated in the first year of the corresponding phase. See example Phase Cost over Time Report below (Figure 41); this example is for thirty years of groundwater monitoring (accounted for via the Monitoring technology) with purge water disposal associated with each event (accounted for via the Residual Waste Management technology). Although residual wastes (purge water) are generated each year, the entire thirty-year cost for the Residual Waste Management technology occurs in the first year (FY2010).

Technology Name	Fiscal Year Year 1 2010	Fiscal Year Year 2 2011	Fiscal Year Year 3 2012	Fiscal Year Year 4 2013	Fiscal Year Year 5 2014	Fiscal Year Year 6 2015	Fiscal Year Year 7 2016	Fiscal Year Year 8 2017	Fiscal Year Year 9 2018
MONITORING	$161,332	$110,625	$110,625	$110,625	$110,625	$110,625	$110,625	$110,625	$110,625
Residual Waste Management	$214,758	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL	$376,090	$110,625	$110,625	$110,625	$110,625	$110,625	$110,625	$110,625	$110,625

	Fiscal Year Year 10 2019	Fiscal Year Year 11 2020	Fiscal Year Year 12 2021	Fiscal Year Year 13 2022	Fiscal Year Year 14 2023	Fiscal Year Year 15 2024	Fiscal Year Year 16 2025	Fiscal Year Year 17 2026	Fiscal Year Year 18 2027
MONITORING	$110,625	$110,625	$110,625	$110,625	$110,625	$110,625	$110,625	$110,625	$110,625
Residual Waste Management	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL	$110,625	$110,625	$110,625	$110,625	$110,625	$110,625	$110,625	$110,625	$110,625

	Fiscal Year Year 19 2028	Fiscal Year Year 20 2029	Fiscal Year Year 21 2030	Fiscal Year Year 22 2031	Fiscal Year Year 23 2032	Fiscal Year Year 24 2033	Fiscal Year Year 25 2034	Fiscal Year Year 26 2035	Fiscal Year Year 27 2036
MONITORING	$110,625	$110,625	$110,625	$110,625	$110,625	$110,625	$110,625	$110,625	$110,625
Residual Waste Management	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL	$110,625	$110,625	$110,625	$110,625	$110,625	$110,625	$110,625	$110,625	$110,625

	Fiscal Year Year 28 2037	Fiscal Year Year 29 2038	Fiscal Year Year 30 2039	Row Total
MONITORING	$110,625	$110,625	$110,625	$1,046,330
Residual Waste Management	$ -	$ -	$ -	$214,758
TOTAL	$110,625	$110,625	$110,625	$1,261,088

Figure 41

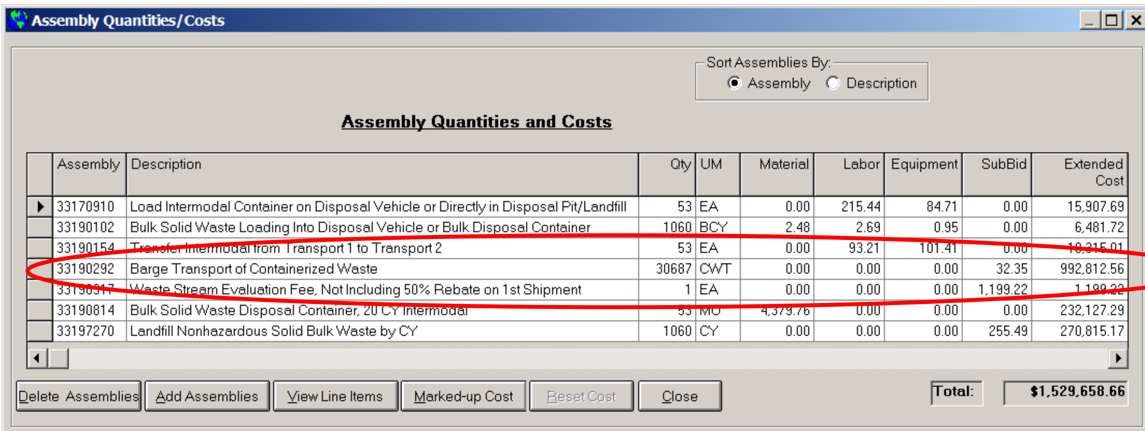
- Recommended Solution: Revise technology to distribute costs over time for appropriate technologies.

System Definition Tab

- Issue: When used in conjunction with the UST Closure/Removal technology, a waste stream of four CY of concrete material is generated for tank removals. The concrete waste stream appears in the Residual Waste Management technology even when the corresponding assembly in the UST Closure/Removal technology is zeroed out (*17020211 Minor site demolition, concrete, reinforced, 7" to 24" thick, remove with backhoe, excludes hauling*).
- Recommended Solution: Revise Residual Waste Management technology to delete concrete when this assembly is zeroed out in companion technology. *Note: this applies to other technologies, such as Monitoring and Excavation. The waste streams in WMS should be linked to assembly quantities of the companion technologies regardless of whether the assembly quantities are user-inputted.*

Assemblies

- Issue: The RACER-generated cost for transport of waste off-site via barge (Figure 42) is commonly substantially higher than actual costs. Furthermore, the barging cost in RACER is not dependent upon number of miles traveled. Cost is the same for barging whether it is going 5 miles or 3,000 miles.



Assembly Quantities/Costs

Sort Assemblies By: Assembly Description

Assembly Quantities and Costs

Assembly	Description	Qty	UM	Material	Labor	Equipment	SubBid	Extended Cost
33170910	Load Intermodal Container on Disposal Vehicle or Directly in Disposal Pit/Landfill	53	EA	0.00	215.44	84.71	0.00	15,907.69
33190102	Bulk Solid Waste Loading Into Disposal Vehicle or Bulk Disposal Container	1060	BCY	2.48	2.69	0.95	0.00	6,481.72
33190154	Transfer Intermodal from Transport 1 to Transport 2	53	EA	0.00	93.21	101.41	0.00	10,315.01
33190292	Barge Transport of Containerized Waste	30687	CWT	0.00	0.00	0.00	32.35	992,812.56
33190317	Waste Stream Evaluation Fee, Not Including 50% Rebate on 1st Shipment	1	EA	0.00	0.00	0.00	1,199.22	1,199.22
33190814	Bulk Solid Waste Disposal Container, 20 CY Intermodal	53	MO	4,379.76	0.00	0.00	0.00	232,127.29
33197270	Landfill Nonhazardous Solid Bulk Waste by CY	1060	CY	0.00	0.00	0.00	255.49	270,815.17

Delete Assemblies | Add Assemblies | View Line Items | Marked-up Cost | Reset Cost | Close

Total: $1,529,658.66

Figure 42

- Recommended Solution: Reevaluate cost of barging and update assembly line item associated with barging. (Assembly line item 33190292 *Barge Transport of Containerized Waste*; per CWT). Reengineer the line item so that the cost of barging is more realistic and is tied to the mileage traveled.

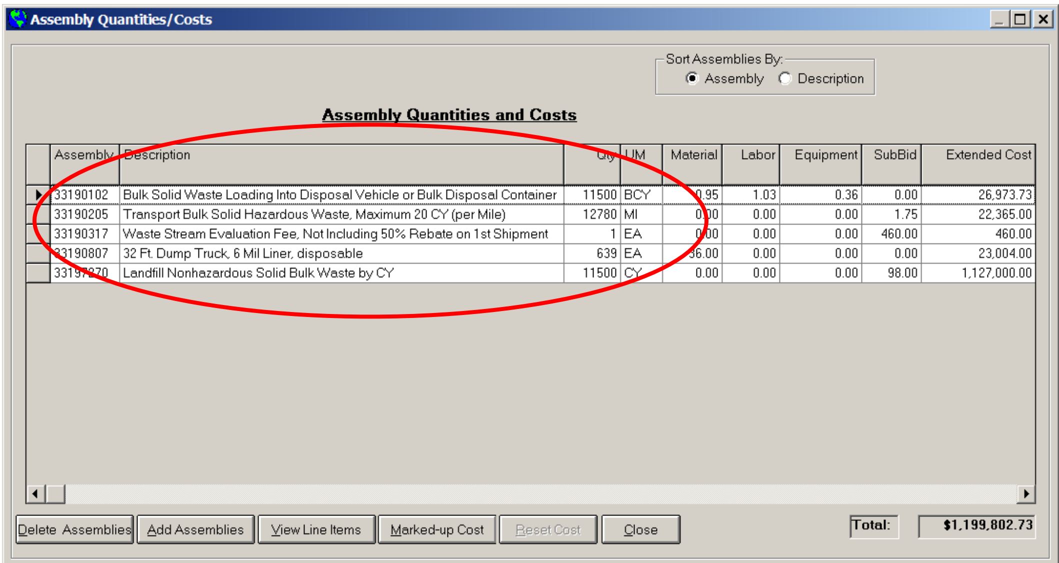
- Issue: Costs of Assembly 33197270 *Landfill Nonhazardous Solid Bulk Waste by CY* ($98/CY), and *33197269 Landfill Nonhazardous Solid Bulk Waste by Ton* ($72.50/TON) were high compared to proposed costs in several projects. Proposed cost for Project SWF-04 (for non-hazardous excavated soil) was $27.5/CY. Based on information obtained from the State of California Integrated Waste Management Board website[34], average disposal fees in the year 2000 for loose or uncompacted solid waste in the State of California were $11.13/CY or $36.00/TON for non-compacted solid waste. Information obtained from the City of Phoenix website[35] indicates a fee of $38[25]/TON for solid waste disposal.

- Recommended Solution: Recent and nationally-relevant averages should be obtained and used for the costs in these assembly line items.

34 *http://www.ciwmb.ca.gov/landfills/tipfees/2000*

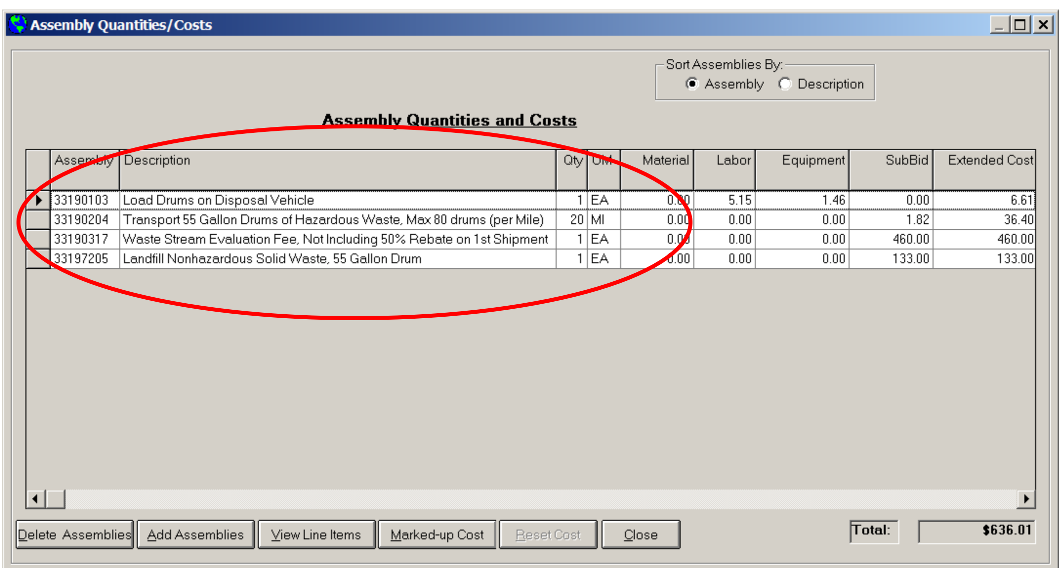
35 *http://phoenix.gov/GARBAGE/landfill.html*

- <u>Issue:</u> Assembly 33190317 *Waste Stream Evaluation Fee, Not Including 50% Rebate on 1st Shipment* at a cost of $460/load of residual waste is a component of the technology. This cost applies to any load of waste, regardless of size/quantity; for example, the quantity and associated cost are the same for a load of one drum and a load of 10,000 CY of soil. Project documentation reviewed for this project indicates that disposal facilities typically do not charge separate evaluation fees for waste streams. Refer to two Figures 43 and 44 below, the first for disposal of 115,000 CY of excavated soil, and the second for disposal of one drum of purge water. Both contain the same quantity and cost for waste stream evaluation.



Assembly	Description	Qty	UM	Material	Labor	Equipment	SubBid	Extended Cost
33190102	Bulk Solid Waste Loading Into Disposal Vehicle or Bulk Disposal Container	11500	BCY	0.95	1.03	0.36	0.00	26,973.73
33190205	Transport Bulk Solid Hazardous Waste, Maximum 20 CY (per Mile)	12780	MI	0.00	0.00	0.00	1.75	22,365.00
33190317	Waste Stream Evaluation Fee, Not Including 50% Rebate on 1st Shipment	1	EA	0.00	0.00	0.00	460.00	460.00
33190807	32 Ft. Dump Truck, 6 Mil Liner, disposable	639	EA	36.00	0.00	0.00	0.00	23,004.00
33197270	Landfill Nonhazardous Solid Bulk Waste by CY	11500	CY	0.00	0.00	0.00	98.00	1,127,000.00

Figure 43



Assembly	Description	Qty	UM	Material	Labor	Equipment	SubBid	Extended Cost
33190103	Load Drums on Disposal Vehicle	1	EA	0.00	5.15	1.46	0.00	6.61
33190204	Transport 55 Gallon Drums of Hazardous Waste, Max 80 drums (per Mile)	20	MI	0.00	0.00	0.00	1.82	36.40
33190317	Waste Stream Evaluation Fee, Not Including 50% Rebate on 1st Shipment	1	EA	0.00	0.00	0.00	460.00	460.00
33197205	Landfill Nonhazardous Solid Waste, 55 Gallon Drum	1	EA	0.00	0.00	0.00	133.00	133.00

Figure 44

- Recommended Solution: Reevaluate cost of waste profiling, and consider including these costs as a component of the disposal fees.

- Issue: There is no assembly for transport of non-hazardous waste streams. Instead, assembly 33190205 *Transport Bulk Solid Hazardous Waste, Maximum 20 CY (per Mile)*; 33190204 *Transport 55 Gallon Drums of Hazardous Waste, Max 80 drums (per Mile)*; or 33190207 *Transport Bulk Liquid/Sludge Hazardous Waste, Maximum 5,000 Gallon (per Mile)* is brought in at the assembly level when waste stream is non-hazardous.
- Recommended Solution: Add additional assemblies to account for transport of non-hazardous waste streams.

- Issue: For purge water generated during semi-annual or quarterly groundwater sampling in the Monitoring technology, the Residual Waste Management assumes only one disposal trip for the year. However, generally purge water is disposed immediately following a sampling event; therefore, there would be two disposal trips for semi-annual sampling and four disposal trips for quarterly sampling. Refer to Figure 45 below where one drum of purge water is generated for each of four annual events (quarterly sampling) but only one disposal trip (Figure 46) is included.

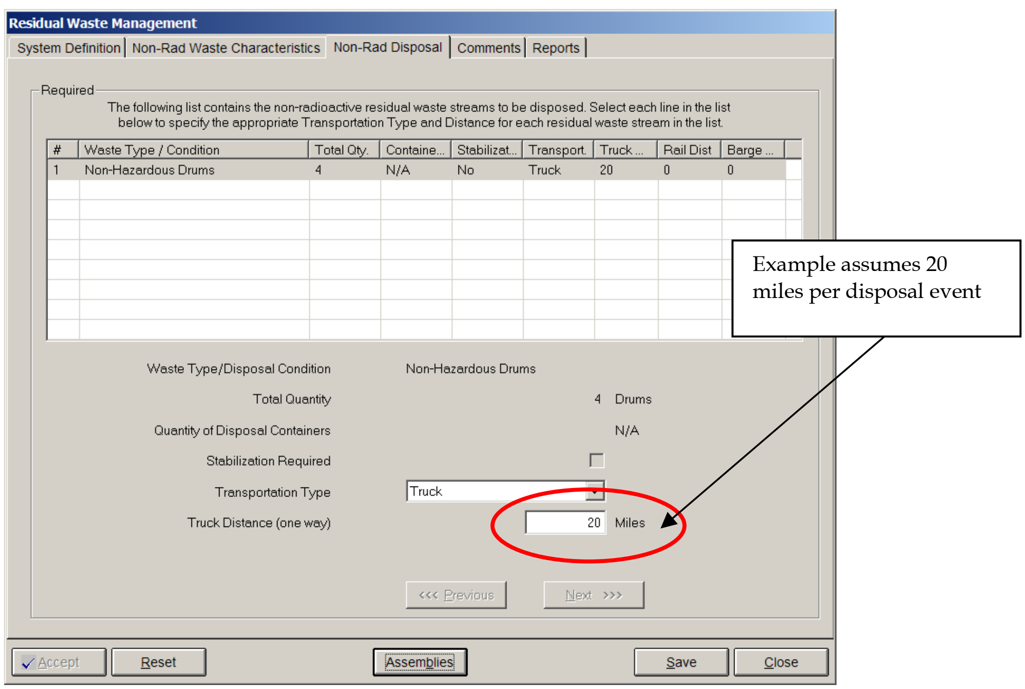
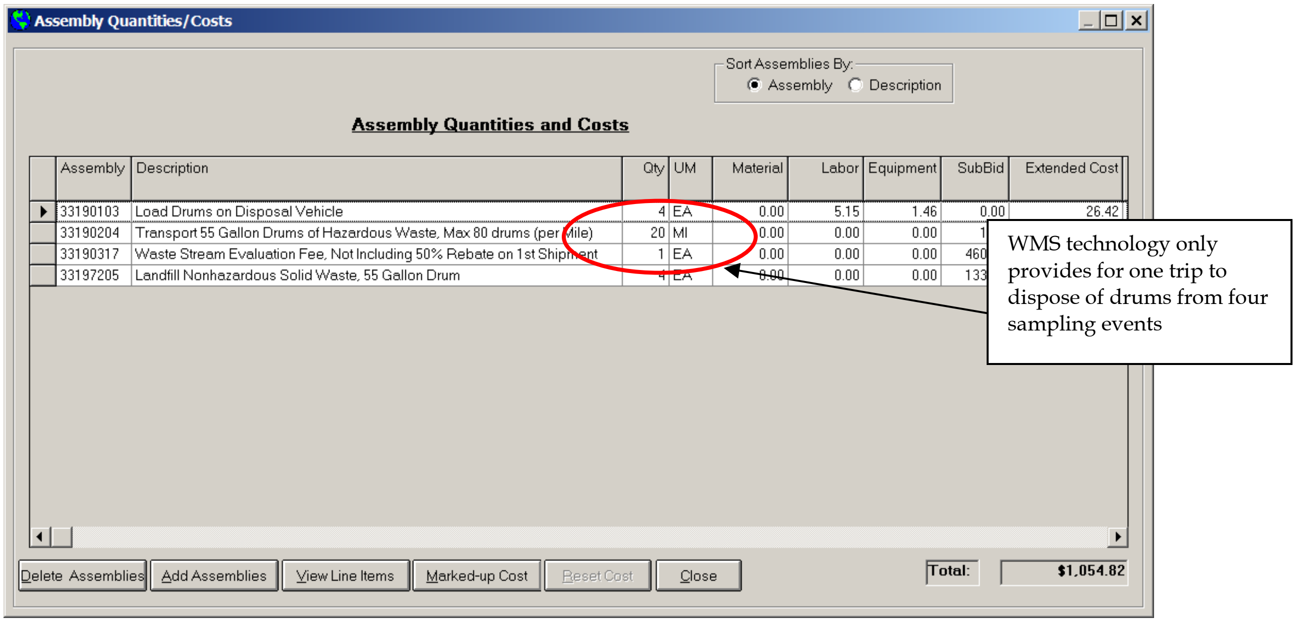


Figure 45



Assembly	Description	Qty	UM	Material	Labor	Equipment	SubBid	Extended Cost
33190103	Load Drums on Disposal Vehicle	4	EA	0.00	5.15	1.46	0.00	26.42
33190204	Transport 55 Gallon Drums of Hazardous Waste, Max 80 drums (per Mile)	20	MI	0.00	0.00	0.00	1	
33190317	Waste Stream Evaluation Fee, Not Including 50% Rebate on 1st Shipment	1	EA	0.00	0.00	0.00	460	
33197205	Landfill Nonhazardous Solid Waste, 55 Gallon Drum	4	EA	0.00	0.00	0.00	133	

Figure 46

- <u>Recommended Solution:</u> Update algorithms to assume equivalent number of disposal events as sampling events

Technology #13: Site Close-Out Documentation

Site Close-Out Documentation was observed a total of 29 times throughout the seven location visits, and two observations were identified in Appendix D. Six instances could be compared at the technology level, and there are a total of eight instances for technology-level comparison when combined with the 2004 data set. The most frequent observations and with suggested solutions are listed below.

General

- <u>Issue:</u> The Help Topic for this technology does not contain enough information to allow the user to properly determine which site complexity is most appropriate for the site. A screen shot of the Help Tab (Figure 47) related to this selection is provided below:

Site Closeout Complexity

Indicates the overall rating of the site in terms of level of contamination and site characteristics. It is used to determine default professional labor hours for separate tasks. The choices are described below:

- Low Site Closeout Complexity – Represents the least complex site in terms of contamination, site characteristics, and access.
- Moderate Site Closeout Complexity - Represents an average site in terms of contamination, site characteristics, and access.
- High Site Closeout Complexity – Represents the most complex site in terms of contamination, site characteristics, and access.

Figure 47

- Recommended Solution: Add additional description to the Help Topic to present details about appropriate complexities for specific sites.

- Issue: Use of this technology often extends to estimate requirements other than site closeout documentation: because RACER does not contain a technology to estimate some types of reporting (e.g., Treatability Reports, Remedial Action Completion Reports) this technology is often used to approximate preparation of other reports.
- Recommended Solution: Consider generalizing this technology to accommodate various types of reporting requirements, with various options for types of reports as the Required Parameter.

Work Plans & Reports tab

- Issue: It is unclear why Progress Reports are included in this technology only, when they are typically a contract requirement for all project types.
- Recommended Solution: Consider adding Progress Reports into a more general technology to cover different types of required reporting (could be a modification to the Site Close-Out Documentation module).

Technology #14: Underground Storage Tank (UST) Closure/Removal

The UST Closure/Removal (UST) technology was observed 18 times throughout the seven location visits; only one instance was able to be compared at the technology level. Combined with technology-level data from the 2004 effort, there are a total of 11 instances of UST that can be compared at the technology level. Several suggestions on enhancements that could be made to the UST technology are provided below.

General

- Issue: RACER does not have the ability to estimate aboveground storage tank (AST) removals/closures. To estimate AST closure, the UST Closure/Removal technology must be used with changes made at the Assembly level to accommodate the aboveground nature of the tanks.
- Recommended Solution: Recommend changing name of UST Closure/Removal to "Tank Closure/Removal" to include options for AST closure/removals in the technology.

- Issue: USTs smaller than 500 gallons can not be estimated in UST Closure/Removal technology (the minimum tank size is 500 gallons.).

- Recommended Solution: Suggest revising the technology to allow for closure/removal of tanks as small as 250 gallons.

- Issue**:** There is no ability to specify piping length in the UST Closure/Removal technology. The technology adds 100 feet of piping demolition as an assembly. These piping lengths can vary greatly, particularly depending on whether or not the tank is connected to a dispenser or a series of dispensers.
- Recommended Solution: Suggest revising the technology and adding an option to allow the user to change the piping length.

- Issue**:** Frequently, tanks of different compositions are located in the same tank pit.
- Recommended Solution: Revise the technology to allow the selection of multiple tank types.

- Issue**:** The technology assumes a straight 50 gallons of contents removed per tank, no matter how large the tank is, if 0% is selected for Tank Percentage Full (average). Suggest making this proportional to tank size. In addition, the amount entered into the % full adds that quantity onto the base of 50 gals. This appears to be an error.
- Recommended Solution: Revise algorithms and revise if necessary.

- Issue: Backfill costs cost for on-site fill appears to be higher than cost for off-site fill; in addition, the quantities are different for the same tank size (and resulting same size excavation):

Assembly	Description	Quantity	Extended Cost
17030423	Unclassified Fill, 6" Lifts, Off-Site, Includes Delivery, Spreading, and Compaction	437 CY	3121.29
17030461	On-Site Backfill for Small Excavations and Trenches, Includes Compaction	402CY	4183.22

- Recommended Solution: Revise algorithms and revise if necessary.

- Issue: For closure-in-place scenarios, the default decontamination for is "none." However, tanks are typically purged prior to tank closure. This is not a selectable option in the UST Removal/Closure technology.

- Recommended Solution: Add a purging option to the tank decontamination method.

- Issue: The only report options available within the UST closure/removal technology are sampling reports.
- Recommended Solution: Revise PLM to include an option for closure reports. Analytical results would be included in these reports. State UST programs typically require more than just the reporting of the analytical results.

Technology #15: Well Abandonment

In the 2004 effort, the following recommendation was made:

> *"Use the historical project data to create a new Well Abandonment cost technology. The new technology will contain options for cutting the well riser below ground, final round of sampling, various types of material to close the well such as gravel, sand and grout, and removal of well casing."*[6]

The recommendation to create a new technology was implemented; however, the options to cut the casing below ground, perform sampling, and choose fill material were not incorporated. Sampling can be accounted for using the Monitoring technology, but the other options are not available to the User. RACER assumes wells will be grouted, and the User is given options only for in-place abandonment or full overdrill/removal of the well.

In the 2008 effort, the well abandonment technology (GWA) was observed 12 times throughout the seven location visits; four instances were able to be compared at the technology level. This technology was new in 2008; therefore, there are no instances brought forward from the 2004 effort. The most frequent observations with GWA and suggested solutions are listed below.

- Issue: The GWA technology does not have the ability to estimate partial removal of well casing, which is a common method of abandonment.
- Recommended Solution: Revise technology to include an option for partial removal, such as cutting casing at a certain depth and grouting.

- Issue: RACER does not include reporting in the Well Abandonment technology. It is common that preparation of a well abandonment or well sealing report is required per state regulations upon completion of abandonment activities. These reports range from short summary letter reports to large-scale detailed well abandonment activity reports. For projects estimated for RACER validation, the

Site Close-Out documentation technology had to be utilized to capture the cost of reporting.

- Recommended Solution: Add an option to GWA to include reports; also consider adding a reporting "level of complexity," as project reporting requirements differ and can range from short summary memos to fully detailed abandonment reports. Since the preparation of reports is a necessary requirement of the well sealing activities, the report option should be included in the GWA technology, not in a separate technology for full site closure reporting (Site Close-Out Documentation).

- Issue: Camera survey/geophysical log was a project requirement that could not be accounted for in RACER.
- Recommended Solution: Add an assembly for this activity from the UPB; if one does not exist in the UPB, suggest that it is researched and submitted for addition to the UPB.

- Issue: Neither GWA or the Groundwater Monitoring Well technology has the ability to estimate well repair.
- Recommended Solution: Revise technology to include addition of items to repair wells; otherwise, ensure adequate assemblies (such as are available so users can add these items.

- Issue: GWA technology does not provide options for selection of grout material. An assembly for grout is included in the estimate; however, most states' well sealing codes call for use of specific materials such as cement grouts, bentonite-based grouts, and clean clay, sand, or gravel.
- Recommended Solution: Add a secondary parameter for the user to select the specific type of grouting material to be used in the well sealing.

- Issue: The system definition screen occasionally does not display all the well groups which have been selected and estimated. Figures 48 and 49, on the following page, show the proper and improper functioning of the system definition screen, respectively. This issue also presents itself in the estimate documentation report, where the full cost is calculated and displayed, but only the first well groups is documented and displayed. This is not auditable estimate documentation.
- Recommended Solution: Review and revise the algorithm which displays the well groups on the system definition screen and on RACER reports.

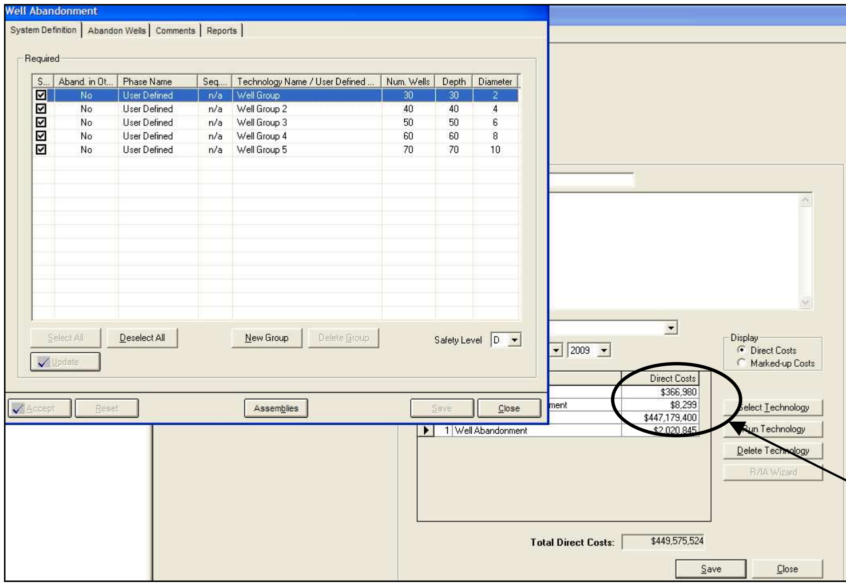


Figure 48

Note that the cost estimates are the same, even though system definition screens do not show the same number of well groups.

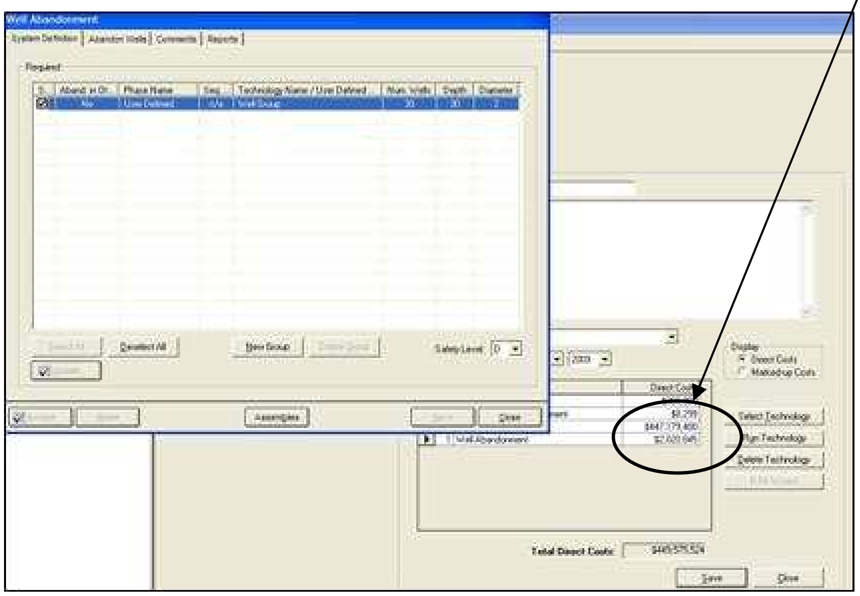


Figure 49

7.0 Findings

This section lists a summary of the overall validation findings that are presented throughout this report. The findings are based on the results of the three pronged analysis employed in the validation to evaluate the performance of the RACER software. The three pronged analysis combines the project-level cost analysis, the technology-level cost analysis, and the technology engineering analysis to provide a more complete picture of software performance.

1. The historical data collection was successful in developing a sample population of sufficient size and diversity to analyze the performance of RACER relative to actual DoD remediation experience. The collection of historical data for completed remediation projects builds upon the previous 2004 RACER Assessment benchmark data. The additional data aids in evaluating and improving the RACER parametric model in two ways:
   - It allows for comparative analysis between the re-engineered RACER 2008 software and the RACER 2004 software
   - It provides a larger sample population for more reliable statistical analyses.
2. The data collection and analysis effort were limited due to the high incidence of FFP contracting utilized at the data collection locations, resulting in difficulty isolating historical costs for comparison to applicable RACER technologies.[36]
3. The project-level cost analysis demonstrates that for the 88 selected projects, the accuracy of RACER as compared to actual costs averaged 28% when only default parameters were modified (Scenario 1), 7% when secondary parameters were also modified (Scenario 2), and 4% when assemblies were also modified (Scenario 3). This analysis demonstrates a significant improvement in the difference between historical costs and the RACER-estimated costs when secondary parameters or assemblies are modified. This finding clearly demonstrates the benefit of utilizing detailed site or project-specific data, where available, in preparing RACER estimates. However, in our project analysis, the use of RACER default values under Scenario 1 produced highly variable results.[37]
4. There is no clear statistical evidence that RACER consistently produces higher or lower estimates in comparison to historical benchmark costs. There is also no clear statistical evidence that RACER produces better estimates for "high cost" or "low cost" projects, defined as greater or less than $500,000 total project cost.
5. Under Scenarios 2, 3, and 4, the true mean cost difference at the project level was lower using RACER 2008 than RACER 2004, indicating improved performance relative to actual costs.

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[36] *Refer to Section 5.0 for a complete discussion of study limitations.*

[37] *See Section 6.0 for further details.*

6. The 14 most frequently occurring technologies were analyzed statistically to determine how the technology-level costs compared to actual costs. Eight of those technologies had negative true mean cost differences, indicating that the average RACER-estimated cost for that technology was lower than actual costs. Six of those technologies had positive true mean cost differences, indicating that the average RACER-estimated cost for that technology was higher than actual costs. The true mean cost difference at Scenario 1 for the fourteen technologies ranged from -44%to 56%. However, only preliminary conclusions should be drawn from the technology-level cost analysis due to the small data sets available for this analysis.[38]

7. Significant recommendations for improved performance of the 14 most frequently occurring RACER technologies (and Well abandonment) are provided in Section 6.0; recommendations for additional technologies are presented in Appendix E.

[38] *Refer to Section 5.0 for more detail on the size of the data sets.*

Appendix A – Acronyms

A&AS	Advisory & Assistance Service
AA	Ammunition Area
AAFES	Army and Air Force Exchange Service
AAP	Army Ammunition Plant
ABS	Absolute
ACS	Alaska Communication System
AEDB-CC	Army Environmental Database—Compliance-Related Cleanup
AEDB-R	Army Environmental Database—Restoration
AFB	Air Force Base
AFCEE	Air Force Center for Engineering and the Environment
AFRIMS	Air Force Restoration Information Management System
AFS	Air Force Station
AOC	Area of Concern
AST	Aboveground Storage Tank
BCY	Bank Cubic Yard
BRAC	Base Realignment and Closure
BTEX	benzene, toluene, ethylbenzene, and xylenes
CAP	Corrective Action Plan
CLIN	Contract Line Item Number
CONUS	Continental United States
CPFF	Cost Plus Fixed Fee
CWT	Counterweight
CY	Cubic Yard
DPE	Dual Phase Extraction
DODI	Department of Defense Instruction
DPT	Direct Push Technology
DRO	Diesel Range Organics
EPA	Environmental Protection Agency
FFID	Federal Facility Identification Number
FFP	Firm, Fixed-Price
FOIA	Freedom of Information Act
FS	Feasibility Study
FUDS	Formerly Used Defense Sites
FUDSMIS	Formerly Used Defense Sites Management Information System
FY	Fiscal Year
GAC	Granular Activated Carbon
GRO	Gasoline Range Organics
GW	Groundwater
GWM	Groundwater Monitoring
HASP	Health and Safety Plan

HVDP	High Vacuum Dual-Phase Extraction
IDW	Investigative-Derived Waste
IGE	Independent Government Estimate
IMR	Interim Model Report
IRP	Installation Restoration Program
ISCO	In-Situ Chemical Oxidation
LEAD	Letterkenny Army Depot
LF	Landfill
LOE	Level of Effort
LSI	Limited Site Inspection
LTM	Long-Term Monitoring
LUC	Land Use Control
MD	Munitions Debris
MEC	Munitions and Explosives of Concern
MMRP	Military Munitions Response Program
MNA	Monitored Natural Attenuation
MR	Munitions Response
O&M	Operations and Maintenance
ORC	Oxygen Release Compound
OU	Operable Unit
PA	Preliminary Assessment
PADEP	Pennsylvania Department of Environmental Protection
PAH	polycyclic aromatic hydrocarbons
PBC	Performance-Based Contract
PCB	Polychlorinated Biphenyl
PDO	Property Disposal Office
PI	Preliminary Investigation
PLM	Professional Labor Management
PNOM	Price Negotiation Objective Memorandum
POC	Point of Contact
PWS	Performance Work Statement
QA	Quality Assurance
QAPP	Quality Assurance Program Plan
RA	Remedial Action
RAB	Restoration Advisory Board
RACER	Remedial Action Cost Engineering and Requirements
RAWP	Remedial Action Work Plan
RCRA	Resource Conservation and Recovery Act
RFP	Request for Proposal
RI	Remedial Investigation
RPM	Remedial Project Manager
RPX	Real Property Exchange

RRO	Residual Range Organics
RRS	Radio Relay Station
SAF/FMC	Secretary of the Air Force/Financial Management and Comptroller
SAP	Sampling and Analysis Plan
SE	South East
SI	Site Inspection
SOS	Scope of Services
SOW	Scope (or Statement) of Work
SSHP	Site Safety and Health Plan (or Site-Specific Health Plan)
SVE	Soil Vapor Extraction
SVOC	Semi-Volatile Organic Compound
SWMU	Solid Waste Management Unit
T&M	Time & Materials
TAL	Target Analyte List
TCA	Trichloroethane
TCE	Trichloroethylene
TERC	Total Environmental Restoration Contract
TO	Task Order
TPH	Total Petroleum Hydrocarbons
TS	Treatability Study
UPB	Unit Price Book
USACE	U.S. Army Corps of Engineers
USAEC	U.S. Army Environmental Command
UST	Underground Storage Tank
VDEQ	Virginia Department of Environmental Quality
VOCs	Volatile Organic Compounds
VV&A	Verification, Validation, & Accreditation
WBG	Winklepeck Burning Ground
WWII	World War II
WWTP	Wastewater Treatment Plant

Appendix B – Project-Level Data Summary Table

Project ID	Historical Cost	Project Year	Esc Fac	Escalated Historical Cost	RACER				%Difference			
					S1	S2	S3	S4	S1	S2	S3	S4
NWK-23	$ 443,805	2008	1.0000	$ 443,805	$ 473,463	$ 413,494	$ 396,452	$ 426,271	7%	-7%	-11%	-4%
NWK-24	$ 405,222	2006	1.0496	$ 425,341	$ 322,839	$ 373,562	$ 357,199	$ 344,557	-24%	-12%	-16%	-19%
NWK-26	$ 80,417	2006	1.0496	$ 84,410	$ 57,532	$ 61,954	$ 67,329	$ 66,453	-32%	-27%	-20%	-21%
AFCEE-04	$ 136,344	2007	1.0240	$ 139,611	$ 152,206	$ 151,036	$ 151,036	$ 94,524	9%	8%	8%	-32%
AFCEE-08	$ 19,999	2007	1.0240	$ 20,478	$ 24,986	$ 22,526	$ 19,375	$ 15,286	22%	10%	-5%	-25%
AFCEE-10	$ 246,763	2007	1.0240	$ 252,676	$ 146,973	$ 146,973	$ 256,556	$ 262,826	-42%	-42%	2%	4%
AFCEE-11	$ 801,482	2008	1.0000	$ 801,482	$ 552,188	$ 777,133	$ 794,930	$ 806,160	-31%	-3%	-1%	1%
AFCEE-12	$ 477,167	2008	1.0000	$ 477,167	$ 374,668	$ 468,775	$ 442,487	$ 372,252	-21%	-2%	-7%	-22%
AFCEE-13	$ 919,983	2006	1.0496	$ 965,659	$ 988,082	$1,047,938	$ 965,490	$ 946,960	2%	9%	0%	-2%
AFCEE-16	$ 272,655	2008	1.0000	$ 272,655	$ 111,103	$ 209,204	$ 237,565	$ 199,598	-59%	-23%	-13%	-27%
AFCEE-24	$1,627,734	2005	1.0821	$1,761,426	$1,440,932	$1,754,068	$1,478,144	$1,049,537	-18%	0%	-16%	-40%
SWF-01	$ 60,462	2002	1.1460	$ 69,289	$ 36,109	$ 30,756	$ 22,749	$ 25,165	-48%	-56%	-67%	-64%
SWF-02	$ 78,396	2003	1.1347	$ 88,955	$ 95,370	$ 91,449	$ 85,785	$ 99,059	7%	3%	-4%	11%
SWF-03	$ 8,597	2004	1.1125	$ 9,564	$ 24,091	$ 16,883	$ 12,037	$ 14,346	152%	77%	26%	50%
SWF-04	$ 121,611	2005	1.0821	$ 131,599	$ 154,133	$ 150,132	$ 122,515	$ 141,472	17%	14%	-7%	8%
SWF-05	$ 67,802	2003	1.1347	$ 76,934	$ 95,666	$ 72,081	$ 66,261	$ 79,903	24%	-6%	-14%	4%
SWF-08	$ 19,125	2007	1.0240	$ 19,583	$ 42,216	$ 42,216	$ 34,721	$ 40,093	116%	116%	77%	105%
SWF-09	$ 232,954	2008	1.0000	$ 232,954	$ 259,122	$ 254,388	$ 243,603	$ 258,985	11%	9%	5%	11%
SWF-10	$ 29,337	2008	1.0000	$ 29,337	$ 26,914	$ 30,519	$ 30,519	$ 36,375	-8%	4%	4%	24%
SWF-12	$ 57,488	2008	1.0000	$ 57,488	$ 102,261	$ 97,433	$ 85,551	$ 102,427	78%	69%	49%	78%
SWF-16	$ 135,089	2007	1.0240	$ 138,326	$ 110,514	$ 120,444	$ 106,142	$ 122,295	-20%	-13%	-23%	-12%
SWF-17	$ 27,769	2007	1.0240	$ 28,434	$ 66,340	$ 36,531	$ 29,764	$ 35,844	133%	28%	5%	26%
POA-01	$1,139,272	2007	1.0240	$1,166,570	$2,096,182	$2,163,543	$2,158,849	$ 858,406	80%	85%	85%	-26%
POA-02	$ 106,903	2007	1.0240	$ 109,464	$ 99,629	$ 94,334	$ 104,473	$ 44,773	-9%	-14%	-5%	-59%
POA-03a	$ 125,413	2008	1.0000	$ 125,413	$ 161,298	$ 89,840	$ 129,489	$ 52,939	29%	-28%	3%	-58%
POA-03b	$ 36,343	2008	1.0000	$ 36,343	$ 108,841	$ 152,741	$ 155,153	$ 62,724	199%	320%	327%	73%
POA-03c	$ 36,343	2008	1.0000	$ 36,343	$ 108,841	$ 152,741	$ 155,153	$ 62,724	199%	320%	327%	73%
POA-04	$ 145,353	2008	1.0000	$ 145,353	$ 111,881	$ 70,662	$ 80,297	$ 62,167	-23%	-51%	-45%	-57%
POA-05	$ 303,951	2008	1.0000	$ 303,951	$ 158,135	$ 77,957	$ 100,753	$ 128,256	-48%	-74%	-67%	-58%
POA-06	$ 462,568	2008	1.0000	$ 462,568	$ 549,185	$ 499,139	$ 348,891	$ 124,692	19%	8%	-25%	-73%

Project ID	Historical Cost	Project Year	Esc Fac	Escalated Historical Cost	RACER				%Difference			
					S1	S2	S3	S4	S1	S2	S3	S4
POA-07	$2,552,638	2006	1.0496	$2,679,372	$2,805,286	$3,072,866	$2,995,141	$1,154,155	5%	15%	12%	-57%
POA-08	$ 122,972	2005	1.0821	$ 133,072	$ 365,111	$ 347,430	$ 282,078	$ 111,730	174%	161%	112%	-16%
POA-09	$2,199,827	2007	1.0240	$2,252,536	$4,586,287	$4,583,199	$3,063,756	$2,392,304	104%	103%	36%	6%
POA-12	$ 125,446	2004	1.1125	$ 139,555	$ 417,257	$ 432,962	$ 268,844	$ 214,738	199%	210%	93%	54%
POA-18	$ 11,264	2003	1.1347	$ 12,781	$ 9,863	$ 9,863	$ 16,891	$ 13,074	-23%	-23%	32%	2%
POA-19	$ 27,045	2003	1.1347	$ 30,688	$ 26,781	$ 27,307	$ 26,106	$ 20,206	-13%	-11%	-15%	-34%
POA-20	$ 345,767	2003	1.1347	$ 392,337	$ 412,513	$ 409,577	$ 409,577	$ 317,275	5%	4%	4%	-19%
POA-22	$ 371,511	2005	1.0821	$ 402,025	$ 548,102	$ 413,329	$ 406,277	$ 315,183	36%	3%	1%	-22%
POA-24	$2,583,842	2001	1.1553	$2,985,030	$7,495,703	$6,338,290	$6,657,638	$2,693,553	151%	112%	123%	-10%
POA-25	$ 263,586	2003	1.1347	$ 299,088	$ 240,496	$ 240,496	$ 358,483	$ 234,558	-20%	-20%	20%	-22%
LRL-01	$ 35,960	2008	1.0000	$ 35,960	$ 70,309	$ 33,629	$ 32,330	$ 36,596	96%	-6%	-10%	2%
LRL-02	$1,122,167	2008	1.0000	$1,122,167	$1,166,439	$1,077,279	$1,145,118	$1,164,900	4%	-4%	2%	4%
LRL-03	$ 88,500	2007	1.0240	$ 90,621	$ 143,464	$ 132,472	$ 146,761	$ 126,300	58%	46%	62%	39%
LRL-04	$ 185,529	2006	1.0496	$ 194,740	$ 131,694	$ 131,694	$ 155,751	$ 142,390	-32%	-32%	-20%	-27%
LRL-05	$ 69,506	2006	1.0496	$ 72,957	$ 110,041	$ 110,041	$ 74,759	$ 60,924	51%	51%	2%	-16%
LRL-06	$1,111,840	2006	1.0496	$1,167,041	$1,015,141	$1,015,141	$ 825,676	$ 756,757	-13%	-13%	-29%	-35%
LRL-07	$ 196,058	2008	1.0000	$ 196,058	$ 188,655	$ 123,445	$ 137,756	$ 140,115	-4%	-37%	-30%	-29%
LRL-08	$ 32,007	2006	1.0496	$ 33,596	$ 90,801	$ 43,040	$ 40,272	$ 41,261	170%	28%	20%	23%
LRL-09	$ 29,868	2006	1.0496	$ 31,351	$ 59,817	$ 40,636	$ 37,259	$ 38,164	91%	30%	19%	22%
LRL-10a	$ 48,778	2007	1.0240	$ 49,947	$ 39,711	$ 39,711	$ 37,783	$ 32,600	-20%	-20%	-24%	-35%
LRL-10b	$ 102,783	2007	1.0240	$ 105,246	$ 42,953	$ 42,953	$ 45,182	$ 38,878	-59%	-59%	-57%	-63%
LRL-10c	$ 103,345	2007	1.0240	$ 105,821	$ 41,111	$ 41,111	$ 42,597	$ 38,786	-61%	-61%	-60%	-63%
LRL-10d	$ 105,802	2007	1.0240	$ 108,337	$ 40,387	$ 40,387	$ 41,761	$ 38,283	-63%	-63%	-61%	-65%
LRL-11	$ 109,124	2008	1.0000	$ 109,124	$ 84,126	$ 109,876	$ 112,097	$ 129,043	-23%	1%	3%	18%
LRL-12	$ 13,420	2005	1.0821	$ 14,522	$ 44,110	$ 44,979	$ 30,434	$ 28,576	204%	210%	110%	97%
LRL-13	$ 132,378	2007	1.0240	$ 135,550	$ 130,404	$ 142,131	$ 139,440	$ 160,887	-4%	5%	3%	19%
LRL-14	$1,600,429	2008	1.0000	$1,600,429	$1,679,874	$1,575,792	$1,548,351	$1,573,611	5%	-2%	-3%	-2%
LRL-15	$ 550,680	2007	1.0240	$ 563,874	$ 203,071	$ 203,071	$ 209,490	$ 212,125	-64%	-64%	-63%	-62%
LRL-16	$ 275,635	2005	1.0821	$ 298,274	$ 308,929	$ 308,929	$ 315,614	$ 318,074	4%	4%	6%	7%
NAB-02	$ 341,779	2008	1.0000	$ 341,779	$ 190,305	$ 371,332	$ 233,190	$ 220,086	-44%	9%	-32%	-36%
NAB-03	$ 29,326	2006	1.0496	$ 30,782	$ 40,246	$ 32,791	$ 30,478	$ 28,521	31%	7%	-1%	-7%
NAB-04	$ 23,972	2005	1.0821	$ 25,941	$ 33,087	$ 32,795	$ 34,620	$ 37,169	28%	26%	33%	43%

Project ID	Historical Cost	Project Year	Esc Fac	Escalated Historical Cost	RACER				%Difference			
					S1	S2	S3	S4	S1	S2	S3	S4
NAB-05	$ 27,420	2005	1.0821	$ 29,672	$ 27,444	$ 27,444	$ 31,249	$ 33,547	-8%	-8%	5%	13%
NAB-08	$ 445,886	2006	1.0496	$ 468,024	$ 636,747	$ 560,370	$ 552,632	$ 538,430	36%	20%	18%	15%
NAB-09	$ 67,448	2007	1.0240	$ 69,064	$ 37,148	$ 37,148	$ 39,369	$ 39,621	-46%	-46%	-43%	-43%
NAB-10	$ 31,262	2007	1.0240	$ 32,011	$ 54,026	$ 42,522	$ 42,522	$ 34,619	69%	33%	33%	8%
NAB-11	$ 36,590	2007	1.0240	$ 37,467	$ 109,004	$ 43,915	$ 47,308	$ 38,745	191%	17%	26%	3%
NAB-12	$ 411,343	2007	1.0240	$ 421,199	$ 380,115	$ 371,040	$ 286,983	$ 289,395	-10%	-12%	-32%	-31%
NAB-16	$ 143,502	2007	1.0240	$ 146,940	$ 173,230	$ 108,695	$ 148,655	$ 146,899	18%	-26%	1%	0%
NAB-17	$1,108,734	2008	1.0000	$1,108,734	$ 946,001	$ 963,591	$1,003,554	$ 841,720	-15%	-13%	-9%	-24%
NAB-18	$ 142,692	2005	1.0821	$ 154,412	$ 149,226	$ 209,309	$ 147,703	$ 137,835	-3%	36%	-4%	-11%
NAB-19	$ 39,467	2005	1.0821	$ 42,709	$ 20,319	$ 20,319	$ 22,666	$ 22,257	-52%	-52%	-47%	-48%
NAB-23	$ 225,427	2007	1.0240	$ 230,828	$ 291,147	$ 281,553	$ 261,316	$ 255,213	26%	22%	13%	11%
SAS-01	$ 518,815	2007	1.0240	$ 531,246	$1,167,346	$1,167,346	$ 541,894	$ 548,627	120%	120%	2%	3%
SAS-02	$ 579,699	2008	1.0000	$ 579,699	$ 576,057	$ 506,219	$ 550,309	$ 649,400	-1%	-13%	-5%	12%
SAS-04	$ 369,300	2005	1.0821	$ 399,632	$ 484,455	$ 283,434	$ 286,845	$ 298,149	21%	-29%	-28%	-25%
SAS-06	$ 898,355	2005	1.0821	$ 972,141	$3,175,487	$ 879,651	$ 872,274	$ 997,506	227%	-10%	-10%	3%
SAS-07	$ 32,529	2008	1.0000	$ 32,529	$ 88,156	$ 57,859	$ 51,543	$ 56,176	171%	78%	58%	73%
SAS-08	$ 72,011	2009	0.9775	$ 70,392	$ 82,990	$ 82,990	$ 82,990	$ 95,364	18%	18%	18%	35%
SAS-10	$ 250,250	2008	1.0000	$ 250,250	$ 601,173	$ 362,009	$ 315,801	$ 369,319	140%	45%	26%	48%
SAS-11	$ 67,114	2006	1.0496	$ 70,446	$ 11,077	$ 31,857	$ 33,008	$ 37,643	-84%	-55%	-53%	-47%
SAS-12	$ 237,280	2008	1.0000	$ 237,280	$ 274,769	$ 279,389	$ 261,085	$ 303,777	16%	18%	10%	28%
SAS-13	$ 672,718	2004	1.1125	$ 748,379	$1,743,403	$ 868,304	$ 952,570	$1,107,940	133%	16%	27%	48%
SAS-14	$ 81,413	2008	1.0000	$ 81,413	$ 115,442	$ 86,549	$ 98,452	$ 115,802	42%	6%	21%	42%
SAS-16	$ 101,276	2008	1.0000	$ 101,276	$ 129,018	$ 138,586	$ 135,482	$ 136,692	27%	37%	34%	35%
SAS-17	$ 77,879	2008	1.0000	$ 77,879	$ 149,630	$ 149,850	$ 127,972	$ 146,010	92%	92%	64%	87%
SAS-18	$ 348,121	2008	1.0000	$ 348,121	$5,766,333	$ 365,739	$ 396,163	$ 453,355	1556%	5%	14%	30%
SAS-19	$ 134,926	2008	1.0000	$ 134,926	$ 86,904	$ 100,260	$ 139,569	$ 157,983	-36%	-26%	3%	17%

Appendix C – Project Summaries for all Historical Projects Selected for Analysis

USACE-NWK-23	
Installation Name:	Fort Riley
FFID:	KS721402075600
Project Name:	Custer Hill Landfill Repairs
Project Date:	28 September 2007 – 30 September 2008 (FY08)
Contract Number:	W912DQ-07-D-0010; Delivery Order 0007
Funding Source:	IRP
Project Location:	Fort Riley, KS
Site(s):	Custer Hill Landfill
Documents Collected:	SOW Revision 1 (20 Sep 07) Contractor's Price Proposal (20 Sep 07) Order for Services (28 Sep 07)
Project Description:	Repair depressions in the cover of the Custer Hill Landfill to eliminate ponding and facilitate runoff, perform surveys, grade drainage features, remove trash and rubble, and perform seeding and mowing.
Total Project Cost:	$443,805
RACER Technologies Used:	1. Cleanup and Landscaping 2. Excavation 3. Trenching/Piping 4. Load and Haul 5. Professional Labor Management

USACE-NWK-24	
Installation Name:	Fort Leonard Wood
FFID:	MO721372097900
Project Name:	Removal of Underground Storage Tanks (USTs)
Project Date:	2005 (FY06)
Contract Number:	W912DQ-05-D-0008
Funding Source:	IRP
Project Location:	Fort Leonard Wood, MO
Site(s):	Buildings 645 & 745
Documents Collected:	SOW (28 Sep 05) IGE (27 Sep 05) Revised Proposal (29 Sep 05)
Project Description:	Remove six (6) USTs at Buildings 645 and 745 along with any contaminated soil, backfill the excavated areas with clean fill, re-plant with a grass cover mix, and provide documentation for bringing the site to closure.
Total Project Cost:	$405,222
RACER Technologies Used:	1. UST Removal/Closure 2. Excavation 3. Residual Waste Management 4. Professional Labor Management

USACE-NWK-26	
Installation Name:	Garland Gap GF Annex and Former Forbes Atlas Missile Site
FFID:	KS79799F027700
Project Name:	Firm Fixed Price Task Order Remediation Services of UST Removals at Former Forbes Atlas Missile Site S-7 in Pottawatomie County, Kansas and Garland Gap GF Annex P-72 Radar Tower, Bourbon County, KS
Project Date:	FY06
Contract Number:	W912DQ-05-D-0008 TO 0004
Funding Source:	FUDS
Project Location:	Bourbon County, KS (Garland Gap)
Site(s):	Garland Gap GF ANX P-72 Radar Tower and Former Forbes Atlas Missile Site S-7
Documents Collected:	Performance Work Statement (Jan 06) Independent Government Estimate (14 Feb 06) Contractor's Proposal (9 Feb 06) Contractor's Revised Proposal (10 Mar 06) Post-Negotiation Price Memorandum (16 Feb 06)
Project Description:	Remove one 5,000 gallon UST (at Garland Gap) and one 275 gallon UST (at Forbes S-7), and perform associated excavation, site restoration, and closure reports.
Total Project Cost:	$80,417
RACER Technologies Used:	1. UST Closure/Removal 2. Cleanup and Landscape 3. Site Close-Out Documentation 4. Residual Waste Management 5. Professional Labor Management

AFCEE-04

Installation Name:	Clear AFS
FFID:	AK057112863800
Project Name:	Site 15 Remedial Investigation
Project Date:	FY07
Contract Number:	F41624-03-D-8597-0205
Funding Source:	Unknown
Project Location:	Clear AFS, AK
Site(s):	Site 15
Documents Collected:	SOW (8 Aug 06) Proposal (23 Aug 06)
Project Description:	Perform Remedial Investigation to aid in the identification of potential source areas of metals contamination in sediment and water at the Site 15 pond.
Total Project Cost:	$136,344
RACER Technologies Used:	1. Remedial Investigation

AFCEE-08

Installation Name:	Andersen AFB
FFID:	GU957309951900
Project Name:	Underground Storage Tank Removal at Building 18017 in Andersen AFB, Guam
Project Date:	15 October 15 2006 through 15 April 15 2007 (FY07)
Contract Number:	FA8903-04-D-8685-004
Funding Source:	Compliance/O&M
Project Location:	Andersen AFB, Guam
Site(s):	UST Removal at Building 18017
Documents Collected:	Supply Order (28 Sep 06) SOW (27 Sep 06) IGE (27 Sep 06) Proposal; Tech & Mgt Approach (26 Sep 06) Cost Proposal (26 Sep 06)
Project Description:	Remove one 650-gallon UST with oil/water separator at Bldg 18017 Andersen AFB, Guam.
Total Project Cost:	$19,999
RACER Technologies Used:	1. UST Removal 2. Residual Waste Management 3. Professional Labor Management

AFCEE-10

Installation Name:	Air Force Plant 85
FFID:	OH557172887000
Project Name:	Air Force Plant 85 Building 10
Project Date:	2006 (FY07)
Contract Number:	F41624-03-D-8597-0196
Funding Source:	Unknown
Project Location:	Columbus, OH
Site(s):	Building 10
Documents Collected:	Proposal (11 Aug 06) SOW (21 Jul 06)
Project Description:	Conduct a Feasibility Study at Building 10 where two former USTs were extracted. The USTs contained 1,1,1-trichloroethane (TCA) and trichloroethylene (TCE). Contamination entered the soil and groundwater. Further investigation is required.
Total Project Cost:	$246,763
RACER Technologies Used:	1. Feasibility Study

AFCEE-11

Installation Name:	Altus AFB
FFID:	OK657152404500
Project Name:	Altus AFB, Site SS-17
Project Date:	2007 (FY08)
Contract Number:	F41624-03-D-8597-0242
Funding Source:	Unknown
Project Location:	Altus AFB, OK
Site(s):	SS-17 & Base Wide (Groundwater monitoring)
Documents Collected:	Proposal (11 Aug 07) SOW (17 Jul 07)
Project Description:	Conduct base wide groundwater monitoring using Monitored Natural Attenuation (MNA) parameters, conduct surface water monitoring, and conduct quarterly maintenance of the Granular Activated Carbon (GAC) system. The monitoring is to verify plume stability throughout the base as well as in the vicinity of the biowall. The GAC system was formerly used to remediate a plume. It is being kept on standby as a secondary remedial technology to the biowall. The GAC system is currently used for the discharge of water obtained during the monitoring of 400 wells.
Total Project Cost:	$801,482
RACER Technologies Used:	1. Natural Attenuation 2. Monitoring 3. Operations & Maintenance

AFCEE-12

Installation Name:	Edwards AFB
FFID:	CA957172450400
Project Name:	OU 5/10 Site 282 Enhanced Bioremediation Treatability Study
Project Date:	21 September 2007 to 20 March 2009 (FY08)
Contract Number:	F41624-03-D-8597, TO 0234
Funding Source:	Unknown
Project Location:	Edwards AFB, CA
Site(s):	Site 282
Documents Collected:	SOW (26 Jun 07) Cost Proposal (6 Sep 07) Technical Proposal (6 Sep 07) Confirmation of Negotiations (18 Sep 07)
Project Description:	Conduct treatability study for enhanced in-situ bioremediation for spots at Site 282; install groundwater monitoring wells; conduct sampling; prepare treatability report; dispose Investigative-Derived Waste (IDW) on site.
Total Project Cost:	$477,167
RACER Technologies Used:	1. Monitoring 2. In Situ Biodegradation 3. Groundwater Monitoring Wells 4. Residual Waste Management 5. Professional Labor Management 6. Site Closeout Documentation

AFCEE-13	
Installation Name:	Chanute AFB
FFID:	IL557002475700
Project Name:	Landfill Operation, Maintenance, and Monitoring for Landfill 1 (LF016), Landfill 2 (LF014), and Landfill 3 (LF018)
Project Date:	January 2006 – July 2007 (FY06 - FY07)
Contract Number:	F41624-03-D-8609, Task Order 0343
Funding Source:	BRAC
Project Location:	Chanute AFB, IL
Site(s):	Landfill 1 (LF016), Landfill 2 (LF014), and Landfill 3 (LF018)
Documents Collected:	Confirmation of Negotiations (19 Dec 05) Price Proposal (14 Dec 05) Technical Proposal (14 Dec 05)
Project Description:	Conduct O&M of three landfills, including landfill inspections, landfill gas monitoring, groundwater and storm water sampling, and landfill repairs
Total Project Cost:	$919,983
RACER Technologies Used:	1. UST Closure/Removal 2. Excavation 3. Off-Site Transportation and Waste Disposal 4. Professional Labor Management 5. Trenching/Piping 6. Operations & Maintenance 7. Monitoring

AFCEE-16

Installation Name:	Edwards AFB
FFID:	CA957172450400
Project Name:	OU 7/Site 3 Groundwater and Vapor Monitoring Sampling FSPM 2007-7655 at Edwards AFB, CA
Project Date:	31 July 2007 through 31 July 2009 (FY07 – FY08)
Contract Number:	F41624-03-D8597-0233
Funding Source:	Unknown
Project Location:	Edwards AFB, CA
Site(s):	OU 7/Site 3
Documents Collected:	SOW (19 Jun 07) Price Negotiation Memorandum (19 Jul 07) Technical Evaluation (12 Jul 07) Confirm of Negotiation (18 Jul 07) Contractor Proposal (10 Jul 07)
Project Description	Conduct one round of groundwater sampling from 14 monitoring wells and one round of vapor sampling from five landfill vapor monitoring wells at site 3.
Total Project Cost:	$272,655
RACER Technologies Used:	1. Monitoring 2. Site Closeout Documentation

AFCEE-24

Installation Name:	Andersen AFB
FFID:	GU957309951900
Project Name:	Interim Remedial Action at Ritidian Point Dump Site
Project Date:	2005 (FY04-FY05)
Contract Number:	FA8903-04-D-8676
Funding Source:	ERA
Project Location:	Andersen AFB, Guam
Site(s):	Ritidian Point Dump Site
Documents Collected:	SOW (5 May 04) Contractor Proposal (29 Jun 04)
Project Description:	Excavate 9,200 BCY of lead-contaminated soil; perform on-site treatment of lead contaminated soil using triple phosphate stabilizing agent. Perform sampling and analysis of contaminated soil, transport waste, and backfill excavated area.
Total Project Cost:	$1,627,734
RACER Technologies Used:	1. Off-Site Transportation and Waste Disposal 2. Excavation 3. Residual Waste Management 4. Professional Labor Management

USACE-SWF-01

Installation Name:	Lone Star Army Ammunition Plant
FFID:	TX621382183100
Project Name:	Removal of Soil and Site Restoration at G Ponds Unit
Project Date:	2002
Contract Number:	DACA63-01-D-0012-0002
Funding Source:	Unknown
Project Location:	Texarkana, TX
Site(s):	Lone Star Army Ammunition Plant, G Ponds
Documents Collected:	Solicitation/MOD (30 Sep 02) Detailed SOW (20 Sep 02) Price Negotiation Memorandum (4 Apr 02) Contractor's Cost Estimate (1 Apr 02)
Project Description:	Conduct contaminated soil removal in two zones; the Eastern PLC Zone (MPSS-75) east of Building G-1, and the Western PLC Zone. Excavate and dispose of the contaminated soil; backfill and restore the site.
Total Project Cost:	$60,462
RACER Technologies Used:	1. Demolition, Underground Pipes 2. Excavation 3. Residual Waste Management 4. Professional Labor Management

USACE-SWF-02

Installation Name:	Lone Star Army Ammunition Plant
FFID:	TX621382183100
Project Name:	Excavation of Contaminated Soil at the K-15 North and South Area
Project Date:	2003
Contract Number:	DACA63-01-D-0012-0008
Funding Source:	Unknown
Project Location:	Texarkana, TX
Site(s):	K-15 North and South
Documents Collected:	Order for Supplies and Services (1 Aug 03) Detailed SOW (Jul 03) Figure of Excavation Area (Aug 01) Purchase Request and Commitment (1 Aug 03) Contractor Cost Estimate (27 Jul 03)
Project Description:	Excavate soil at the K-15 North and South areas. Remove approximately 609 CY of soil; work included soil excavation, disposal of stockpiled soil, and restoration of the site.
Total Project Cost:	$78,396
RACER Technologies Used:	1. Excavation 2. Cleanup and Landscaping 3. Residual Waste Management 4. Professional Labor Management

USACE-SWF-03	
Installation Name:	Former Zapata AFS
FFID:	TX69799F674400
Project Name:	Removal of (2) 500 gallon UST @ Former Zapata AFS
Project Date:	March 2004 (FY04)
Contract Number:	DACA63-01-D-0012-0011
Funding Source:	Unknown
Project Location:	Zapata, TX
Site(s):	N/A
Documents Collected:	SOW (2 Mar 04) Proposal (17 Feb 04) Order for Supplies or Services (31 Mar 04) Purchase Request and Commitment (11 Mar 04) Price Negotiation Memorandum (5 Mar 04)
Project Description:	Remove two 500 gallon USTs, vents, fill pipes, and associated piping. Conduct sampling and analysis of soil from all four sides and under each tank, purging and ensuring the tanks are empty, backfill the tank hold, topsoil replacement, grass seeding and mulch, and create and submit four copies of closure report.
Total Project Cost:	$8,597
RACER Technologies Used:	1. UST Closure/Removal 2. Residual Waste Management

USACE-SWF-04

Installation Name:	Lone Star Army Ammunition Plant
FFID:	TX621382183100
Project Name:	Excavation of Contaminated Soil at Unit 16 - High Explosive Burning Ground
Project Date:	2004
Contract Number:	DACA63-01-D-0012-0017
Funding Source:	Unknown
Project Location:	Texarkana, TX
Site(s):	Unit 16
Documents Collected:	SOW (19 Apr 05) Contractor Proposal (7 Apr 05) Order for Supplies or Services (4 May 2005)
Project Description:	Excavate contaminated soil to facilitate site remediation and subsequent closure of Unit 16. Perform all activities required for remediation of the site including soil excavation and stockpiling, disposal of stockpiled soil, and restoration of the site. Confirmation sampling and analyses and waste characterization were performed under a separate contract.
Total Project Cost:	$121,611
RACER Technologies Used:	1. Excavation 2. Residual Waste Management 3. Professional Labor Management

USACE-SWF-05

Installation Name:	Fort Bliss
FFID:	TX621372010100
Project Name:	Fort Bliss Assessment and Remediation Activities
Project Date:	March 2003
Contract Number:	DACA631-01-D-0013-0015
Funding Source:	Unknown
Project Location:	Fort Bliss, TX
Site(s):	Buildings 11106, 2469, 11024, 1742
Documents Collected:	SOW (3 May 03) Proposal (12 Mar 03) Price Negotiation Memorandum (20 Mar 03)
Project Description:	Conduct pilot tests using high vacuum dual-phase extraction (HVDP) technology. Annual groundwater monitoring will also be performed at Buildings 11106 and 2469, with additional free product and groundwater assessment to be performed at Building 11106. Following quarterly sampling and an annual groundwater monitoring and reporting event, monitoring wells at Building 11024 will be plugged and abandoned and the Final Site Closure Report will be prepared and submitted. Monitoring wells at Building 1742 will be plugged and abandoned and the Final Site Closure Report will be prepared and submitted.
Total Project Cost:	$67,802
RACER Technologies Used:	1. Groundwater Monitoring Well 2. Monitoring 3. Residual Waste Management 4. Well Abandonment 5. Site Close-out Documentation

USACE-SWF-08

Installation Name:	Lone Star Army Ammunition Plant
FFID:	TX621382183100
Project Name:	Excavation of Contaminated Soil at Unit 6-BB-15 Area
Project Date:	November 2006 (FY07)
Contract Number:	W9126G-06-D-0018
Funding Source:	Unknown
Project Location:	Texarkana, TX
Site(s):	Unit 6 BB-15 Area
Documents Collected:	Order for Supplies and Services (5 Dec 06) Detailed SOW (1 Nov 06) MOD 1 (23 Oct 06) Contractor's Price Proposal (11 Nov 06)
Project Description:	Transport approximately 300 cubic yards of contaminated soil from stockpile Area A within the BB-15 area to a Class 1 disposal facility.
Total Project Cost:	$19,125
RACER Technologies Used:	1. Load and Haul

USACE-SWF-09	
Installation Name:	Fort Polk
FFID:	LA621402071600
Project Name:	Removal of Underground Storage Tanks, Buildings 1725 & 4919
Project Date:	September 2007
Contract Number:	W9126G-06-D-0018-0009
Funding Source:	Unknown
Project Location:	Fort Polk, LA
Site(s):	Building 1725 and Building 4919
Documents Collected:	SOW (10 Sep 07) Proposal (17 Sep 07) Order for Supplies or Services (25 Sep 07)
Project Description:	Remove six 10,000-gallon USTs and associated piping, three tanks at Building 1725 and three at Building 4919, residual liquid or sludge in the tanks, and associated facilities and piping; conduct testing and reporting; and complete site restoration.
Total Project Cost:	$232,954
RACER Technologies Used:	1. UST Closure/Removal 2. Demolition, Pavements 3. Residual Waste Management 4. Resurfacing Roadways/Parking Lots 5. Professional Labor Management

USACE-SWF-10

Installation Name:	U.S. Border Patrol Site, Brackettville, TX
FFID:	Unknown
Project Name:	Cleanup and Remediation of a 2.6 acre site for the US Customs and Border Patrol Facility
Project Date:	March 2008
Contract Number:	W9126G-06-D-0018-0011
Funding Source:	Unknown
Project Location:	Brackettville, TX
Site(s):	N/A
Documents Collected:	SOW (25 Feb 08) Proposal (25 Feb 08) Order for Supplies or Services (5 Mar 08)
Project Description:	Remove debris and potentially contaminated soil at the 2.6 acre site.
Total Project Cost:	$29,337
RACER Technologies Used:	1. Drum Staging 2. Excavation 3. Off-site Transportation and Waste Disposal 4. Residual Waste Management 5. Professional Labor Management

USACE-SWF-12

Installation Name:	Fort Bliss
FFID:	TX621372010100
Project Name:	Soil Gas Survey and Methane Remediation, Municipal Solid Waste Landfill
Project Date:	September 2007
Contract Number:	W9126G-06-D-0020-0013
Funding Source:	Unknown
Project Location:	Fort Bliss, TX
Site(s):	Municipal Solid Waste Landfill
Documents Collected:	SOW (31 Aug 07) Proposal (7 Sep 07)
Project Description:	Perform a methane gas survey and install two passive vent wells. Revise methane gas monitoring plan.
Total Project Cost:	$57,488
RACER Technologies Used:	1. Groundwater Monitoring Well 2. Remedial Investigation 3. Residual Waste Management 4. Professional Labor Management

USACE-SWF-16	
Installation Name:	Lone Star Army Ammunition Plant, TX
FFID:	TX621382183100
Project Name:	Long Term Monitoring at the G Ponds and O Ponds Compliance Plan No. CP-50292 at Lone Star Army Ammunition Plant, TX
Project Date:	March 2007 through February 2008
Contract Number:	W9126G-06-D-0017-0006
Funding Source:	Unknown
Project Location:	Texarkana, TX
Site(s):	Long Term Monitoring at the G Ponds and O Ponds
Documents Collected:	Supply Order (23 Feb 07) SOW (2 Feb 07) Acceptance Memo (14 Feb 07) Technical Analysis (14 Feb 07) Cost Proposal (13 Feb 07)
Project Description:	Perform groundwater and surface water monitoring at the G and O Ponds at the LSAAP, Texarkana, TX.
Total Project Cost:	$135,089
RACER Technologies Used:	1. Monitoring 2. Residual Waste Management

USACE-SWF-17

Installation Name:	Fort Bliss
FFID:	TX621372010100
Project Name:	FY06 Groundwater Monitoring and Reporting at Building 11106
Project Date:	30 September 2006
Contract Number:	W9126G-06-D-0020-0008
Funding Source:	Unknown
Project Location:	Fort Bliss, TX
Site(s):	Building 11106
Documents Collected:	Order for Services (30 Sep 06) SOW (13 Sep 06) Proposal (27 Sep 06)
Project Description:	Perform one annual groundwater monitoring event in December 2006 at 36 monitoring wells, and analyze each sample for TPH and benzene, toluene, ethylbenzene, and xylenes (BTEX.)
Total Project Cost:	$27,769
RACER Technologies Used:	1. Monitoring 2. Residual Waste Management

USACE-POA-01

Installation Name:	Amaknak Island (FUDS)
FFID:	AK09799F299500
Project Name:	Environmental Design and Remediation, Pre-WWII Tank Farm
Project Date:	2007
Contract Number:	DACA85-95-D-0018, TO 0026 Mod 09
Funding Source:	Unknown
Project Location:	Amaknak Island, Unalaska, Alaska
Site(s):	Pre-WWII Tank Farm
Documents Collected:	Proposal No. 2 (21 Aug 07) Modification of Contract (7 Sep 07) Final Focused Feasibility Study Report (May 06) Final Remedial Action Report (May 08)
Project Description:	Excavate petroleum contaminated soil, collect and analyze confirmatory samples, and transport and dispose of excavated soil off-site.
Total Project Cost:	$1,139,272
RACER Technologies Used:	1. Excavation 2. Residual Waste Management 3. Professional Labor Management

USACE-POA-02	
Installation Name:	Amaknak Island (FUDS)
FFID:	AK09799F299500
Project Name:	GW Monitoring, Amaknak Pre-WWII Tank Farm
Project Date:	2007
Contract Number:	W911KB-05-D-007
Funding Source:	Unknown
Project Location:	Unalaska, Alaska
Site(s):	Amaknak Pre-WWII Tank Farm
Documents Collected:	GW Monitoring Program 2006 Annual Report (Aug 06) Final GW Monitoring Program 2007 Annual Report (8 Feb 08) Order for Supplies or Services (29 Mar 07) Contractor Proposal (29 Mar 07)
Project Description	GW Monitoring to occur between May 1 and June 19, 2007. Based on previous monitoring, sampling should be conducted for VOCs, PAH and fuels. One sampling event will take place at seven wells. Wells containing free product will not be sampled.
Total Project Cost	$106,903
RACER Technologies Used:	1. Monitoring

USACE-POA-03a	
Installation Name:	Amaknak Island (FUDS)
FFID:	AK09799F299500
Project Name:	Well Installation, Amaknak Pre-WWII Tank Farm
Project Date:	2008
Contract Number:	W911KB-08-D-0004
Funding Source:	Unknown
Project Location:	Unalaska, Alaska
Site(s):	Amaknak Pre-WWII Tank Farm
Documents Collected:	Amaknak Pre-WWII Tank Farm Well Installation and Monitoring Work Plan (Jul 08) Contractor Proposal (20 Jun 08) GW Monitoring Program 2006 Annual Report (Aug 06)
Project Description	Under this task, the contractor will install, develop, and survey five monitoring wells.
Total Project Cost	$125,413
RACER Technologies Used:	5. Monitoring 6. Professional Labor Management 7. Residual Waste Management 8. Groundwater Monitoring Well

USACE-POA-03b	
Installation Name:	Amaknak Island (FUDS)
FFID:	AK09799F299500
Project Name:	2009 GW Sampling, Amaknak Pre-WWII Tank Farm
Project Date:	2008
Contract Number:	W911KB-08-D-0004
Funding Source:	Unknown
Project Location:	Unalaska, Alaska
Site(s):	Amaknak Pre-WWII Tank Farm
Documents Collected:	Amaknak Pre-WWII Tank Farm Well Installation and Monitoring Work Plan (Jul 08) Contractor Proposal (20 Jun 08) GW Monitoring Program 2006 Annual Report (Aug 06)
Project Description	The contractor will sample and analyze GW for diesel range organics, residual range organics, benzene, toluene, ethylbenzene, and xylenes (BTEX), and PAHs.
Total Project Cost	$36,343
RACER Technologies Used:	1. Monitoring 2. Residual Waste Management

USACE-POA-03c	
Installation Name:	Amaknak Island (FUDS)
FFID:	AK09799F299500
Project Name:	2010 GW Sampling, Amaknak Pre-WWII Tank Farm
Project Date:	2008
Contract Number:	W911KB-08-D-0004
Funding Source:	Unknown
Project Location:	Unalaska, Alaska
Site(s):	Amaknak Pre-WWII Tank Farm
Documents Collected:	Amaknak Pre-WWII Tank Farm Well Installation and Monitoring Work Plan (Jul 08) Contractor Proposal (20 Jun 08) GW Monitoring Program 2006 Annual Report (Aug 06)
Project Description	The contractor will sample and analyze GW for diesel range organics, residual range organics, BTEX, and PAHs.
Total Project Cost	$36,343
RACER Technologies Used:	1. Monitoring 2. Residual Waste Management

USACE-POA-4

Installation Name:	Fort Richardson
FFID:	AK021002215700
Project Name:	Well Assessment and Compliance Moose Run Golf Course
Project Date:	July 2008 (Contract Award)
Contract Number:	W911KB-05-D-0007 TO 0008 Mod 05
Funding Source:	Unknown
Project Location:	Fort Richardson, Alaska (13 miles outside Anchorage)
Site(s):	N/A
Documents Collected:	Final Tech Memo (29 Sep 08) Contract Award (28 Jul 08) SOW (28 May 08) Proposal (25 Jun 08)
Project Description:	GW Monitoring of eight wells for pesticides & herbicides.
Total Project Cost:	$145,353
RACER Technologies Used:	1. Monitoring

USACE-POA-05

Installation Name:	Former Alaska Communications Site
FFID:	AK09799F272200
Project Name:	Alaska Communications System Radio Relay Site Drum Removal
Project Date:	August 2007
Contract Number:	W911KB-06-D-0006 TO 0005
Funding Source:	FUDS
Project Location:	Tok, AK
Site(s):	Buried Drum
Documents Collected:	Proposal (May 07) Project Work Plan (Aug 07) Project Final Report (Jan 08)
Project Description:	Removal of buried drums suspected of containing Agent Orange. Excavate 75'x10'x10 area to uncover suspected buried drums (six suspected), transfer product to new drums; over-pack old drums; dispose of ~300 pounds of hazardous waste at closest Canadian Hazardous Waste facility. Characterize excavation surface beneath each drum for contaminants of concern (Pesticide, Herbicide, GRO, DRO, BTEX, and Dioxins); perform TCPL characterization (VOC, SCOC, Pesticide, Herbicide, and Metals) on drum contents for disposal profiling; backfill excavation with excavated material and supplement with clean fill to account for removed drum voids.
Total Project Cost:	$303,951
RACER Technologies Used:	1. Buried Drum Removal 2. Excavation 3. Drum Staging 4. Residual Waste Management 5. Professional Labor Management

USACE-POA-06	
Installation Name:	American River FUDS
FFID:	F10AKF10AK0814_01
Project Name:	American River Formerly Used Defense Site
Project Date:	2007
Contract Number:	W911KB-06-D-009 DO 0002
Funding Source:	FUDS
Project Location:	American River FUDS (near Nome, AK)
Site(s):	American River FUDS
Documents Collected:	Order for Supplies or Services (28 Dec 07) Contractor Proposal (20 Dec 07) IGE (19 Dec 07)
Project Description:	This project is to remove and treat/dispose of one overpacked drum and six tons of lead contaminated soil at this site. Options include removing and treating/disposing of additional 14 tons of lead contaminated soil and 38 tons of petroleum contaminated soil. The deliverable is a Remedial Action Report providing information on the tasks performed, characterization data, and results.
Total Project Cost:	$462,568
RACER Technologies Used:	1. Excavation 2. Monitoring 3. Off-site Transportation and Waste Disposal 4. Professional Labor Management

USACE-POA-07	
Installation Name:	DoD Facilities located on Cape Sarichef
FFID:	AK09799F293400
Project Name:	2006 Cape Sarichef Interim Removal Action
Project Date:	2006
Contract Number:	DACA85-95-D-0018 TO 0027
Funding Source:	FUDS
Project Location:	Cape Sarichef, Alaska
Site(s):	White Alice Communication System (WACS) and the United States Coast Guard (USCG) Long Range Aid to Navigation (LORAN) Facilities
Documents Collected:	Work Plan, 2006 Cape Sarichef Interim Removal Action (Jul 06) Final Report, Cape Sarichef Interim Removal Action (Mar 07) Contractor Estimate and Basis of Estimate (10 Jan 06) Individual Contracting Report (documents contract completion 28 Nov 08) Order for Supplies or Services (24 Jan 06) Scope of Work (Jan 06)
Project Description	Cape Sarichef Interim Removal Action and Demobilization. Removal of pipeline, ASTs, USTs. Drain and treat UST contents and drain ASTs of usable fuel. Confirmatory samples at all removal sites.
Total Project Cost	$2,552,638
RACER Technologies Used:	1. Monitoring 2. UST Closure/Removal 3. Off-Site Transportation and Waste Disposal 4. Site Close out Documentation 5. Site inspection 6. Residual Waste Management

USACE-POA-08	
Installation Name:	Fort Learnard, Unalaska, AK
FFID:	AK09759F250700
Project Name:	Additional Investigation of Eight Sites
Project Date:	August 2007
Contract Number:	W911KB-06-D-0006/TO 0005
Funding Source:	FUDS
Project Location:	Unalaska, AK
Site(s):	E1-10, E1-14, E1-17, E1-18, E1-24, E1-28, E1-42, E1-46,
Documents Collected:	SOW (24 Oct 05) Project Work Plan (Jun 06) Project Final Characterization Report (Oct 07)
Project Description:	Supplemental investigation to fill data gaps and confirm absence or extent of soils contamination. Primary COC is fuels contamination (GRO, DRO, RRO, BTEX), but also metals (esp. lead), and PCBs (Site E-46, transformer storage). Also, magnetometer survey to locate USTs at two sites, use of on-site IR spectrometer for screening soil samples for lead, and UXO safety officer oversight required for accessing site E1-42.
Total Project Cost:	$122,972
RACER Technologies Used:	1. Remedial Investigation

USACE-POA-09	
Installation Name:	Hoonah Remedial Relay Station
FFID:	AK09799F261200
Project Name:	Hoonah Remedial Relay Station Remedial Action
Project Date:	2007
Contract Number:	W911KB-06-D-0007
Funding Source:	Unknown
Project Location:	Hoonah, Alaska
Site(s):	Hoonah Radio Relay Station
Documents Collected:	Hoonah RRS RA Report – Final (Apr 08) Hoonah RRS RA Work Plan Rev 1, (Jul 07) Hoonah Summary of Work (15 Nov 05) Proposal Requirements (undated) Unsolicited Price Proposal, Mod 1 (15 Aug 07)
Project Description	Excavate, transport and dispose of PCB-contaminated soil in excess of 1,271 tons at a price of $1,479.34 per ton. Site Closeout documentation and reports will be provided upon completion of fieldwork.
Total Project Cost	$2,199,827
RACER Technologies Used:	1. Decontamination Facilities 2. Excavation 3. Professional Labor Management 4. Residual Waste Management

USACE-POA-12

Installation Name:	Northeast Cape
FFID:	AK017002757200
Project Name:	NE Cape (Saint Lawrence Island) RA, soil removal
Project Date:	2004
Contract Number:	W911KB-04-C-0019
Funding Source:	Unknown
Project Location:	Saint Lawrence Island, Alaska
Site(s):	Northeast Cape
Documents Collected:	Solicitation, Offer & Award; Supplies or Services and Price Costs; Statement of Work (Apr 04)
Project Description:	This project covers CLIN 0014- Excavating, packaging, transporting and disposing of PCB contaminated soil from 7 locations.
Total Project Cost:	$125,446
RACER Technologies Used:	1. Decontamination Facilities 2. Excavation 3. Cleanup and Landscaping 4. Professional Labor Management 5. Residual Waste Management

USACE-POA-18

Installation Name:	Fort Richardson
FFID:	AK021002215700
Project Name:	Circle Drive Soil Stockpile Assessments and Bldg 47-220 Soil Excavation Assessment and Treatment
Project Date:	2002
Contract Number:	DACA-85-02-C-0013 P00001
Funding Source:	Unknown
Project Location:	Fort Richardson, Alaska
Site(s):	Circle Drive Soil Stockpile
Documents Collected:	Fence proposal (18 Sep 02) Revised SOW (13 Sep 002) IGE (13 Sep 02)
Project Description:	This project specifies installing a fence around Stockpile A at Fort Richardson.
Total Project Cost:	$11,264
RACER Technologies Used:	1. Fencing

USACE-POA-19	
Installation Name:	Wildwood Air Force Station
FFID:	AK09799F273900
Project Name:	Wildwood AFS Well Installation and LTM
Project Date:	2004
Contract Number:	DACA85-03-C-0019 P0002
Funding Source:	Unknown
Project Location:	Wildwood Air Force Station
Site(s):	Monitoring Wells 30 and 31
Documents Collected:	Statement of Work (Jan 04) Contractor Item 9 Revised Assumptions (Oct 03) Contracting Action (Mar 04)
Project Description:	Install and Develop Two GW Monitoring Wells (MW-30 and MW-31) at former tank farm area at Wildwood Air Force Station.
Total Project Cost:	$27,045
RACER Technologies Used:	1. Groundwater Monitoring Well 2. Monitoring 3. Residual Waste Management

USACE-POA-20

Installation Name:	Whittier, Alaska
FFID:	AK09799F906800
Project Name:	Port of Whittier Utilidor Removal
Project Date:	2003
Contract Number:	DACA85-03-C-0016
Funding Source:	Unknown
Project Location:	Whittier, Alaska
Site(s):	Monitoring Wells 30 and 31
Documents Collected:	Memo for Record (19 Nov 03) Modification to Contract (24 Jun 03) Price Negotiation Memo (13 Nov 03) Cost Proposal, Mod# P00002, Tech & Mgt Approach (10 Oct 03)
Project Description:	Remove and dispose of asbestos insulation from 550 LF of 6 to 8 inch pipe. Remove and dispose up to 250 cubic yards (cy) of debris containing soil, concrete rebar, and piping that is contaminated with asbestos and Bunker "C" fuel. Treat or dispose up to 24,000 gallons of petroleum contaminated water.
Total Project Cost:	$345,767
RACER Technologies Used:	1. Asbestos Removal 2. Excavation 3. Residual Waste Management 4. Off-site Transportation and Disposal 5. Professional Labor Management

USACE-POA-22	
Installation Name:	Former Yakutat Air Force Base
FFID:	AK09799F703900
Project Name:	Focused Remedial Investigation
Project Date:	2005
Contract Number:	DACA85-03-D-0003 TO 0009
Funding Source:	Unknown
Project Location:	Yakutat, AK
Site(s):	Army Dock Area (Concern D); Engineer Road (Concern L and Aviation Gasoline Pipeline)
Documents Collected:	SOW Revision 1 (24 Mar 05) Contractor Proposal (28 Mar 05)
Project Description:	This project continues Remedial Investigation of this site. Additional site investigation at Concern D involves installation of 4 GW monitoring wells and performing a pipeline survey of the diesel fuel system. The survey will include providing information on pipeline and associated equipment specifics. Characterization of soil and water will occur during well installation. Site investigation of Engineer Road involves determination of presence or absence of a 6-inch gasoline pipeline. The survey will also include providing information on pipeline and associated equipment specifics. The deliverable is a RI report providing information on the tasks performed, characterization data, conclusions, and recommendations.
Total Project Cost:	$371,511
RACER Technologies Used:	1. Remedial Investigation 2. Groundwater Monitoring Well 3. Residual Waste Management

USACE-POA-24

Installation Name:	Drury Gulch
FFID:	Not Provided
Project Name:	Drury Gulch (Kodiak Island) Contaminated Soil Removal
Project Date:	2001
Contract Number:	DACA85-95-D-0018 TO0006
Funding Source:	Unknown
Project Location:	Kodiak, Alaska
Site(s):	Drury Gulch
Documents Collected:	RI/FS Report (October 02) RA Report (May 04) SOW (Dec 00) Award Documentation (22 Dec 00) Clarification/Verification Report (Dec 02)
Project Description:	Approximately 2,963 cubic yards (CY) of PCB-contaminated soil will be excavated and disposed of. Area will be backfilled with clean fill.
Total Project Cost:	$2,583,842
RACER Technologies Used:	1. Excavation 2. Residual Waste Management 3. Sanitary Sewer 4. Professional Labor Management

USACE-POA-25

Installation Name:	Fort Wainwright and Fort Richardson
FFID:	AK021452242600 & AK021002215700
Project Name:	Decommissioning GW Monitoring Wells, Fort Wainwright and Fort Richardson, AK
Project Date:	2003
Contract Number:	DACA-85-01-R-0030 TO 0004
Funding Source:	DERA
Project Location:	Anchorage, AK (Fort Richardson) & Fairbanks, AK (Fort Wainwright)
Site(s):	Various sites on each installation
Documents Collected:	Statement of Work (8 Jul 03) Contractor Proposal (21 Jul 03) Final Contracting Action (31 Mar 04)
Project Description:	Decommissioning and repair of GW Monitoring Wells at Fort Wainwright (Fairbanks, AK) and Fort Richardson (Anchorage, AK). This project calls for the closure of 41 wells at Fort Richardson and 126 wells at Fort Wainwright in accordance with Alaska Department of Environmental Conservation (ADEC) guidelines. In addition, 4 wells at Fort Richardson will be repaired. Work Plans, Summary Reports, and Review Meetings are included in the task.
Total Project Cost:	$263,586
RACER Technologies Used:	1. Well Abandonment 2. Decontamination Facilities 3. Demolition, Pavements 4. Site Closeout Documentation 5. Load & Haul 6. Professional Labor Management

USACE-LRL-01

Installation Name:	Former Nike CD-78 Launch Area
FFID:	OH59799F365000
Project Name:	Nike CD-78 Monitored Natural Attenuation
Project Date:	2008
Contract Number:	W912QR-04-D-0037 DO 0008
Funding Source:	FUDS
Project Location:	Oxford, OH
Site(s):	Former Nike CD-78 Launch Area
Documents Collected:	Performance Work Statement (Dec 07) IGE, Revision 1 (19 Dec 07) Proposal, Revision 1 (20 Dec 07) Order for Supplies or Services (28 Dec 07)
Project Description:	The project objective is to conduct one year (base year for the contract) of monitored natural attenuation sampling, analysis, and reporting (at seven existing wells using pumps, and five off-site locations using Direct Push Technology (DPT)) at the Nike CD-78 FUDS site.
Total Project Cost:	$35,960 *(This cost is the sum of the base-year awarded cost for MNA ($34,800), and the cost for IDW disposal cost for four drums ($1160), per memo from Advanced Waste Services priced for fourth option year. IDW disposal cost is not included in the base year awarded cost.)*
RACER Technologies Used:	1. Monitoring 2. Residual Waste Management

USACE-LRL-02	
Installation Name:	Ravenna AAP
FFID:	OH521382073600
Project Name:	Sampling of Soils below floor Slabs & Excavation & Transportation of Contaminated Soils to Load Line 4
Project Date:	2008
Contract Number:	W912QR-04-D-0025 DO 0006
Funding Source:	IRP
Project Location:	Ravenna, OH
Site(s):	LL-2, LL-3, LL-4
Documents Collected:	Modification of Contract (22 Aug 08) Revised SOW (10 Jul 08) Proposal (11 Jun 08) Revised Proposal (7 Jul 08) Purchase Request (8 Aug 08)
Project Description:	This project is to sample and analyze 75 four-foot deep soil cores, 11 surface soils, and surface water stored in a tank. Scope includes transporting and disposal of this surface water (6,000 gallons). Other tasks include excavation and disposal of 300 yd^3 of Polychlorinated biphenyl (PCB)-contaminated soils. Contractor will also transfer 300 yd^3 of piled soil to another on-site location and transport/dispose of approximately 5,000 yd^3 of excavated soils. Scope includes digging a trench approximately 2,500 feet for soil assessment. This project will also restore the excavated areas of approximate 2 acres. Deliverables include work plans, ESS Amendments, and a Remediation Report.
Total Project Cost:	$1,122,167
RACER Technologies Used:	1. Remedial Investigation 2. Off-site Transportation and Waste Disposal 3. Bulk Material Storage 4. Excavation 5. Load and Haul 6. Monitoring 7. Trenching/Piping

USACE-LRL-03

Installation Name:	Former Camp McDowell Radar School
FFID:	N/A
Project Name:	UST Removal
Project Date:	2007
Contract Number:	W912QR-04-D-0037 DO 0005
Funding Source:	FUDS
Project Location:	Naperville, IL
Site(s):	Former Camp McDowell Radar School
Documents Collected:	PWS (Feb 07) Order for Supplies & Services (14 Mar 07) Contractor Proposal (8 Mar 07) Project Closeout Documentation (7 Nov 08)
Project Description:	Fuel, pesticide, metal, and PCB contaminated soil removal. Decommission of underground steel pipe. Removal of three USTs, and removal of sludge and contaminated water associated with the USTs.
Total Project Cost:	$88,500
RACER Technologies Used:	1. UST Closure/Removal 2. Residual Waste Management

USACE-LRL-04

Installation Name:	Carmi Air Force Station
FFID:	IL59799F218900
Project Name:	Limited Site Inspection
Project Date:	2006
Contract Number:	W912QR-04-D-0020 DO 0014
Funding Source:	FUDS
Project Location:	Carmi, IL
Site(s):	Carmi Air Force Station
Documents Collected:	Order for Supplies (30 Mar 06) SOW for Limited Site Inspection (28 Feb 06) IGE dated (27 Mar 06) Proposal for Limited Site Inspection (17 Mar 06)
Project Description:	This project is to perform a limited site inspection for Carmi Air Force Station located at Carmi, IL. Tasks involve obtaining surface and sub-surface soil samples, and groundwater samples. Five groundwater monitoring wells will be installed to determine groundwater flow. This project will also perform a geotechnical survey for the southwestern portion of the site to locate a possible septic tank. The deliverable is a Limited Site Inspection (LSI) report for this site.
Total Project Cost:	$185,529
RACER Technologies Used:	1. Site Inspection 2. Groundwater Monitoring Well 3. RCRA Facility Investigation 4. Residual Waste Management

USACE-LRL-05

Installation Name:	Boston RPX Site
FFID:	N/A
Project Name:	Potential RPX Site Phase II Site Investigation
Project Date:	2006
Contract Number:	W912QR-04-D-0020 DO 0016
Funding Source:	FUDS
Project Location:	Boston, MA
Site(s):	Boston RPX Site
Documents Collected:	Order for Supplies & SOW (15 Jun 06) IGE dated (27 Mar 06) Proposal for Phase II Site Investigation (12 Jun 06)
Project Description:	This project is to perform a Phase II Site Investigation for a potential RPX site (Boston RPX Site) located at Boston, MA. Tasks involve obtaining sub-surface soil samples from 11 soil bores, and groundwater samples from two new monitoring wells developed from two soil bores. Two groundwater monitoring wells will be installed to determine groundwater flow. This project will also review data from the Phase I Site Investigation. The deliverable is Phase II report for this site.
Total Project Cost:	$69,506
RACER Technologies Used:	1. Site Inspection 2. Groundwater Monitoring Well 3. Residual Waste Management

USACE-LRL-06	
Installation Name:	Camp Ellis Military Reserve
FFID:	IL59799F804800
Project Name:	Limited Site Inspection
Project Date:	2006
Contract Number:	W912QR-04-D-0020 DO 0016
Funding Source:	FUDS
Project Location:	Table Grove, IL
Site(s):	Camp Ellis Military Reserve
Documents Collected:	Order for Supplies & SOW (29 Jun 06) IGE dated (19 Jun 06) Revised Proposal for Limited Site Inspection (27 Jun 06)
Project Description:	This project is to perform an LSI for the former Camp Ellis Military Range located at Table Grove, IL. Tasks involve performing geophysical surveys of 240 acres; installing soil borings, piezometers, and groundwater monitoring wells; and collecting and analyzing soil and groundwater. Two groundwater monitoring wells will be installed to determine groundwater flow. This project will also review data from previous investigations. The deliverable is an LSI report for this site.
Total Project Cost:	$1,111,840
RACER Technologies Used:	1. Site Inspection 2. Groundwater Monitoring Well 3. Residual Waste Management 4. RCRA Facility Investigation

USACE-LRL-07

Installation Name:	Ravenna AAP
FFID:	OH521382073600
Project Name:	MEC Removal Action
Project Date:	2008
Contract Number:	W912QR-04-D-0040 DO 0003
Funding Source:	IRP
Project Location:	Ravenna, OH
Site(s):	Winklepeck Burning Grounds
Documents Collected:	Revised IGE (30 Jul 08) Revised SOW (30 Jul 08) Cost Summary (30 Jul 08) Price Negotiation Memo (30 Jul 08) Revised Contractor Proposal (28 May 08) Modification of Contract (22 Aug 08)
Project Description:	This project is in support of the munitions and explosives of concern (MEC) disposal and munitions debris (MD) final disposition supporting the survey and munitions response (MR) at the Winklepeck Burning Ground (WBG) pads # 61,61A, 67, and 70 at Ravenna AAP.
Total Project Cost:	$196,058
RACER Technologies Used:	1. MEC Removal Action 2. Monitoring 3. Excavation 4. Professional Labor Management 5. Residual Waste Management

USACE-LRL-08

Installation Name:	Marion Engineer Depot
FFID:	OH59799F367500
Project Name:	Relative Risk Site Assessment
Project Date:	1998
Contract Number:	DACW27-97-D-0015 DO 0005 WAD 6
Funding Source:	FUDS
Project Location:	Marion, OH
Site(s):	Dump Site and Property Disposal Site
Documents Collected:	Summary of Cost by WAD, TO 0005 (undated) Mod 6 (Undated) Contractor's Proposal, Technical Approach and Assumptions (27 Mar 98) Pre-Negotiation Objectives Memorandum (5 Feb 98) Price Negotiation Memorandum (17 Apr 98)
Project Description:	WAD-6- Relative Risk Site Evaluation for Marion Engineer Depot.
Total Project Cost:	$32,007
RACER Technologies Used:	1. Monitoring

USACE-LRL-09

Installation Name:	Marion Engineering Depot
FFID:	OH59799F367500
Project Name:	Well Assessment and Closure
Project Date:	2006
Contract Number:	W912QR-04-D-0019 DO 0021
Funding Source:	FUDS
Project Location:	Marion, OH
Site(s):	Local Training Area
Documents Collected:	Order for Supplies and Services (Sep 06) SOW (Jul 06) IGE (Jul 06) Final Proposal (Aug 06) Contract Completion Statement (Mar 07)
Project Description:	Assess an approximately 100-foot well and provide proper abandonment and closure of the well, as well as a well sealing report. Collect samples for analysis of VOCs, SVOCs, and metals.
Total Project Cost:	$29,868
RACER Technologies Used:	1. Monitoring 2. Well Abandonment 3. Professional Labor Management

USACE-LRL-10	
Installation Name:	Calumet Harbor Yard (USACE-LRL-10a) Chanute Quartermaster Area (USACE-LRL-10b) C-60 Housing and Gunsite (USACE-LRL-10c) Nike Battery C-46 (USACE-LRL-10d)
FFID:	IL59799F223900, IL557002475700, Unknown for C-60 Housing, IN59799F951500
Project Name:	Preliminary Assessments for Four Formerly Used Defense Sites
Project Date:	2007
Contract Number:	W912QR-04-D-0020 DO 0028
Funding Source:	FUDS
Project Location:	Chicago, IL Rantoul, IL Bedford Park, IL Munster, IN
Site(s):	Calumet Harbor Yard Chanute Quartermaster Area C-60 Housing and Gunsite Nike Battery C-46
Documents Collected:	Order for Supplies (7 Jun 07) SOW for Preliminary Assessment (May 07) IGE (2 May 07) Proposal for Preliminary Assessments (5 Jun 07)
Project Description:	This project is to perform three full performance assessments (PA) for three FUDS: Calumet Harbor Yard, Chanute Quartermaster Area, and Nike Battery C-46. This project will also perform an abbreviated PA and a geotechnical survey for C-60 Housing and Gunsite. The deliverables are the PA reports for these four sites.
Total Project Cost:	$360,708 (10a: $48,778, 10b: $102,783, 10c: $103,345, 10d: $105,802)
RACER Technologies Used:	1. Preliminary Assessment 2. Remedial Investigation

USACE-LRL-11	
Installation Name:	Blue Grass Army Depot
FFID:	KY421002010500
Project Name:	2008 IRP Groundwater LTM
Project Date:	2008
Contract Number:	W912QR-04-D-0018 DO 0029
Funding Source:	BRAC
Project Location:	Richmond, KY
Site(s):	Installation-wide
Documents Collected:	Scope of Work (11 Mar 08) Order for Supplies and Services (9 Apr 08) IGE (19 Feb 08) Contractor Proposal (13 Mar 08)
Project Description	The scope of work for this project entails development of a Site-wide Long-Term Monitoring and Operations Plan. Work will generally consist of obtaining water level readings, collection of samples, laboratory analysis of samples, and reporting findings from the six sites being monitored.
Total Project Cost	$109,124
RACER Technologies Used:	1. Monitoring

USACE-LRL-12	
Installation Name:	Army Reserve Center, Wausau, WI
FFID:	WI521044346200
Project Name:	Groundwater Sampling
Project Date:	2005
Contract Number:	W912QR-04-D-0020 DO 0003
Funding Source:	Unknown
Project Location:	Wausau, WI
Site(s):	Army Reserve Center, Wausau, WI
Documents Collected:	Proposal (26 Sep 05) Revised Proposal (28 Sep 05) Modification of Contract (29 Sep 05) Acceptance of CH2M Hill Proposal (Sep 05) IGE (22 Sep 05) SOW (Sep 05)
Project Description:	Contractor to perform one round of groundwater sampling at Army Reserve Center, Wausau, WI.
Total Project Cost:	$13,420
RACER Technologies Used:	1. Monitoring 2. Off-site Transportation and Waste Disposal 3. Professional Labor Management

USACE-LRL-13	
Installation Name:	Lexington Blue Grass Army Depot
FFID:	KY421002050900
Project Name:	Long Term Monitoring of Landfills
Project Date:	2007
Contract Number:	W912QR-05-D-0026 CY01
Funding Source:	BRAC
Project Location:	Lexington, KY
Site(s):	Landfills
Documents Collected:	Order for Supplies and Services (27 Nov 07) Scope of Work (2 Oct 07) IGE (26 Nov 07) Contractor Proposal (15 Nov 07)
Project Description	Monitoring events will take place at three surface water locations and 13 groundwater wells to sample for metals and VOCs. Samples will be collected over a period of four years. The contractor will be responsible for submitting annual groundwater monitoring reports.
Total Project Cost	$132,378
RACER Technologies Used:	1. Monitoring

USACE-LRL-14	
Installation Name:	Ravenna AAP
FFID:	OH521382073600
Project Name:	Environmental Services at Sand Creek (RVAAP-34), Open Demolition Area No. 1 (RVAAP-03), and Suspected Mustard Agent Burial Site (RVAAP-28)
Project Date:	2008
Contract Number:	W912QR-08-D-0013 DO 0002
Funding Source:	IRP
Project Location:	Ravenna, OH
Site(s):	Sand Creek Disposal Road Landfill (RVAAP-34) Open Demolition Area #1 (RVAAP-03) Suspected Mustard Agent Burial Site (RVAAP-28) Winklepeck Burning Grounds (RVAAP-05)
Documents Collected:	Order for Supplies (22 Sep 08) SOW for Environmental Services (26 Aug 08) IGE (29 Aug 08) Price Negotiation Memorandum (19 Sep 08)
Project Description:	This project is to perform RI activities for the Sand Creek Disposal Road Landfill. RI activities include sampling surface water, surface soils, sub-surface soils, and sediments. The deliverable is an RI report for this site. This project will also prepare FS Reports, Proposed Plans, and Records of Decision for the Sand Creek, Open Demolition, and Suspected Mustard sites. Additional characterization work to be performed includes geophysical investigations of these three sites without intrusive activities. The deliverable is a Geophysical Investigation Report. Other activities for this project are to put up new signs at the Open Demolition site and to provide support to the client for meetings with the Restoration Advisory Board.
Total Project Cost:	$1,600,429
RACER Technologies Used:	1. Restoration Advisory Board 2. MEC Site Characterization & Removal 3. Remedial Investigation 4. Administrative Land Use Controls 5. Feasibility Study

USACE-LRL-15

Installation Name:	Various FUDS
FFID:	Nike CL-11: OH9799F3653; Nike CL-13: OH9799F3654; Nike CL-34: OH9799F3655; Nike CL-67: OH9799F3658; Nike CL-69: OH9799F3651; Nike CD-46: OH9799F3649
Project Name:	Six Former Nike Sites Preliminary Assessments
Project Date:	2007
Contract Number:	W912QR-04-D-0044 DO 0011
Funding Source:	FUDS
Project Location:	Ohio, Various
Site(s):	Nike CL-11; Nike CL-13; Nike CL-34; Nike CL-67; Nike CL-69; Nike CD-46
Documents Collected:	SOW (21 May 07) Revised Basis of Proposal (24 May 07)
Project Description:	Preliminary assessments of six former Nike Missile Sites. Includes Property Visit, interviews, photo interpretation, records search via telephone Freedom of Information Act (FOIA) requests, visits to local Ohio based agencies in three counties, and visits to two National Archive offices (Chicago and Washington DC), an Air Force Historical Archive, Maxwell AFB, AL, and the Military History Inst., Carlisle Barracks, PA.
Total Project Cost:	$550,680
RACER Technologies Used:	1. Preliminary Assessment 2. Remedial Investigation

USACE-LRL-16

Installation Name:	Former Kincheloe Air Force Base
FFID:	MI59799F226000
Project Name:	Remedial Action at Fuel Storage Area (FS01)
Project Date:	2005
Contract Number:	DACW27-97-D-0015 DO 4009 Mod 07
Funding Source:	FUDS
Project Location:	Kinross Township, MI
Site(s):	Fuel Storage Area (FS01) Underground Storage Tank 10 (US10)
Documents Collected:	Modification of Contract (29 Jun 05) Cost Proposal (7 Jun 05)
Project Description:	This project is to prepare an RI report using available data obtained from previous studies. No additional RI will be done, such as characterization activities. The deliverable is an RI report for this site. This project will also prepare an FS Report, Proposed Plan, and Decision Document for these two sites of concern.
Total Project Cost:	$275,635
RACER Technologies Used:	1. Remedial Investigation 2. Feasibility Study

USACE-NAB-02

Installation Name:	Fort Drum
FFID:	NY221402028100
Project Name:	2007 Basewide Sampling, Analysis, and Reporting
Project Date:	2008
Contract Number:	W912DR-05-D-0004 DO 0003 Mod 05
Funding Source:	IRP
Project Location:	Fort Drum, NY
Site(s):	Basewide
Documents Collected:	Award Document (29 Aug 07) SOW (26 Jun 06) Contractor Proposal (12 Jul 07) IGE (12 Jul 07)
Project Description:	This project will include the development of Work Plans (Monitoring Plans, Quality and Assurance Program Plan, a Corrective Measures Study Work Plan and a Final Work Plan for Groundwater Sampling). Groundwater and Surface water sampling events will take place in Fall 2007 and Spring 2008. Each sampling event will be followed by consolidated monitoring reports. Eight wells will be decommissioned upon completion of the groundwater and surface water sampling.
Total Project Cost:	$341,779
RACER Technologies Used:	1. Monitoring 2. Site Close-Out Documentation 3. Well Abandonment 4. Residual Waste Management

USACE-NAB-03	
Installation Name:	Fort Drum
FFID:	NY221402028100
Project Name:	Basewide Sampling and Analysis
Project Date:	2006
Contract Number:	W912DR-05-D-0004 DO 0003 Mod 04
Funding Source:	IRP
Project Location:	Fort Drum, NY
Site(s):	Gasoline Alley Area 1295
Documents Collected:	Award Document (20 Sep 05) SOW (17 Aug 05) Contractor Proposal (19 Aug 05) Price Negotiation Memorandum (20 Sep 05) Contracting Action Report (30 Jun 07) IGE (19 Aug 05)
Project Description:	This project encompasses collection of five groundwater samples from the Gasoline Alley Area 1295. The samples are to be collected via direct push rig, and samples analyzed for benzene, toluene, ethylbenzene, and xylenes (BTEX) only. Field water quality measurements for DO, ORP, pH, and turbidity also will be collected via water quality meter. The project will require a technical report presenting sampling results, evaluating nature and extent of contamination, and discussing data evaluation. No work plan is required, as existing plans will be used. However, a permit, Health and Safety Plan update, and drawings showing proposed locations will be required.
Total Project Cost:	$29,326
RACER Technologies Used:	1. Monitoring

USACE-NAB-04

Installation Name:	Fort Eustis
FFID:	VA321372032100
Project Name:	2005 Long Term Monitoring Program
Project Date:	2005
Contract Number:	W912DR-05-D-0004 DO 0005
Funding Source:	IRP
Project Location:	Fort Eustis, VA
Site(s):	Oil/Sludge Holding Pond Site
Documents Collected:	Award Document (18 Apr 05) SOW (12 Jan 05) Contractor Proposal (26 Jan 05) Price Negotiation Memorandum (18 Apr 05) IGE (14 Jan 05)
Project Description:	This project is to perform long-term monitoring in 2005. Tasks include preparing a Sampling & Analysis plan, obtaining groundwater samples from four existing monitoring wells, and analyzing the samples. The deliverable is a sampling report for this site.
Total Project Cost:	$23,972
RACER Technologies Used:	1. Monitoring

USACE-NAB-05

Installation Name:	Fort Eustis
FFID:	VA321372032100
Project Name:	Incinerator Ash Assessment
Project Date:	2005
Contract Number:	W912DR-05-D-0004 DO 0011
Funding Source:	IRP
Project Location:	Fort Eustis, VA
Site(s):	Building 801 Area
Documents Collected:	Award Document (7 Jun 05) SOW (11 Apr 05) Contractor Proposal (19 Apr 05) Price Negotiation Memorandum (7 Jun 05) IGE (15 Apr 05) Project Closeout (13 Nov 06)
Project Description:	Conduct an assessment of the incinerator ash and surrounding soils in accordance with EPA Region III and Virginia Department of Environmental Quality (VDEQ) criteria. Collect continuous split spoon soil samples from 12 borings using direct push method, analyze for pesticides, polychlorinated biphenyls (PCBs), and Target Analyte List (TAL) metals, and prepare and assessment report.
Total Project Cost:	$27,420
RACER Technologies Used:	1. Site Inspection

USACE-NAB-08	
Installation Name:	Fort Belvoir
FFID:	VA321022008200
Project Name:	CAP Implementation at Building 1197 and Continued CAP Implementation at Nine Sites
Project Date:	2006
Contract Number:	W912DR-06-D-0003 DO 0001
Funding Source:	IRP
Project Location:	Fort Belvoir, VA
Site(s):	Building 1197 Nine petroleum-contaminated sites: Building 305 Building 1124 Building 2217 Building 247 Building324 Building 1199 Building 2444 Building 3161 Building 1138
Documents Collected:	Award Document (6 Mar 06) SOW (20 Feb 06) Contractor Proposal (21 Feb 06) IGE (21 Feb 06)
Project Description:	This project is to implement the Corrective Action Plan (CAP) at Building 1197 and to continue CAP activities at the other nine sites. CAP implementation at Building 1197 includes installation of a Soil Vapor Extraction (SVE) system, preparation of O&M manuals, start-up, and O&M. CAP activities at the other sites include continued O&M, sampling, decommissioning, and well/subsurface line abandonment. The deliverables are quarterly O&M reports and decommissioning letter reports.
Total Project Cost:	$445,886
RACER Technologies Used:	1. Trenching/Piping 2. Load and Haul 3. Soil Vapor Extraction 4. Professional Labor Management 5. Operations and Maintenance 6. Monitoring 7. Well Abandonment 8. Site Close-Out Documentation

USACE-NAB-09	
Installation Name:	Letterkenny Army Depot
FFID:	PA321382050300
Project Name:	Well Abandonment
Project Date:	2007
Contract Number:	W912DR-05-D-0026 DO 0023
Funding Source:	Unknown
Project Location:	Chambersburg, PA
Site(s):	Letterkenny Army Depot (LEAD), Ammunition Area (AA), Property Disposal Office (PDO) Area, and Southeast (SE) Area Monitoring Well Abandonment.
Documents Collected:	Official Contract Record Checklist (6 Sep 07) Award Document (5 Sep 07) Pre-Negotiation Objective Memorandum (including IGE) (Apr 07) Contractor Proposal (4 Apr 07) SOW (including PA Monitoring Well Guidance) (5 Jul 07) Signed Final Invoice and Payment (15 Aug 08)
Project Description:	Abandon 18 wells in three areas of LEAD according to Pennsylvania Department of Environmental Protection (PADEP) Guidelines, prepare a PADEP well abandonment form for each well abandoned, produce one well abandonment map, and dispose of all waste generated by well abandonment activities.
Total Project Cost:	$67,448
RACER Technologies Used:	1. Well Abandonment 2. Site Close-Out Documentation

USACE-NAB-10	
Installation Name:	Camp Kilmer
FFID:	
Project Name:	Biennial Inspections/Certification for Land-Use Controls
Project Date:	2007
Contract Number:	W912DR-05-D-0026 DO 0028
Funding Source:	Unknown
Project Location:	Camp Kilmer, Edison Township, NJ
Site(s):	Basewide
Documents Collected:	Official Contract Record Checklist (17 Dec 07) Award Document (14 Dec 07) SOW (11 Dec 07) Pre-negotiation Objective Memorandum (including IGE) (4 Oct 07) Contractor Proposal (16 Oct 07)
Project Description:	Provide Biennial Inspection/Certification for Land Use Controls (LUCs), at Camp Kilmer. Total project cost of $15,362.00 includes Option Year 1 to Provide Biennial Inspection/Certification for LUCs at $15,900.00 for a total of $31,262.00.
Total Project Cost:	$31,262
RACER Technologies Used:	1. Administrative Land Use Controls

USACE-NAB-11

Installation Name:	Fort Monmouth
FFID:	NJ221382059700
Project Name:	GW and Surface Water Monitoring
Project Date:	2007
Contract Number:	W912DR-05-D-0026 DO 0021
Funding Source:	BRAC
Project Location:	Fort Monmouth, NJ
Site(s):	Evans Area
Documents Collected:	Award Document (10 Aug 07) SOW (10 July 07) Price Negotiation Memorandum (Aug 07) Pre-Negotiation Objective Memorandum(1 Aug 07) Contractor Proposal (6 Aug 07)
Project Description:	This project is to perform long-term monitoring in 2007. Tasks include obtaining groundwater samples from 13 GW monitoring wells and five surface water samples from predetermined locations along Laurel Gulley Brook, and analyzing the samples. In addition, a composite soil sample will be taken from a soil pile for characterization. The deliverables are an annual sampling report for the water samples and a letter report for the soil sample.
Total Project Cost:	$36,590
RACER Technologies Used:	1. Monitoring

USACE-NAB-12	
Installation Name:	Letterkenny Army Depot
FFID:	PA321382050300
Project Name:	LEAD IWWS Building 37 Bypass Pumping
Project Date:	2007
Contract Number:	W912DR-05-D-0026 DO 0020
Funding Source:	IRP
Project Location:	Chambersburg, PA
Site(s):	Building 37
Documents Collected:	Official Contract Record Checklist (4 May 07) Award Document (2 May 07) SOW (13 Apr 07) Pre-Negotiation Objective Memorandum (Including IGE) (Apr 07) Contractor Proposal (20 Apr 07)
Project Description:	This project is to transport wastewater from Building 37 storage tanks to Lift Station 1 via tanker truck for a three-month period. Other tasks include performing wastewater sampling at two lift stations and preparing a letter report summarizing results. The scope also includes cleanout of five 21,000-gallon temporary storage tanks and a wet well. Waste materials will be placed in containers provided by the Army. Scope does not include off-site disposal.
Total Project Cost:	$411,343
RACER Technologies Used:	1. Transportation 2. Monitoring 3. Professional Labor Management 4. Underground Storage Tank Closure / Removal

USACE-NAB-16	
Installation Name:	U.S. Army Garrison Fort Hamilton
FFID:	NY221402039500
Project Name:	O&M of Multi Phase Extraction System
Project Date:	2007
Contract Number:	W912DR-05-D-0026
Funding Source:	Unknown
Project Location:	Brooklyn, NY
Site(s):	AAFES Station (Bldg. 200)
Documents Collected:	IGE (7 Aug 08) Order for Supplies (2 Sep 08) SOW (7 Aug 08) Purchase Request (22 Aug 08) Request for Proposal (RFP) (1 Aug 08) Scope of Services (7 Aug 08) Remedial Action Work Plan (RAWP) (Final) (Dec 07) Quality Assurance Project Plan (QAPP) (Oct 07) Final Health and Safety Plan (HASP) (Dec 07) Final Field Sampling Plan (FSP) (Nov 07)
Project Description:	This project is to perform Operation and Maintenance (O&M) of a multi-phase extraction system at Army & Air Force Exchange Service (AAFES) Station (Bldg. 200). Tasks include O&M, monitoring, sampling, and reporting for a period of nine months. The deliverables are three quarterly reports.
Total Project Cost:	$143,502
RACER Technologies Used:	1. Operations and Maintenance 2. Monitoring 3. Residual Waste Management

USACE-NAB-17	
Installation Name:	Frankford Arsenal
FFID:	PA39799F144700
Project Name:	Hazardous, Toxic, and Radioactive Waste Interim Removal Action
Project Date:	2008
Contract Number:	W912DR-07-D-0038 DO 0002
Funding Source:	FUDS
Project Location:	Frankford, PA
Site(s):	Area I
Documents Collected:	Contract (25 Sep 08) SOW (4 Aug 08) IGE (15 Aug 08) Contractor Approach and Proposal (29 Aug 08)
Project Description:	Excavations, UST Removals, and off-site transportation and disposal of residual wastes.
Total Project Cost:	$1,108,734
RACER Technologies Used:	1. Excavation 2. Site Close-Out Documentation 3. Feasibility Study 4. Decontamination Facilities 5. Professional Labor Management 6. Residual Waste Management

USACE-NAB-18

Installation Name:	Tobyhanna Army Depot
FFID:	PA321382089200
Project Name:	Install Nine Monitoring Wells
Project Date:	2005
Contract Number:	W912DR-05-D-0022 DO 0002
Funding Source:	Unknown
Project Location:	Tobyhanna, PA
Site(s):	Building 21 Building 300 Wherry Housing Area #1
Documents Collected:	Contract (11 May 05) SOW (11 May 05) Contractor approach and Proposal (4 April 05)
Project Description:	This estimate is for the installation of nine monitoring wells at three former UST sites. The wells were installed via sonic drilling methods. Subsequent quarterly GW monitoring was conducted on the newly installed wells for one year after the wells were completed.
Total Project Cost:	$142,693
RACER Technologies Used:	1. Groundwater Monitoring Well 2. Monitoring 3. Professional Labor Management 4. Residual Waste Management

USACE-NAB-19

Installation Name:	DDSP New Cumberland
FFID:	PA397152064200
Project Name:	Remedial Investigation- DDSP
Project Date:	2005
Contract Number:	W912DR-05-D-0022 DO 0007
Funding Source:	Unknown
Project Location:	New Cumberland, PA
Site(s):	Aircraft Maintenance Shop Closure Site (AMSCS)
Documents Collected:	Contract (30 Jun 05) SOW (2 Jun 05) Contractor approach and Proposal (13 Jun 05)
Project Description:	This project covers the labor, materials, and equipment necessary to abandon six residential monitoring wells. A final report (letter) will be prepared, for each well, that documents that activities conducted at each residence. For three of the six wells, a geophysical survey will be performed on a 50'x50' area to determine exact location and estimate size and depth of wells.
Total Project Cost:	$39,467
RACER Technologies Used:	1. Well Abandonment 2. Site Close-Out Documentation 3. Remedial Investigation

USACE-NAB-23

Installation Name:	Fort Drum
FFID:	NY221402028100
Project Name:	Remedial Design and Remedial Action, Soil Vapor Extraction, Aquifer Air Sparging, and World War II Landfill Limited Excavation
Project Date:	2007
Contract Number:	DACA31-01-D-0031 DO 0007
Funding Source:	Unknown
Project Location:	Fort Drum, NY
Site(s):	Area 1795, Gasoline Alley
Documents Collected:	SOW (21 Jul 06) Contractor Proposal (17 Aug 06) Award Document (22 Sept 06)
Project Description:	This project encompasses excavation of 1200 cubic yards (CY) of debris from a Word War II (WWII) era landfill and transporting the waste debris for disposal as nonhazardous waste at another facility. Also included is a surface soil sampling event prior to excavation activities to determine extent of contamination, clear and grub of two acres to allow for site access, and post-excavation confirmatory sampling. According to the WWII Landfill Excavation Option of the proposal, no backfilling will occur.
Total Project Cost:	$225,427
RACER Technologies Used:	1. Excavation 2. Clear and Grub 3. Professional Labor Management 4. Residual Waste Management 5. Monitoring

USACE-SAS-01

Installation Name:	Fort Bragg
FFID:	NC421402032800
Project Name:	Wastewater Treatment Plant Pollution Prevention Biosolids Recycling Project
Project Date:	2007
Contract Number:	W912HN-05-D-0031 DO 0004
Funding Source:	IRP
Project Location:	Fort Bragg, NC
Site(s):	Operable Unit (OU) 7 (Wastewater Treatment Plant Sludge Drying Beds – Solid Waste Management Unit (SWMU) 50)
Documents Collected:	IGE (25 Sep 06) Contractor's Proposal (26 Sep 06) SOW (28 Sep 06) Revised Contractor's Proposal (28 Sep 06) Price Negotiation Memorandum (28 Sep 06) Award (29 Sep 06)
Project Description:	This project is to remove and dispose of approximately 9,800 yd^3 (13,720 tons) of Class A treated sludge from the sludge drying bed area located at OU7 (Wastewater Treatment Plant Sludge Drying Beds – SWMU 50) in Fort Bragg, North Carolina. The deliverable is a brief addendum to the Construction Completion Report detailing all work performed and total volume of treated sludge removed.
Total Project Cost:	$518,815
RACER Technologies Used:	1. Off-site Transportation and Waste Disposal 2. Professional Labor Management

USACE-SAS-02

Installation Name:	Fort Bragg
FFID:	NC421402032800
Project Name:	FY08 Heating Oil Tank Removals/Replacements, Building E-3556
Project Date:	2008
Contract Number:	W912HN-07-D-0011 DO 0010
Funding Source:	Unknown
Project Location:	Fort Bragg, NC
Site(s):	Various
Documents Collected:	SOW (17 Aug 07) Contractor's Proposal (21 Sep 07) Price Negotiation Memorandum (21 Sep 07) Award (30 Sep 07) Draft Site Safety and Health Plan (Nov 07) Final Tank Closure Assessment Report (9 Jul 08) Final Work Plan (Jan 08) Final Payment/invoice screen (8 Dec 08)
Project Description:	The project objectives are to remove 26 USTs, collect confirmatory samples, provide closure reports, and install 18 replacement Aboveground Storage Tanks (ASTs).
Total Project Cost:	$579,699
RACER Technologies Used:	1. Underground Storage Tank Closure/Removal 2. Professional Labor Management 3. Residual Waste Management 4. Storage Tank Installation 5. Monitoring 6. Fencing 7. Site Close-out Documentation

USACE-SAS-04

Installation Name:	Former McCoy AFB
FFID:	FL49799F453600
Project Name:	Pilot Scale Alternatives Assessment and Implementation Plan for Groundwater VOC/SVOC Reduction at Fire Fighter Training Area
Project Date:	2005, 2006
Contract Number:	F41624-03-D-8607 DO CV01
Funding Source:	FUDS
Project Location:	Orlando, FL
Site(s):	Fire Fighter Training Area
Documents Collected:	Final Revised SOW (Mar 04) IGE (23 Mar 04) Contractor's Proposal (26 Mar 04) Award (30 Mar 04) Final Work Plan Addendum (Sep 04) Draft Final Pilot Test Plan (Mar 05)
Project Description:	This project is to install seven groundwater monitoring wells to define the source area and monitor the selected remedial action. Groundwater samples will be collected from 15 groundwater monitoring wells and analyzed for a baseline assessment during the pilot-scale test. Other scope includes preparing a Pilot Test Plan that includes Remedial Alternatives evaluation, proposed remedial alternative, proposed pilot test design, and required monitoring. The scope will also implement the pilot test and perform the required monitoring. The deliverable is a report that recommends the remedial action with a 35% construction cost.
Total Project Cost:	$369,300
RACER Technologies Used:	1. Remedial Investigation 2. Groundwater Monitoring Well 3. Monitoring 4. Feasibility Study 5. In Situ Biodegradation 6. Residual Waste Management

USACE-SAS-06

Installation Name:	Former Edenton Naval Auxiliary Air Station
FFID:	NC49799F483300
Project Name:	Monitored Natural Attenuation at Former Edenton Naval Auxiliary Air Station Fuel Storage Complex
Project Date:	2005
Contract Number:	W912HN-04-D-0005 DO0005
Funding Source:	FUDS
Project Location:	Chowan County, NC
Site(s):	Fuel Storage Complex
Documents Collected:	Performance Work Statement (14 Feb 05) IGE (20 Mar 05) Award (30 Mar 05) Modification of Contract (6 May 05) Contractor's Proposal (8 Jun 06)
Project Description:	This project is to install 29 groundwater monitoring wells to monitor the selected remedial action and natural attenuation. A baseline monitoring of 31 wells will be conducted after installation of the wells. Other scope includes performing four Oxygen Release Compound (ORC) injections using a geoprobe over a two-year period (4 events). Groundwater sampling will occur on 14 wells approximately 30 days after ORC injections. If successful, the scope includes well abandonment. The deliverables are progress reports after each injection event.
Total Project Cost:	$898,355
RACER Technologies Used:	1. Remedial Investigation 2. Groundwater Monitoring Well 3. Monitoring 4. In Situ Biodegradation 5. Well Abandonment 6. Professional Labor Management 7. Site Close-Out Documentation 8. Residual Waste Management

USACE-SAS-07

Installation Name:	Fort McPherson
FFID:	GA421402056500
Project Name:	Buildings #105 and #143 Investigation
Project Date:	2008
Contract Number:	W912HN-08-D-0018 DO0001
Funding Source:	IRP
Project Location:	Fort McPherson, GA
Site(s):	Buildings #105 and #143
Documents Collected:	SOW (May 08) Award (19 Jun 08) Price Negotiation Memorandum(13 Jun 08) Contractor's Proposal (10 Jun 08)
Project Description:	Install four groundwater monitoring wells; dispose of soil cuttings. Collect groundwater samples from 18 groundwater monitoring wells in two areas and analyze for BTEX. Prepare one letter report summarizing groundwater sampling results at each area (two total reports); attend one meeting to discuss groundwater sampling results at each area. Prepare Accident Prevention Plan, Site Specific Health and Safety Plan, Field Sampling and Analysis Plan (SAP), and combined Work Plan.
Total Project Cost:	$32,529
RACER Technologies Used:	1. Monitoring 2. Groundwater Monitoring Well 3. Professional Labor Management 4. Residual Waste Management

USACE-SAS-08

Installation Name:	Fort Bragg
FFID:	NC421402032800
Project Name:	FY09 Heating Oil Tank Removals/Replacements
Project Date:	2009
Contract Number:	W912HN-08-D-0018 DO 0006
Funding Source:	IRP
Project Location:	Fort Bragg, NC
Site(s):	Various tanks
Documents Collected:	SOW (26 Sep 08) (including App E, List of Tanks) Contractor's Proposal (29 Sep 08) Award (30 Sep 08)
Project Description:	The project objectives are to remove 34 USTs, collect confirmatory samples, provide closure reports, and install 15 replacement ASTs. Due to a lack of detail in the project documentation, only three of the tasks were estimated. Those tasks include Task 2 (Work Plan), Task 4 (Reports), and Task 6 (Well Abandonment).
Total Project Cost:	72,011
RACER Technologies Used:	1. Well Abandonment 2. Site Close-Out Documentation 3. Remedial Investigation

USACE-SAS-10

Installation Name:	Hunter Army Airfield
FFID:	GA421402273300
Project Name:	Soil Remediation and FY08 Groundwater Monitoring at Former Pumphouse #2
Project Date:	2008
Contract Number:	W912HN-07-D-0012 DO 0007
Funding Source:	Unknown
Project Location:	Savannah, GA
Site(s):	Former Pumphouse #2 (Facility ID #9-025086; near Former Building 8065)
Documents Collected:	SOW (Oct 07) Contractor's Proposal (Nov 07) Award (Jan 08) Corrective Action Plan (Jan 09)
Project Description:	For the Former Pumphouse #2 Site at Hunter Army Airfield, GA, this project consists of preparation of a Work Plan and Accident Prevention Plan, excavation of 3,334 ft^2 of contaminated soils to a depth of 14 feet, removal and replacement of four groundwater monitoring wells, semi-annual groundwater sampling, preparation of a Corrective Action Plan Part B Addendum Report, and preparation of semi-annual project progress reports.
Total Project Cost:	$250,250
RACER Technologies Used:	1. Well Abandonment 2. Residual Waste Management 3. Professional Labor Management 4. Groundwater Monitoring Well 5. Excavation 6. Monitoring

USACE-SAS-11

Installation Name:	Fort Benning
FFID:	GA421372101800
Project Name:	Installation Gas Station, Building 3763, UST Monitoring CAP Part B Compliance
Project Date:	2006
Contract Number:	DACA21-02-D-0004 DO 0068
Funding Source:	Unknown
Project Location:	Fort Benning, GA
Site(s):	Bldg 3763 UST
Documents Collected:	Revised SOW (Jun 06) Contractor's Proposal (8 Jun 06) Award (20 Jun 06)
Project Description:	This project is to install three permanent injection wells for an In-Situ Chemical Oxidation (ISCO) pilot study and perform ISCO treatment. The existing Corrective Action Plan (CAP) will be amended along with the Health and Safety Plan.
Total Project Cost:	$67,114
RACER Technologies Used:	1. In Situ Biodegradation 2. Professional Labor Management

USACE-SAS-12	
Installation Name:	Former Turner AFB
FFID:	GA49799F474900
Project Name:	Amend Corrective Action Plan and Initiate Monitored Natural Attenuation at Site B and Initiate Long Term Monitoring at Site A11J
Project Date:	2008
Contract Number:	W912HN-05-D-0015 DO 0018
Funding Source:	Unknown
Project Location:	Albany, GA
Site(s):	Site B and Site A11J
Documents Collected:	SOW (8 May 08) Contractor's Proposal (13 Jun 08) Award (19 Jun 08) Final Payment Invoice (25 Jun 08)
Project Description:	This project entails work to be performed at two sites at the Former Turner AFB. Objectives for Site B are to revise CAP, implement monitored natural attenuation, and submit monitoring reports for each monitoring event. Objectives for Site A11J are to place free product removal devices in existing wells, prepare and submit draft and final long term monitoring plans, initiate long term monitoring for a two-year period, and submit monitoring reports for each monitoring event.
Total Project Cost:	$237,280
RACER Technologies Used:	1. Residual Waste Management 2. Monitoring 3. Feasibility Study 4. Remedial Investigation

USACE-SAS-13

Installation Name:	Former Turner AFB
FFID:	GA49799F474900
Project Name:	Complete Remedial Action Site B
Project Date:	2004
Contract Number:	DACA21-03-D-0009 DO 0002
Funding Source:	FUDS
Project Location:	Albany, GA
Site(s):	Site B
Documents Collected:	Site B Sampling Matrix (6 Jun 03) Revised SOW (24 Jun 03); Modification 01 to Contract (23 Jun 06); Modification 02 of Contract (5 Mar 08) Contractor's Proposal (24 Jun 03) IGE (24 Jun 03) Price Negotiation Memorandum (24 Jun 03) Award (30 Jun 03) Final Project Management Plan (Dec 04) Pre-Negotiation Objective/Price Negotiation Memorandum (25 Oct 07) Final Release of Lien/Contractor's Certification of Invoice (3 Mar 08)
Project Description:	This project is to perform a Preliminary Investigation (PI) to define the limits of contamination to the south and southeast of the site by installing four shallow and four intermediate wells, and performing sampling and analysis. Results of the PI and recommendation for installation and operation of a remedial action will be provided in a CAP Part B Addendum. The Remedial Action is installing a Dual-Phase Vacuum Extraction (DPE) system. Implementation consists of installing 12 recovery wells to address the source area free product, smear zone and groundwater contamination. O&M requires operating the system for 12 months and performing vapor, soil, and groundwater sampling and analyses. Deliverable is a Corrective Action Report.
Total Project Cost:	$672,718
RACER Technologies Used:	1. Remedial Investigation 2. Groundwater Monitoring Well 3. Special Well Drilling & Installation 4. Residual Waste Management 5. Bioslurping 6. Fencing 7. Professional Labor Management 8. Operations and Maintenance 9. Monitoring

USACE-SAS-14

Installation Name:	Fort Jackson
FFID:	SC4210028QG100
Project Name:	Interim Corrective Action Free Product Removal, Bldg 4120, AAFES Gas Station
Project Date:	2008
Contract Number:	W912HN-07-D-0018 DO 0006
Funding Source:	Unknown
Project Location:	Fort Jackson, SC
Site(s):	Bldg 4120 (AAFES Gas Station)
Documents Collected:	Scope of Services (26 Sep 07) Award (29 Sep 07) Contractor's Proposal (29 Sep 07) Draft Work Plan (23 Jun 08) Final Payment Invoice (undated)
Project Description:	This project is to install eight shallow wells (20 ft bgs) and four deep wells (45 ft bgs) in order to conduct surfactant vacuum pilot tests. Scope involves preparation of a work plan that includes a Site Safety and Health Plan (SSHP). Options (1-2) include performing 2 surfactant vacuum capture events on both shallow and deep wells. Other tasks include sampling and analyzing soil samples from each well installation. The deliverable is the Corrective Action Summary Report detailing all field activities.
Total Project Cost:	$81,413
RACER Technologies Used:	1. Special Well Drilling & Installation 2. Monitoring 3. Residual Waste Management 4. Professional Labor Management

USACE-SAS-16

Installation Name:	Former Bushnell AAF
FFID:	FL49799F436400
Project Name:	Baseline/Composite Sampling of all Onsite Wells for Two Events
Project Date:	2008
Contract Number:	W912HN-05-D-0015 DO 0004
Funding Source:	IRP
Project Location:	Bushnell, FL
Site(s):	East Pumping Station study area
Documents Collected:	Final Supplemental Contamination Assessment Report (Jun 00) IGE (24 Sep 07) SOW (May 08) Contractor's Proposal (28 Jun 08) Award (30 Jun 08)
Project Description:	The Scope of Work consists of groundwater monitoring at all wells on site for two events during a hydrologic year (once during the summer and once during the winter). A total of 40 wells will be sampled for Fuels, TPH, and PAH. Offsite disposal of nonhazardous Investigative-Derived Waste (IDW) will be at a licensed disposal facility.
Total Project Cost:	$101,276
RACER Technologies Used:	1. Monitoring 2. Residual Waste Management

USACE-SAS-17

Installation Name:	Fort Bragg
FFID:	NC421402032800
Project Name:	Investigate Soil Contamination
Project Date:	2008
Contract Number:	W912HN-07-D-0018 DO 0017
Funding Source:	IRP
Project Location:	Fort Bragg, NC
Site(s):	Special Operations Shoot House
Documents Collected:	SOW (29 Jul 08) Contractor's Proposal (22 Aug 08) Price Negotiation Objective Memorandum (22 Aug 08) Award (28 Aug 08)
Project Description:	The project objective is to conduct an investigation and prepare an assessment report. Tasks to be performed are: prepare a Work Plan, SSHP, and Accident Prevention Plan; perform a field investigation of a 30 ft x 50 ft contaminated area, including collection of 50 soil samples and one groundwater sample; excavate, remove and dispose of contaminated soils to a depth of 2 ft, including collection of 15 confirmatory soil samples; backfill, compaction, and seeding of excavated area; prepare an Assessment Report and a Remedial Action Report.
Total Project Cost:	$77,879
RACER Technologies Used:	1. Residual Waste Management 2. Monitoring 3. Groundwater Monitoring Well 4. Excavation 5. Professional Labor Management

USACE-SAS-18

Installation Name:	Fort Benning
FFID:	GA421372101800
Project Name:	Corrective Action Design and Implementation
Project Date:	2008
Contract Number:	W912HN-07-D-0018 DO 0016
Funding Source:	IRP
Project Location:	Fort Benning, GA
Site(s):	SWMU FBSB-100 (Running Track)
Documents Collected:	SOW (Jul 08) Contractor's Proposal (22 Aug 08) Price Negotiation Objective Memorandum (22 Aug 08) Award (28 Aug 08)
Project Description:	This project is to inject Regenesis 3-D to the subsurface using an injection grid around two monitoring wells. Tasks include site visits and preparation of a work plan. The work plan is to specify the injection system and will include SSHP, Quality Assurance Plan, and SAP. Monthly progress reports are required. Injection of Regenesis 3-D is to occur through 140 injection points located on 15-foot centers in a 200-ft wide by 150-ft long grid. Another task includes updating the Community Relations Plan. This project will also conduct a second injection around 2 other groundwater monitoring wells through two 50 x 50 grid with 25 injection points (50 injection points in total). Monitoring consists of a baseline sampling from all required wells and the data is to be provided in the first Quarterly CAP Progress Report. Additional sampling involves two semiannual sampling events from 10 monitoring wells. A CAP Progress Report is to be provided after each sampling event. IDW disposal is also included in this project.
Total Project Cost:	$348,121
RACER Technologies Used:	1. Remedial Investigation 2. In Situ Biodegradation 3. Monitoring 4. Residual Waste Management

USACE-SAS-19

Installation Name:	Fort Bragg
FFID:	NC421402032800
Project Name:	Free Product Removal
Project Date:	2008
Contract Number:	W912HN-07-D-0011 DO 0009
Funding Source:	Unknown
Project Location:	Fort Bragg, NC
Site(s):	Simmons Army Airfield, Former Airport Hydrant System
Documents Collected:	SOW (15 Aug 07) Contractor's Proposal (21 Sep 07) Award (29 Sep 07)
Project Description:	This project is to perform free product removal from two six-inch and three four-inch wells located at Fort Bragg. Free product removal will be done monthly using a vacuum truck. Another task is to prepare a work plan containing an Accident Prevention Plan and Site Safety and Health Plan. The contractor is also responsible for disposal of the removed water/free product. The deliverable for this project is a Remedial Action Report along with a Waste Closeout Report at the completion of the project.
Total Project Cost:	$134,926
RACER Technologies Used:	1. Operations and Maintenance 2. Site Close-Out Documentation

Appendix D – Cumulative List of RACER Observations

RACER Technology	Site Visit Location	Project	Observation	Suggested Solution
Bioventing	Alaska	POA-23	RACER does not provide for addition of more than one horizontal trench per blower.	Provide options to select number of trenches per blower.
Decontamination Facilities	Louisville	LRL-09	The conditions of use of Decontamination Facilities module should be more clearly spelled out in the Help Topic. For example, are decontamination costs typically included in labor hour calculations for tasks like in the Well Abandonment technology? It is not clear.	Revise Help Topic for Decontamination Facilities.
Demolition, Underground Pipes	Fort Worth	SWF-01	No shoring option; technology uses old Load and Haul-type inputs for waste disposal	Insert shoring options similar to excavation technology; revise load and haul screens to more closely parallel off-site T&D.
Excavation	Alaska	POA-06	The backfill hauling distance is limited to 20 miles.	RACER should allow longer distances especially for remote sites.
Excavation	Alaska	POA-06	This project involved transport of workers and material to and from the site via helicopter. There are no options available for selecting different modes of transporting excavated materials or fill. Trucks are assumed.	RACER could provide a "remote" option. When selected, other options or combinations of options would be presented for selection (similar to the list provided under Residual Waste Management but revised for helicopter usage).
Excavation	Alaska	POA-06	There are no options for selecting method of excavation.	RACER could provide options of excavation: default, hand, and others.
Excavation	Fort Worth	SWF-01	Cannot account for surveying requirements	Need Surveying in excavation technology
Excavation	Fort Worth	SWF-01	Cannot account for travel requirements/per diem	Have per diem option in technology.

RACER Technology	Site Visit Location	Project	Observation	Suggested Solution
Excavation	Kansas City	NWK-23	Excavation sometimes brings up 22 CY Scraper by BCY assembly. Is this most appropriate for a 5 ft excavation?	Reevaluate assemblies for construction equipment to dig excavation to ensure most appropriate.
Feasibility Study	Alaska	POA-23	RACER only provides a default cost for bench-scale and pilot-scale treatability studies (TS) without modifiers that could increase or decrease the default costs. It might be more accurate not to use the TS option but to cost out all TS tasks individually using applicable technologies.	Develop cost modifiers that the user can select so that RACER derives a cost. Most preferably, the selection would be based on type of technology to be evaluated such as bioventing, chemical injections, and others. The technologies should be those commonly seen in the field.
Feasibility Study	Louisville	LRL-16	There is no option for additional meetings; also the Help Topic does not indicate if the cost accounts for internal technical reviews of deliverables.	The technology could be amended by adding a secondary requirement for meetings and distances to the meeting. The estimator would input the number of meetings, distance, airfare, and number of persons. RACER would calculate per diem, labor, and other travel costs using the inputs. The Help Topic should be amended to indicate whether internal technical reviews are accounted for.
Groundwater Monitoring Well	Alaska	POA-03a	GW Monitoring Well technology (for well installation) does not account for creation of a well installation report.	Revise technology to include option drafting a well installation report.
Groundwater Monitoring Well	Alaska	POA-03a POA-19	GW Monitoring Well technology (for well installation) does not account for well development.	Revise technology to include option for developing wells.

RACER Technology	Site Visit Location	Project	Observation	Suggested Solution
Groundwater Monitoring Well	Alaska	POA-19	GW Monitoring Well technology does not provide drums for drill cuttings; then in the Residual Waste Management technology, the only option is “use existing containers.” The user has to manually add in cost of drums.	Revise GWM technology to properly include cost of drums for containerizing drill cuttings.
Groundwater Monitoring Well	Fort Worth	SWF-12	No option to deselect surface pad installation when installing a well - many wells do not have surface pads	Revise technology to make surface pads an option.
Groundwater Monitoring Well	Louisville	LRL-04	Installation of a well with a direct push rig is not provided by RACER. In many cases, a well is completed using a direct push rig after a bore is taken for sampling soils.	Direct push could be added to the list of drilling methods.
Groundwater Monitoring Well	Alaska	POA-22 POA-24	There are no technologies to add surveying crews when installing wells. Surveying cannot be added in Scenarios 1 and 2; it requires addition of assemblies.	Consider a separate technology for conducting surveys, or incorporating surveys as secondary parameters in key technologies.
In-Situ Biodegradation	Savannah	SAS-11 SAS-18	RACER does not provide costs for peroxide or other chemicals used in ISCO treatments.	An extensive list of chemicals should be provided as options.
In-Situ Biodegradation	Savannah	SAS-11	The In-Situ Biodegradation technology does not provide options of using injection without well development, i.e., when injection wells are already available. If selected for well installation, then technology should provide option to select well diameters, materials of construction, and other well information.	The In-Situ Biodegradation technology should provide options of using injection without well development. If selected for well installation, then technology should provide option to select well diameters, materials of construction, and other well information.

RACER Technology	Site Visit Location	Project	Observation	Suggested Solution
MEC Site Characterization & Removal Assessment	Louisville	LRL-06	When this technology is used to cost the geophysical surveys alone (without reports or other field activities), results were observed which were much higher than historical contractor's costs.	Review and revise the technology as necessary; one option is to have a mini-model for geophysical surveys at MEC sites.
Monitoring	Alaska	POA-02	RACER does not provide ability to just measure for depth to water.	Revise Monitoring technology to include option for measuring depth to water.
Monitoring	Alaska	POA-02	RACER does not include assemblies for RRO/DRO,. Also, available assembly costs for laboratory analyses are much greater than (approximately twice) actual cost. For BTEX - RACER cost: $247, actual cost: $132. For PAHs - RACER cost: $540, actual cost: $224.	Add DRO and GRO as analyses; review and revise other analysis costs as necessary.
Monitoring	Alaska	POA-03a	RACER does not have an assembly for rental of oil/water interface probe.	Revise assembly cost database to include an assembly for rental of oil/water interface probe.
Monitoring	Alaska	POA-03b POS-19	RACER does not include assemblies for RRO/DRO, Alaska methods. Also, available assembly costs for laboratory analyses are much greater (approximately twice) than actual cost. DRO/RRO (AK methods not available in RACER so substitute TPH) - RACER cost: $243, actual cost: $95. PAHs - RACER cost: $540, actual cost: $185. The user has to approximate using TPH.	Add DRO and GRO as analyses; review and revise other analysis costs as necessary.
Monitoring	Alaska	POA-03b	RACER does not provide ability to measure for depth to water or presence of free product. This is required oftentimes at wells that are not otherwise sampled, and there is not way to account for that effort.	Revise Monitoring technology to include option for measuring depth to water and measuring presence of free product.

RACER Technology	Site Visit Location	Project	Observation	Suggested Solution
Monitoring	Alaska	POA-03b	The LOE (labor) for the Comprehensive Reporting option seems incorrect. For this project, selecting Abbreviated Report provides 29 total hours in the Data Management Element; selecting Standard Report provides 40 total hours in the Data Management Element; selecting Comprehensive provides 371 total hrs LOE in the Data Management Element. The jump from 40 to 371 seems unrealistically high and was a major contributor to the cost differential on this project.	Review and revise technology accordingly.
Monitoring	Alaska	POA-04	Analyses are more expensive in the proposal than in RACER; proposal lists $3,400 for separate shipping of herbicide samples.	Review and revise analysis costs as necessary.
Monitoring	Alaska	POA-04	RACER does not include an assembly for the SW 9056 analysis.	Revise assembly cost database to include an assembly for SW 9056 analysis.
Monitoring	Baltimore	NAB-08	The Monitoring technology does not contain options for preparation of quarterly reports, and the Help Topic does not indicate whether changing the "number of events per year" changes the number of reports prepared for each event; resulting assembly quantity changes are not indicative of this. An existing assembly for Job Hazards Analysis was used to estimate the cost for an additional report(s).	Provide an option to select more than one report; modify Help Topic to better explain reporting.

RACER Technology	Site Visit Location	Project	Observation	Suggested Solution
Monitoring	Baltimore	NAB-11	RACER does not provide an option for no data validation.	An option could be provided for rare cases when no validation is required. Or, the Help Topic could be revised to describe what assemblies are affected, so that the user could make informed assembly changes should they choose to remove the LOE associated with data validation.
Monitoring	Baltimore	NAB-16	The Monitoring technology does not contain options for preparation of quarterly reports, and the Help Topic does not indicate whether changing the "number of events per year" changes the number of reports prepared for each event; resulting assembly quantity changes are not indicative of this. An existing assembly for Job Hazards Analysis was used to estimate the cost for an additional report(s).	Provide an option to select more than one report; modify Help Topic to better explain reporting.
Monitoring	Louisville	LRL-09	Noticed problem/inaccuracy with Monitoring Plan option on Data Management tab. For this project collect only one GW sample, when No Monitoring Plan is selected, marked up cost is $8177, when Abbreviated Monitoring Plan is selected, marked up cost goes up to $20,167 ($11,990 increase), and when Standard Plan is selected, marked up cost is $30,381 ($22,204 increase), and when Comprehensive Plan is selected, marked up cost is 49993 ($41,816 increase). These cost increases do not seem realistic for a sampling event involving only one sample.	The Monitoring Plan cost should be reevaluated following a review of the Monitoring Model Addendum.

RACER Technology	Site Visit Location	Project	Observation	Suggested Solution
Monitoring	Louisville	LRL-11	Default values for Monitoring Report (Data Management tab) are not functioning in accordance with the Help Topic. For example, in this estimate the number of samples in the first year is 53. According to Help Topic, the default for Report should be Comprehensive, but it is Abbreviated.	Review Monitoring Model Addendum and Help Topic; revise technology software code accordingly to correct the error.
Monitoring	Louisville	LRL-11	The Help Topic does not adequately define the terms for selection of the various options for Monitoring Plan (Abbreviated, Standard, and Comprehensive). It only lists the options with no corresponding definitions.	Add more detail to Monitoring Plan section of the Help Topic.
Monitoring	Louisville	LRL-11	The Comprehensive Reporting LOE seems unrealistically high. For this example, changing from Abbreviated Report to Standard to Comprehensive increases the marked up total project cost from $104,787 (for Abbreviated Report) to $109,776 (for Standard Report) to $209,782 (for Comprehensive Report). There appears to be a problem with the algorithm.	Review Model Addendum for Reporting options to determine if this is an error; if so, revise software code accordingly. If not, consider review and revision of the Model Addendum to ensure these cost increases related to Reporting are correct.
Monitoring	Louisville	LRL-12	This high cost differential for this project is primarily due to the Monitoring Plan selection (with no plan selected, cost is ~$16K; adding abbreviated plan almost double cost to ~$29K). Plan costs do not appear to be reasonable.	Reevaluate Model Addendum calculations for LOE for Monitoring Plans to determine if this is an error; if so, revise software code accordingly. If not, consider review and revision of the Model Addendum.

RACER Technology	Site Visit Location	Project	Observation	Suggested Solution
Monitoring	Louisville	LRL-13	Metals analyses listed in the project proposal are for single elements (manganese, cadmium, chromium, nickel) and are $10/ea. That is not an available option in RACER (except for chromium) so total metals was used as a substitution but the cost is much greater ($332/sample).	Consider adding assemblies for single element analyses.
Monitoring	Savannah	SAS-12 SAS-17	RACER assigns travel for the entire roundtrip distance for each day of sampling during a round (ex: if sampling 18 wells at 6 wells/day, RACER calculates 3 round trips of mileage and 3 round trips of driving hours for 2 technicians, just for the 18 wells).	Modify the calculations so that the travel for the sampling technicians is by car up to a reasonable number of miles, and by air for greater distances.
Monitoring	Savannah	SAS-12 SAS-17	RACER does not properly calculate the volume of purge water.	Check technology algorithm to ensure this functionality is working as intended; if so, consider revision.
Monitoring	Savannah	Various	The average sample depth for surface water samples does not impact cost.	Check technology algorithm to ensure this functionality is working as intended; if so, consider revision.
Monitoring	Savannah	SAS-17	Hand Auger - RACER appears to assign a maximum of 8 hand auger borings/day, even if these borings are only 2 ft. deep.	Check technology algorithm to ensure this functionality is working as intended; if so, consider revision.
Monitoring	AFCEE	AFCEE-11	There is no way in Monitoring to account for travel to site via airplane. If large site distance is selected, mileage for automobile is increased at the Assembly level to account for distance. Typically for large site distances the sampling crew would fly and rent a car.	Under Site Distance on System Definition tab, suggest adding option for travel to site via airline, which would generate airfare assemblies and per diem.

RACER Technology	Site Visit Location	Project	Observation	Suggested Solution
Monitoring Natural Attenuation	AFCEE	AFCEE-11	Monitoring was re-engineered but Natural Attenuation was not. Cost for collection/analysis of 400 GW samples assuming default parameters is $700K in the Monitoring module (with MNA Analytical Template used) and $1M in the Natural Attenuation module with the same parameters selected.	Need to reevaluate Natural Attenuation and update it to be more in sync with the re-engineered Monitoring technology.
N/A	Kansas City	NWK-23	Several project tasks include survey work. There is no technology to account for this requirement.	Add a technology for survey work.
N/A	Baltimore	NAB-19	RACER does not contain an assembly for a flame ionization detector (FID). There is an assembly for a Photo-Ionization detector (PID) but not the FID. The only FID-related assemblies in RACER are for soil/sediment sampling *using* a FID.	Add an assembly for daily rental of a FID.
Off-Site Transportation and Disposal	AFCEE	AFCEE-13	Landfill disposal cost for non-hazardous solid waste appears too high (RACER is $86/ton; proposed cost is $29/ton).	Reevaluate assembly-level disposal costs for non hazardous solid waste (Assembly 33197270 *Landfill Nonhazardous Solid Bulk Waste by CY*).
Operations and Maintenance	Savannah	SAS-19	Professional Labor assemblies did not change between "Moderate" and "Minimum." Values for "Minimum" were the same as "Exclude from Estimate."	Check technology algorithm to ensure this functionality is working as intended; if so, consider revision.
Operations and Maintenance	Savannah	SAS-19	RACER does not provide the option of using a vacuum truck for free product removal.	Provide an option in the Free Product Removal or O&M technology to perform removal work using a vacuum truck.
Operations and Maintenance	Savannah	SAS-19	RACER does not provide Professional Labor hours when "Minimum" is selected.	Check technology algorithm to ensure this functionality is working as intended; if so, consider revision.

RACER Technology	Site Visit Location	Project	Observation	Suggested Solution
Preliminary Assessment	Fort Worth	SWF-12	In order to get options for soil gas survey, RI technology must be run even when a full RI is not necessary.	Include items like soil gas survey in technologies such as Preliminary Assessment and Site Inspection.
Preliminary Assessment	Louisville	LRL-10	Project Management hours are minimal compared to contractor's proposal.	Review and revise technology accordingly.
Preliminary Assessment	Louisville	LRL-10	This technology does not provide for preparation of plans such as QA, SAP, and HASP.	Add option for preparation of supplemental plans such as in Site Inspection. For Remedial Action projects, these activities are accounted for in the Professional Labor Management technology; however, Professional Labor Management can not be added to a Study-type phase in RACER.
Preliminary Assessment	Louisville	LRL-10	Labor hours are very inconsistent with the contractor's proposals for these sites. Note that the sites are large (38, 10 and 14 acres) and this is more complex than the High selection for site complexity is intended to account for (see Help Topic). For example, RACER is estimating 319 hrs total for the HIGH complexity for the Chanute site, and contractor has proposed 921. The other three sites are similarly off.	Reevaluate LOE for varying complexities.
Preliminary Assessment	Louisville	LRL-10	PA technology does not account adequately for title search/search of real estate records. Proposal states that this task alone is assumed to add 166 LOE/location. According to RACER Help Screen, RACER adds 66 hours for high site complexity.	Reevaluate LOE for varying complexities.

RACER Technology	Site Visit Location	Project	Observation	Suggested Solution
Preliminary Assessment	Louisville	LRL-15	The large cost difference is due to a massive difference in the number of labor hours for each task. For example, in the proposal, the task for reporting is 528 hours per site, while RACER gives only 96 hours for reporting, at high site complexity.	Reevaluate LOE for varying complexities.
Professional Labor Management	Alaska	POA-06	PLM does not distinguish site complexities that should impact the default percentage. Site complexities include mobilization/demobilization activities or setting up camps for temporary living.	A site complexity option could be added to PLM that would adjust the default percentage.
Professional Labor Management	Alaska	POA-06 POA-23	RACER does not provide sufficient options for reports such as Remedial Action Report or Treatability Studies.	Technologies could be developed for preparation of such deliverables.
Remedial Investigation	Alaska	POA-22	There are no options for transportation of personnel, supplies, and equipment.	Provide transportation options similar to those used for Residual Waste Management.
Remedial Investigation	Louisville	LRL-16	There is no option for additional meetings; also the Help Topic does not indicate if the cost accounts for internal technical reviews of deliverables.	The technology could be amended by adding a secondary requirement for meetings and distances to the meeting. The estimator would input the number of meetings, distance, airfare, and number of persons. RACER would calculate per diem, labor, and other travel costs using the inputs. The Help Topic should be amended to indicate whether internal technical reviews are accounted for.
Remedial Investigation	Louisville	LRL-16	There is no option for travel via airlines. RACER assumes travel by truck even for long distances.	RACER should determine appropriate travel method based on mileage or provide an option for travel.

RACER Technology	Site Visit Location	Project	Observation	Suggested Solution
Residual Waste Management	AFCEE	AFCEE-11AFCEE-12	These projects involve on-site treatment of IDW, so there are loading and transportation-related costs but no disposal fees. There is no way to account for loading and transport to an on-site facility (with no disposal cost) without making assembly-level changes.	Include on-site disposal option in Residual Waste Management technology.
Residual Waste Management	Alaska	POA-01	The cost for transport of waste off-site via barge is substantially higher than the actual cost for this project. Furthermore, the barging cost is not dependent upon number of miles traveled. Cost is the same for barging whether it is going 5 miles or 3000. The Alaska District PMs indicated that the barging cost never models reality; therefore, they are not using it. Instead they are substituting trucking for barging when barging is required.	Reevaluate cost of barging and update assembly line item associated with barging. (Assembly line item 33190292 Barge Transport of Containerized Waste; per CWT). Reengineer the line item so that the cost of barging is more realistic and is tied to the mileage traveled.
Residual Waste Management	Alaska	POA-02	Transport of purge water to an on-site disposal facility cannot be handled in Residual Waste Management.	Add options to account for the containerizing and transport to on-site facility.
Residual Waste Management	Alaska	POA-03b	The barging cost is not dependent upon number of miles traveled. Cost is the same for barging whether it is going 5 miles or 3000.	Reevaluate cost of barging and update assembly line item associated with barging. (Assembly line item 33190292 Barge Transport of Containerized Waste; per CWT). Reengineer the line item so that the cost of barging is more realistic and is tied to the mileage traveled.
Residual Waste Management	Alaska	POA-04	Transport of purge water to an on-site disposal facility cannot be handled in Residual Waste Management.	Add options to account for the containerizing and transport to on-site facility.

RACER Technology	Site Visit Location	Project	Observation	Suggested Solution
Residual Waste Management	Alaska	POA-04	Transport of purge water to an on-site disposal facility cannot be handled in Residual Waste Management.	Add options to account for the containerizing and transport to on-site facility (no disposal fee).
Residual Waste Management	Alaska	POA-06	RACER does not include an option for using a helicopter to transport waste.	A helicopter option and concomitant combination options could be added to the current transportation options.
Residual Waste Management	Alaska	POA-06	There is no option for using Supersacks. This packaging type is becoming more common.	Incorporate Supersacks as a containering option.
Residual Waste Management	Fort Worth	SWF-03	Concrete disposal present in residual waste even when zeroed out in UST.	Revise Residual Waste Management technology to delete concrete when none is selected in companion technology.
Residual Waste Management	Fort Worth	SWF-04	Assembly 33197270 *Landfill Nonhazardous Solid Bulk Waste by CY* may be too high ($84.87/CY). Proposed cost (for non-hazardous excavated soil) is $27.5/CY.	Reevaluate assembly-level disposal costs for non hazardous solid waste (Assembly 33197270 *Landfill Nonhazardous Solid Bulk Waste by CY*).
Residual Waste Management	Fort Worth	SWF-09	Concrete disposal present in residual waste even when zeroed out in UST.	Revise Residual Waste Management technology to delete concrete when none is selected in companion technology.
Residual Waste Management	Louisville	LRL-11	Technology does not allow for transport/disposal at onsite Wastewater Treatment Plant (WWTP).	Consider modifying technology to include option for onsite disposal (loading and transport only).
Residual Waste Management	Savannah	SAS-17	RACER cost for roll-off containers is very high - $2,420/month.	Revise cost for roll-offs. Cost is usually nominal - mostly covered by the disposal of the contents.

RACER Technology	Site Visit Location	Project	Observation	Suggested Solution
Restoration Advisory Board	Louisville	LRL-14	This technology provides three options for number of RAB meetings.	The options should be modified for the user to select the number of meetings rather than having to select from just three. RACER can then determine the appropriate cost.
Restoration Advisory Board	Louisville	LRL-14	The system definition tab has an input field for duration (in years). However, when a number of years greater than 1 is entered, RACER puts the costs for all the years into the first year, rather than allocating those costs equally on a year by year basis. This results in an incorrect cost over time report.	Review and revise the algorithm which allocates costs for the cost over time calculations to parallel the monitoring technology (which has similar input fields but properly allocates the costs over time).
Site Closeout Documentation	AFCEE	AFCEE-12	The project included preparation of a Treatability Report. There is no technology for reports, such as Treatability Report so Site Closeout Documentation had to be used to approximate cost of Treatability Report.	Suggest considering new RACER technology to accommodate various types of reporting requirements. Could be a modification to the Site Closeout Documentation module to turn this module into a Reporting technology with various options for types of reports as the Required Parameter.
Site Closeout Documentation	Savannah	SAS-19	RACER does not provide the option of using a car and inputting distance for travel in Site Close-Out Documentation.	Revise technology so that travel distances below a certain reasonable distance are assumed to be by car, and greater distances are assumed to be by air travel.

RACER Technology	Site Visit Location	Project	Observation	Suggested Solution
Site Inspection	Alaska	POA-22	For this project, the RI technology was used because the project contained specific activities only available in this technology; however, the SI technology should include these activities. The RI technology over-estimated the total cost, as this was just an SI-type of investigation.	Add geophysical tests to SI technology.
Site Inspection	Baltimore	NAB-10	Selecting Biennial for frequency puts cost in each year when a cost over time report is run.	Revise algorithm so that cost over time displays the correct dollar amounts per year.
Site Inspection	Louisville	LRL-05	Some tasks require filling in bore holes after sampling with bentonite.	An option to be provided under well abandonment or wherever soil sampling is provided to fill bore holes.
Site Inspection	Louisville	LRL-06	RACER does not have an option for installation of piezometers.	Provide for an option either in this and similar technologies for installation of piezometers.
Site Inspection	Louisville	LRL-06	Performance of on-site analyses cannot be estimated.	Provide for an option either in this and similar technologies for performance of on-site analyses such as with x-ray fluorescence detectors and others.
Special Well Drilling	Savannah	SAS-09	Options should be provided in RACER for installation of sparge points.	Utilize algorithms from other technologies that include installation of sparge points to ensure consistency of this activity throughout RACER.
UST Closure/Removal	Fort Worth	SWF-03	Has assembly for “Minor Demolition, Concrete” included, even if none needed. No ability to specify piping length.	Revise technology. Delete concrete when none selected. Add option for piping length.

RACER Technology	Site Visit Location	Project	Observation	Suggested Solution
UST Closure/Removal	Fort Worth	SWF-03	USTs smaller than 500 gallons can not be estimated in UST Closure/Removal technology.	Revise technology to allow for closure/removal of tanks smaller than 500 gallons.
UST Closure/Removal	Kansas City	NWK-13 (Evaluated but not estimated due to lack of information)	This project included the removal for ASTs but the RACER Module for tank removals does not accommodate that option. UST Closure has to be estimated and changes made at the Assembly level to accommodate aboveground nature of the tanks.	Change UST Closure/Removal to Tank Closure/Removal and include option for ASTs in module.
UST Closure/Removal	Kansas City	NWK-26	275 Gallon UST at Forbes S-7 site was estimated as a 500 Gallon tank; minimum valid value for "Average Volume of Tank" in UST Closure Module is 500 Gallons	Revise technology to allow for closure/removal of tanks smaller than 500 gallons.
UST Closure/Removal	Savannah	SAS-02	UST technology cannot account for AST removal or closure. These are common activities.	Revise technology to include option for ASTs.
Various	Savannah	SAS-14	Stand-alone pumping units for injection of surfactants or other chemicals are not provided.	Provide technology or assemblies with stand-alone pumping units.
Various (Groundwater Monitoring Well, Soil Vapor Extraction, etc.)	Baltimore	NAB-08	RACER does not provide a technology for modifying well heads from one purpose to another, i.e., from a monitoring well to a SVE well.	Addition of an assembly, or a mini technology, would assist such occasions.
Various / Remedial Action Technologies	Alaska	POA-06	RACER's mobilization and demobilization costs for remedial actions reflects average site conditions. Some remote sites can only be accessed by helicopter, barges, and/or off-road vehicles. Some sites will require site workers to live on site in temporary facilities.	RACER should better account for access to remote sites.

RACER Technology	Site Visit Location	Project	Observation	Suggested Solution
Various / System-wide issue	Alaska	POA-02	Travel to island cannot be accounted for in RACER unless assemblies are added. Increasing Site Distance on the System Definition tab only adds additional miles for Sample Collection Vehicle, and does not include the option of air travel then truck rental, which is the more likely scenario.	Consider addition of options and/or assemblies that would allow user to generate an accurate cost for travel to remote sites.
Various / System-wide issue	Alaska	POA-03a, POA-03b	Travel to island cannot be accounted for in RACER unless assemblies are added. Increasing Site Distance on the System Definition tab only adds additional miles for Sample Collection Vehicle, and does not include the option of air travel then truck rental, which is the more likely scenario.	Consider addition of options and/or assemblies that would allow the user to generate an accurate cost for travel to remote sites.
Various / System-wide issue	Alaska	POA-12	RACER can not estimate mobilization and demobilization to remote camps.	Consider addition of options and/or assemblies that would allow the user to generate an accurate cost for travel to remote sites.
Well Abandonment	Alaska	POA-25	Technology does not have the ability to estimate partial removal, which is a common method of abandonment.	Revise technology to include an option for partial removal, such as cutting casing at a certain depth and grouting.

RACER Technology	Site Visit Location	Project	Observation	Suggested Solution
Well Abandonment	Baltimore	NAB-09	RACER does not include reporting in the Well Abandonment technology. It is common that preparation of a Well Abandonment report is required upon completion of abandonment activities; in the case of this project, a short "summary letter" was prepared for each well, and RACER was unable to estimate this activity within the technology. The Site Close-Out documentation technology had to be run to capture this cost.	Add an option to Well Abandonment to include reports; also consider adding a reporting "level of complexity," as project reporting requirements differ and can range from short summary memos to fully detailed abandonment reports.
Well Abandonment	Baltimore	NAB-19	RACER does not include reporting in the Well Abandonment technology. It is common that preparation of a Well Abandonment report is required upon completion of abandonment activities; in the case of this project, a short "summary letter" was prepared for each well, and RACER was unable to estimate this activity within the technology. The Site Close-Out documentation technology had to be run to capture this cost.	Add an option to Well Abandonment to include reports; also consider adding a reporting "level of complexity," as project reporting requirements differ and can range from short summary memos to fully detailed abandonment reports.
Well Abandonment	Louisville	LRL-09	Camera survey/geophysical log was a project requirement that could not be accounted for in RACER.	Consider adding an assembly for this activity from the UPB; if one does not exist in the UPB, suggest that it is researched and added.
Well Abandonment	Louisville	LRL-09	Well abandonment report preparation was a project requirement and could not be accommodated by the technology.	Consider adding option for well abandonment report to the technology.
Well Abandonment	Baltimore	NAB-19	RACER does not contain an assembly for concrete mix; all concrete-related assemblies include labor and equipment but there is no assembly for the material only.	Include cost book line items for concrete mix.

RACER Technology	Site Visit Location	Project	Observation	Suggested Solution
Well Abandonment Groundwater Monitoring Well	Alaska	POA-25	Neither technology has the ability to estimate well repair.	Revise technology to include addition of items to repair wells; otherwise, ensure adequate assemblies are available so users can add these items.

Appendix E – Description of Outliers to the Project and Technology Data Sets

Project-level Outliers														
Site Loca-tion	**Project Name**	**Hist cost**	**Pro-ject Year**	**Esc Fac**	**Esc. Hist Cost**	**S1 Estimate**	**S2 Estimate**	**S3 Estimate**	**S4 Estimate**	**S1 % Differ-ence**	**S2 % Differ-ence**	**S3 % Differ-ence**	**S4 % Differ-ence**	**Reason for Outlier**
Alaska	POA-03b	$36,343	2008	1.0000	$36,343	$108,841	$152,741	$155,153	$62,724	199.48%	**320.28%**	**326.91%**	72.59%	The large increase in cost difference from Scenario 1 (S1) to Scenario 2 (S2) is due to the change of Monitoring Report from the RACER default of Abbreviated to Comprehensive, per the reference documentation.
Alaska	POA-03c	$36,343	2008	1.0000	$36,343	$108,841	$152,741	$155,153	$62,724	199.48%	**320.28%**	**326.91%**	72.59%	The large increase in cost difference from S1 to S2 is due to the change of Monitoring Report from the RACER default of Abbreviated to Comprehensive, per the reference documentation.
Alaska	POA-12	$125,446	2004	1.1125	$139,555	$417,257	$432,962	$268,844	$214,738	198.99%	**210.24%**	92.64%	53.87%	The high cost difference for this project is primarily due to the cost difference of the Monitoring technology, used to account for borehole installation and groundwater sampling. Refer to the technology-level analysis below for a detailed explanation of the reasons for the cost difference for that technology.
Louis-ville	LRL-12	$13,420	2005	1.0821	$14,522	$44,110	$44,979	$30,434	$28,576	**203.74%**	**209.72%**	109.57%	96.77%	The quantity of delivery points was 800 by RACER default in S1, changed to 169 in S2. In addition, delivery method was changed from Injection Wells (default) to Direct Push. This change dramatically reduced the overall cost and brought the RACER cost in line with the historical cost.

Project-level Outliers														
Site Loca-tion	**Project Name**	**Hist cost**	**Pro-ject Year**	**Esc Fac**	**Esc. Hist Cost**	**S1 Estimate**	**S2 Estimate**	**S3 Estimate**	**S4 Estimate**	**S1 % Differ-ence**	**S2 % Differ-ence**	**S3 % Differ-ence**	**S4 % Differ-ence**	**Reason for Outlier**
Savan-nah	SAS-06	$898,355	2005	0.9241	$972,141	$3,175,487	$879,651	$872,274	$997,506	**226.65%**	-9.51%	-10.27%	2.61%	The quantity of delivery points was 800 by RACER default in S1, changed to 169 in S2. In addition, delivery method was changed from Injection Wells (default) to Direct Push. This change dramatically reduced the overall cost and brought the RACER cost in line with the historical cost.
Savan-nah	SAS-18	$348,121	2008	1.0000	$348,121	$5,766,333	$365,739	$396,163	$453,355	**1556.42%**	5.06%	13.80%	30.23%	The task is to perform a Regenesis 3DME injection in two monitoring wells. The In-Situ Biodegradation technology was used. In this case, the primary parameters did not produce an accurate model. The default number of delivery points was >100% too high; also the delivery method was direct push, instead of the default injection well installation. Together, these two changes account for the majority of the cost difference at S1.

Technology-level Outliers														
Project No.	**Technolo-gy**	**Hist cost**	**Pro-ject Year**	**Esc Fac**	**Esc. Hist Cost**	**S1 Estim-ate**	**S2 Estim-ate**	**S3 Estim-ate**	**S4 Estim-ate**	**S1 % Differ-ence**	**S2 % Differ-ence**	**S3 % Differ-ence**	**S4 % Differ-ence**	**Reason for Outlier**
AFCEE-12	Residual Waste Manage-ment	$7,185	2008	1.0000	$7,185	$24,036	$25,489	$4,625	$4,220	***234.5%***	***254.7%***	-35.6%	-41.3%	The high percent difference for this technology is due to the fact that the Residual Waste Management technology cannot account for on-site disposal (with no associated disposal fees) in S1 or S2. This project involved IDW management, which included containerizing the soil cuttings and purge water in drums, and disposing as non-hazardous at an on-base location.
USACE-LRL-02	Off-Site Transpor-tation and Waste Disposal	$2,940	2008	1.0000	$2,940	$11,532	$11,532	$11,532	$11,732	***292.2%***	***292.2%***	***292.2%***	***299.0%***	This technology is being used to account for the disposal of 6K gallons of nonhazardous water. It appears that the technology overestimated the requirements associated with that task.
USACE-LRL-08	Monitoring	$23,815	2006	0.9527	$24,997	$90,801	$43,040	$40,272	$41,261	***263.2%***	72.2%	61.1%	65.1%	The high cost difference in S1 is due primarily to the fact that QA/QC samples and a monitoring plan were not required.
USACE-LRL-12	Monitoring	$12,099	2005	0.9241	$13,093	$42,460	$43,329	$28,783	$27,029	***224.3%***	***230.9%***	119.8%	106.4%	The high cost difference in S1 and S2 is due primarily to the fact that Fuels analytical templates are used. This means that certain components of the template are not required and are zeroed out at assembly level (zeroed out PAH and BTEX for groundwater, and PAH, TPH, and BTEX for soil).

Technology-level Outliers														
Project No.	**Technolo-gy**	**Hist cost**	**Pro-ject Year**	**Esc Fac**	**Esc. Hist Cost**	**S1 Estim-ate**	**S2 Estim-ate**	**S3 Estim-ate**	**S4 Estim-ate**	**S1 % Differ-ence**	**S2 % Differ-ence**	**S3 % Differ-ence**	**S4 % Differ-ence**	**Reason for Outlier**
USACE-LRL-13	Monitoring	$42,401	2007	0.9766	$43,417	$130,404	$142,131	$119,360	$135,188	***200.4%***	***227.4%***	174.9%	***211.4%***	This technology was used to account for the annual sampling of 13 groundwater wells and three surface water locations. The reason for the cost difference could not be effectively isolated, but it is likely that it is partially due to the high LOE involved in the preparation of Standard Monitoring Plans.
USACE-LRL-14	MEC Site Character-ization & Removal Assess-ment	$169,237	2008	1.0000	$169,237	$653,361	$522,390	$522,390	$530,103	***286.1%***	***208.7%***	***208.7%***	***213.2%***	The contractor likely assumed that they were not going to find much; cost proposal included a minimal crew with a wheeled EM61. The technology assumes a site where ordinance would be found. Therefore there is a heavy load of labor for management, planning, and characterization, even though surface clearance and intrusive investigations were deleted.
USACE-NAB-08	Remedial Design	$1,307	2006	0.9527	$1,372	$7,051	$5,556	$2,919	$2,837	***413.8%***	***304.9%***	112.7%	106.7%	Since RD is calculated as a default percentage based upon the approach, it appears that the percentage is not correct in this case.
USACE-NAB-08	Monitoring	$7,702	2006	0.9527	$8,085	$80,231	$29,134	$25,195	$24,496	***892.4%***	***260.4%***	***211.6%***	***203.0%***	Cost difference at S1 is primarily due to inclusion of a monitoring plan & QA/QC samples. This plan and the QA/QC sampling are not necessary for this project, and were eliminated in S2. While these two items do not account for the entire difference, they account for ¾ of the difference between S1 and the historical cost. This brings the RACER cost much closer to the historical cost.

Technology-level Outliers														
Project No.	**Technolo -gy**	**Hist cost**	**Pro-ject Year**	**Esc Fac**	**Esc. Hist Cost**	**S1 Estim-ate**	**S2 Estim-ate**	**S3 Estim-ate**	**S4 Estim-ate**	**S1 % Differ-ence**	**S2 % Differ-ence**	**S3 % Differ-ence**	**S4 % Differ-ence**	**Reason for Outlier**
USACE -NAB-08	Monitoring	$9,361	2006	0.9527	$9,826	$58,475	$22,898	$18,527	$18,011	***495.1%***	133.0%	88.6%	83.3%	Cost difference at S1 is primarily due to inclusion of a monitoring plan & QA/QC samples. This plan and the QA/QC sampling are not necessary for this project, and were eliminated in S2. While these two items do not account for the entire difference, they account for ¾ of the difference between S1 and the historical cost. This brings the RACER cost much closer to the historical cost.
USACE -NAB-08	Monitoring	$9,826	2006	0.9527	$10,314	$52,026	$25,756	$22,481	$21,850	***404.4%***	149.7%	118.0%	111.9%	Cost difference at S1 is primarily due to inclusion of a monitoring plan & QA/QC samples. This plan and the QA/QC sampling are not necessary for this project, and were eliminated in S2. While these two items do not account for the entire difference, they account for ¾ of the difference between S1 and the historical cost. This brings the RACER cost much closer to the historical cost.
USACE -NAB-11	Monitoring	$2,170	2007	0.9766	$2,222	$38,582	$7,475	$9,098	$7,493	***1636.4%***	***236.4%***	***309.5%***	***237.2%***	Cost difference at S1 is primarily due to inclusion of a monitoring plan & QA/QC samples and purge water collection. The plan and purge water disposal are not necessary for this project, and were eliminated in S2. QA/QC samples were dramatically reduced. While these items do not account for the entire difference, they account for ¾ of the difference between S1 and the historical cost. This brings the RACER cost much closer to the historical cost.

Technology-level Outliers														
Project No.	**Technolo-gy**	**Hist cost**	**Pro-ject Year**	**Esc Fac**	**Esc. Hist Cost**	**S1 Estim-ate**	**S2 Estim-ate**	**S3 Estim-ate**	**S4 Estim-ate**	**S1 % Differ-ence**	**S2 % Differ-ence**	**S3 % Differ-ence**	**S4 % Differ-ence**	**Reason for Outlier**
USACE -NAB-12	Monitoring	$13,585	2007	0.9766	$13,911	$62,258	$24,149	$24,033	$24,154	***347.6%***	73.6%	72.8%	73.6%	Cost difference at S1 is primarily due to inclusion of a monitoring plan & QA/QC samples. This plan and the QA/QC sampling are not necessary for this project, and were eliminated in S2. While these two items do not account for the entire difference, they account for ¾ of the difference between S1 and the historical cost. This brings the RACER cost much closer to the historical cost.
USACE -NAB-16	Residual Waste Manage-ment	$425	2007	0.9766	$435	$1,972	$1,972	$1,092	$1,076	***353.1%***	***353.1%***	150.9%	147.3%	Cost difference from S1 & S2 to S3 was primarily due to the disposal of the liquid versus an on-site treatment. When this change was made at the assembly level in S3, the RACER cost (while still high) came much closer to the historical cost.
USACE -NAB-18	Residual Waste Manage-ment	$1,100	2005	0.9241	$1,190	$13,969	$14,701	$5,501	$5,132	***1073.5%***	***1135.0%***	***362.1%***	***331.1%***	RACER was dramatically overestimating the quantity of purge water for disposal. RACER calculated quantity is 1,504 gallons, whereas the historical quantity is 600 gallons. When this quantity was reduced at the assembly level in S3, the RACER cost (while still high) came much closer to the historical cost.
USACE -POA-01	Profession-al Labor Manage-ment	$46,980	2007	0.9766	$48,106	$298,427	$304,829	$304,168	$135,233	***520.4%***	***533.7%***	***532.3%***	181.1%	Since PLM is a default percentage, it appears that the percentage is not correct in this case.

Technology-level Outliers														
Project No.	**Technolo-gy**	**Hist cost**	**Pro-ject Year**	**Esc Fac**	**Esc. Hist Cost**	**S1 Estim-ate**	**S2 Estim-ate**	**S3 Estim-ate**	**S4 Estim-ate**	**S1 % Differ-ence**	**S2 % Differ-ence**	**S3 % Differ-ence**	**S4 % Differ-ence**	**Reason for Outlier**
USACE-POA-03b	Monitoring	$35,261	2008	1.0000	$35,261	$105,734	$149,649	$152,553	$61,721	199.9%	***324.4%***	***332.6%***	75.0%	The large increase in cost difference from S1 to S2 is due to the change of Monitoring Report from the RACER default of Abbreviated to Comprehensive, per the reference documentation.
USACE-POA-03c	Monitoring	$35,261	2008	1.0000	$35,261	$108,841	$149,649	$152,553	$61,721	***208.7%***	***324.4%***	***332.6%***	75.0%	The large increase in cost difference from S1 to S2 is due to the change of Monitoring Report from the RACER default of Abbreviated to Comprehensive, per the reference documentation.
USACE-POA-12	Cleanup and Landscap-ing	$39,846	2004	0.8989	$44,328	$240,827	$240,827	$76,709	$65,903	***443.3%***	***443.3%***	73.1%	48.7%	This technology is used to account for the seeding of 29 acres. It appears that the technology overestimated the requirements associated with that task. Hydroseeding is the RACER default, however S3 replaced hydroseeding with a less expensive seeding assembly. Also, watering and mowing is included at the assembly level for all areas selected for seeding. However, in this project those activities were not required and were zeroed out at S3, bringing the cost closer to historical. However, the cost was still 73% higher than historical cost; even at S3. It is likely that the high location modifier for this project contributed to the 73% difference at S3, since the % difference improves at S4.
USACE-SAS-01	Profession-al Labor Manage-ment	$9,864	2007	0.9766	$10,100	$179,744	$179,744	$87,797	$88,881	***1679.6%***	***1679.6%***	***769.2%***	***780.0%***	Since PLM is a default percentage, it appears that the percentage is not correct in this case.

Technology-level Outliers														
Project No.	**Technolo-gy**	**Hist cost**	**Pro-ject Year**	**Esc Fac**	**Esc. Hist Cost**	**S1 Estim-ate**	**S2 Estim-ate**	**S3 Estim-ate**	**S4 Estim-ate**	**S1 % Differ-ence**	**S2 % Differ-ence**	**S3 % Differ-ence**	**S4 % Differ-ence**	**Reason for Outlier**
USACE-SAS-04	Monitoring	$10,852	2005	0.9241	$11,743	$48,756	$26,053	$27,819	$29,038	***315.2%***	121.9%	136.9%	147.3%	Cost difference at S1 is primarily due to inclusion of a monitoring plan. This plan is not necessary for this project, and was eliminated in S2.
USACE-SAS-04	Monitoring	$3,359	2005	0.9241	$3,635	$33,640	$10,042	$11,252	$11,745	***825.5%***	176.3%	***209.6%***	***223.1%***	Cost difference at S1 is primarily due to inclusion of a monitoring plan & QA/QC samples. This plan and the QA/QC sampling are not necessary for this project, and were eliminated in S2. While these two items do not account for the entire difference, they account for ¾ of the difference between S1 and the historical cost.
USACE-SAS-06	In-situ Biodegra-dation	$418,519	2005	0.9241	$452,893	$2,391,174	$384,621	$369,624	$423,583	***428.0%***	-15.1%	-18.4%	-6.5%	The quantity of delivery points was 800 by RACER default in S1, changed to 169 in S2. In addition, delivery method was changed from Injection Wells (default) to Direct Push. This change dramatically reduced the overall cost and brought the RACER cost in line with the historical cost.
USACE-SAS-06	Residual Waste Manage-ment	$3,465	2005	0.9241	$3,750	$5,903	$14,651	$18,465	$21,224	57.4%	***290.7%***	***392.5%***	***466.0%***	The number of drums of purge water for disposal increased from 23 drums (default) in S1 to 56 drums in S2. This increase is due to the automatic calculation of the volume of purge water from the monitoring technology. The actual volume of drums disposed (70) was entered in S3. The cost difference at this Scenario is likely due to a difference in disposal cost between historical cost and RACER.

Technology-level Outliers														
Project No.	**Technolo-gy**	**Hist cost**	**Pro-ject Year**	**Esc Fac**	**Esc. Hist Cost**	**S1 Estim-ate**	**S2 Estim-ate**	**S3 Estim-ate**	**S4 Estim-ate**	**S1 % Differ-ence**	**S2 % Differ-ence**	**S3 % Differ-ence**	**S4 % Differ-ence**	**Reason for Outlier**
USACE-SAS-13	Bioslurp-ing	$64,395	2004	0.8989	$71,638	$921,104	$166,057	$175,779	$205,349	***1185.8%***	131.8%	145.4%	186.6%	The number of vapor extraction wells was reduced from 75 (RACER default) in S1 to 11 (actual historical quantity) in S2. The default number of wells used in S1 overestimated the actual quantity by almost 7 times. The reduction from S1 to S2 brought the cost much closer to the historical cost.
USACE-SAS-13	Monitoring	$779	2004	0.8989	$867	$29,020	$5,900	$5,662	$6,618	***3248.7%***	***580.8%***	***553.3%***	***663.7%***	Cost difference at S1 is primarily due to inclusion of a monitoring plan & QA/QC samples. This plan and the QA/QC sampling are not necessary for this project, and were eliminated in S2. While these two items do not account for the entire difference, they account for ¾ of the difference between S1 and the historical cost.
USACE-SAS-14	Monitoring	$7,428	2008	1.0000	$7,428	$43,689	$21,248	$22,749	$27,115	***488.1%***	186.0%	***206.2%***	***265.0%***	Cost difference at S1 is primarily due to inclusion of a monitoring plan & QA/QC samples. This plan and the QA/QC sampling are not necessary for this project, and were eliminated in S2. While these two items do not account for the entire difference, they account for ¾ of the difference between S1 and the historical cost.
USACE-SAS-18	In-situ Biodegra-dation	$182,608	2008	1.0000	$182,608	$4,228,816	$209,188	$219,708	$251,540	***2215.8%***	14.6%	20.3%	37.7%	The quantity of delivery points was 300 by RACER default in S1, changed to 140 in S2. Method was also changed from injection wells (RACER default) to direct push. These changes dramatically reduced the overall cost and brought the RACER cost in line with the historical cost.

Technology-level Outliers														
Project No.	**Technolo-gy**	**Hist cost**	**Pro-ject Year**	**Esc Fac**	**Esc. Hist Cost**	**S1 Estim-ate**	**S2 Estim-ate**	**S3 Estim-ate**	**S4 Estim-ate**	**S1 % Differ-ence**	**S2 % Differ-ence**	**S3 % Differ-ence**	**S4 % Differ-ence**	**Reason for Outlier**
USACE-SAS-18	In-situ Biodegra-dation	$58,882	2008	1.0000	$58,882	$1,411,412	$54,357	$59,580	$68,313	***2297.0%***	-7.7%	1.2%	16.0%	The quantity of delivery points was 100 by RACER default in S1, changed to 50 in S2. Method was also changed from injection wells (RACER default) to direct push. These changes dramatically reduced the overall cost and brought the RACER cost in line with the historical cost.
USACE-SWF-01	Residual Waste Manage-ment	$1,440	2002	0.8726	$1,650	$15,987	$15,987	$1,705	$1,526	***868.8%***	***868.8%***	3.3%	-7.5%	The high percent difference for this technology is due to the fact that the Residual Waste Management technology cannot account for on-site disposal (with no associated disposal fees) in S1 or S2. This project involved IDW management, which included landfilling excavated material at an on-site Army landfill.

Appendix F – Cumulative List of Lessons Learned During Data Gathering Site Visits

Listed below are some of the lessons learned that were encountered during the Data Collection Site Visits under both the AFCEE and USAEC TOs, and should be considered for future efforts of a similar nature.

- An actively engaged contracting staff is extremely helpful, as it allows more time for the Data Collection Team to interview project managers and identify projects that are suitable for the validation effort. For example, at the Savannah District, the contracting staff were particularly helpful in locating contracting files, delivering them to the Data Collection Team, and returning them to the file room following review by the Data Collection Team. The contracting staff's knowledge of the file system and file check-out procedures enabled them to perform these tasks much quicker than the Data Collection Team.
- Collecting data on-location is more efficient than trying to coordinate follow-up data collection after the data collection team has returned to their home offices.
- Collecting the signed final contracting action (e.g., "Order for Supplies or Services") that documents awarded project cost is critical to a complete data set. Contracting representatives at the Alaska District had a better knowledge of this documentation than the project managers. Their participation allowed the data gathering team to locate the required documents.
- Complex or "blanket"-type projects are not always good candidates for cost analysis. For example, projects that include several small activities/technologies in one lump-sum historical cost can be difficult to model in RACER.
- Final invoicing information can be obtained from project managers and contracting POCs. These data are most easily obtained via access of a database; print-outs of the on-screen data are sufficient to document that the contract has been closed-out. This is a critical piece of information for projects to be classified as having "high" data completeness.
- Having contract personnel available during the site visit is also very important. Contracts personnel can be more familiar with the contract files than project personnel and provide insight and guidance to the data gathering team.
- It is critical for contracting staff to participate in pre-data gathering site visit planning teleconferences. Sensitive contracting files will need to be copied and/or scanned by the data collection team, and it is imperative that contracting representatives are fully aware of this and are comfortable with the data collection team's non-disclosure agreement.[39]

[39] *The data collection team signed non-disclosure agreements at AFCEE, Fort Worth, and Kansas City; these signed agreements were designed to provide contracting representatives with an additional assurance that the project team would not use collected*

- It is important that the data gathering team has assistance in deciphering District-specific contracting vehicles and documentation. Unique contracting vehicles, such as the Alaska District's Total Environmental Restoration Contract (TERC), often contain several modifications, as well as contract documentation, that differs from traditional contracts. The Alaska District's contracting representatives were engaged and available throughout the visit, providing assistance in understanding these documents and gathering the necessary documentation to verify historical project costs. The contracting representatives at the Alaska District were extremely helpful in this regard; in addition, the District's Project Managers had ample knowledge of these issues as well and also provided direction to the data gathering team.
- It is important to log all gathered project data, regardless of whether the project is included in the final data set for analysis. A subjective analysis of environmental remediation and restoration projects is important to determine if there are any emerging technologies or processes not currently captured by the RACER system.
- Large IDIQ contracts can be very difficult to navigate and are frequently not good candidates for the validation effort. Frequently the Statement of Work is brief, as is the contractor's proposal, resulting in not enough detailed information to estimate the project.
- On-site internet access for Booz Allen staff is not necessary; however, it is helpful in collection, transfer, and storage of data. Since the use of portable "flash" drives is restricted, transfer of scanned data is limited to e-mailing directly from the scanner. Without internet access, it is difficult to determine that the files transferred correctly. Several files had to be re-scanned during and following the Savannah visit due to file transfer errors.
- Performance-based contracts also pose a challenge. These projects typically have Statements of Work and proposals that do not contain the task specific information and pricing that is needed to accurately cost the project and compare it to actual historical costs.
- Project documentation that is stored at the District offices on CD can be easily transferred and logged for use in Data Deconstruction and estimating. This is often the easiest method of obtaining Remedial Action Reports, Work Plans, Monitoring Reports, and other similar documents which are useful supplements to the contractor's cost estimate and SOW.
- Project-specific interviews with program and project managers allowed the data gathering team to get a better understanding of even simple projects. Waste handing, decontamination, and mobilization/demobilization are all examples of key project components which generally are not detailed in the contractor's proposals but are included in the project cost. In order to determine whether the

data for purposes other than specifically stated in this contract PWS. Team members are already under a non-disclosure agreement as part of the GEITA05 contract.

RACER system accurately estimates these costs, the actual methodologies for these tasks must be captured as accurately as possible.

- The Alaska District staff made themselves readily available for post-visit follow up and project interviews. This allowed the data gathering team to gather complete data sets for a larger number of projects than would have otherwise been possible.
- The scanning of contract data is much more efficient than copying the data and bringing it back. Also important is the organization of this electronic data while still on site and while the information is still fresh in the minds of the data gathering team.
- The signed final contracting action ("Order for Supplies or Services") is critical for a project's inclusion in the final data set, as it is the key differentiator between projects identified as "low" and "medium" data completeness.

Appendix G – Project Documentation (RACER-Generated Estimate Documentation Reports (EDRs))

Complete documentation of each estimate will be delivered for storage to USAEC in hard copy along with gathered project and contract data and RACER databases, as per the PWS.