FINAL REPORT GUIDANCE

Environmental Restoration Projects

May 2018

OVERVIEW

A Final Report is a requirement of all Environmental Security Technology Certification Program (ESTCP) projects. This report must be reviewed and approved by ESTCP. The Final Report is a comprehensive technical report documenting the project's activities, results, and conclusions.

This document provides general guidance for writing Final Reports for projects that receive funding under the ESTCP Environmental Restoration program area. The guidance provided in this document will help to ensure that all project reporting of demonstration results is consistent with the ESTCP standards.

The guidance provided here is general and all elements may not apply to all ESTCP Environmental Restoration projects. It will be the responsibility of each investigator, with concurrence of ESTCP, to decide what is most appropriate, and to what degree, for his or her site and technology.

Security Review

Because all Final Reports will be made available to the public via ESTCP's web site (http://www.serdp-estcp.org), a security review is required. A Standard Form 298 Report Documentation Page (SF 298) must be included in each document submission.

- For government agencies, the author will be responsible for Security and Distribution Classification review through their own agency's authority. The SF 298 should reflect the allowable distribution (i.e., unlimited public release) as determined by the clearing organization.
- For private and academic institutions, the SF 298 should be filled out to the extent possible, and ESTCP will conduct a Security and Policy Review through the Department of Defense's (DoD) Directorate for Freedom of Information and Security Review (FOISR).

All Final Reports should have the statement, "**Approved for public release; distribution is unlimited**" on the SF298. If any portion of the ESTCP-sponsored work requires limited distribution (i.e., proprietary, classified, or other distribution limitations), the principal investigator (PI) should contact the Environmental Restoration program manager for guidance.

The reports will also be posted on Defense Technical Information Center (DTIC) (http://www.dtic.mil). Federal organizations are responsible for ensuring that their publications are forwarded to DTIC. The ESTCP office will submit all non-DoD organization reports to DTIC.

Format

Final reports are intended for publication. As such, ESTCP expects them to be professionally written and properly edited. The following general formatting parameters are recommended:

Cover	Use the cover of this document as a template; include ESTCP project name and number, your organization's project number (if applicable), date (month/year), document version number, and the researcher(s) name(s) and organization.
Font	Times New Roman proportional font
Cover Main Title	26 pt, bold, flush right
Cover Title	18 pt, bold, flush right
Section headings	14 pt, bold, flush left
Subsection headings	12 pt, bold, flush left
Text	12 pt
Margins	1" top, left, right, bottom
Page numbering	Bottom center Cover page: none Front matter: i, ii, iii, iv… Body of document: 1, 2, 3, 4…
Word processing software	Use either Microsoft Word or provide a PDF document
Figures, tables, and photographs	Insert in the document on the same or first page following the first reference. Liberal use is highly recommended.

How to Submit a Draft Final Report

Final Reports must be submitted to the ESTCP Support Office. The report may be sent using ***one of the methods*** indicated below:

- For files that are 100MB or less: Submit the report in SEMS 2.0 (https://sems2.serdp-estcp.org). Follow the instructions below for uploading your document:
  - From the project dashboard, click "Overview & Plan" in the left-hand panel, then click "Project Plan".
  - Scroll down to the document milestone and click "Upload" in the milestone box.
  - Select the file you would like to upload and click the "Upload" button.
  - Click "Submit" in the bottom right corner of the milestone box.
- For files larger than 100MB: Contact serdp-estcp.documents@noblis.org to receive an email with the web link that will allow access to the system to upload your file(s). Please make sure you include the project number and the title(s) of the document(s) to allow identification of your files.

Please do not submit reports directly to the ESTCP Program Manager.

SECTION-BY-SECTION FINAL REPORT GUIDANCE

Cover Page: Using the cover page provided in the Word version of this guidance document and also available at http://www.serdp-estcp.org/Investigator-Resources/ESTCP-Resources/Technical-Reports, include the Demonstration title, ESTCP project number, your organization's project number (if applicable), date (month/year), document version number, and the researcher(s) name(s) and organization.

Standard Form 298 Report Documentation Page: Include report date, type, title, author(s), contract number, project number, performing organization name and address, abstract, subject terms, number of pages, and name and phone number of responsible person.

Front Matter: Provide a Table of Contents and lists of Acronyms, Figures, and Tables.

Acknowledgments: State the individuals and/or organizations that contributed to the demonstration project and the generation of the Final Report.

Abstract: Provide a one page abstract with the following sections:

- Introduction and Objectives
- Technology Description
- Performance and Cost Assessment
- Implementation Issues
- Publications

The abstract will be used to update the project web page.

Executive Summary: Provide a 5 to 10 page extended Executive Summary. The Executive Summary will be posted as a stand-alone document on the SERDP & ESTCP web site. It should include key graphics and tables from the Final Report. Include the following sections:

- Introduction
- Objectives
- Technology Description
- Performance Assessment
- Cost Assessment
- Implementation Issues

1.0 INTRODUCTION

This section is intended to provide a general overview of the project. Specific subsections as described below should be included in this section.

1.1 BACKGROUND

Describe the environmental problem being addressed and its impact on DoD operations. Briefly describe the technology that was demonstrated and its potential benefit compared to conventional practices and alternatives.

1.2 OBJECTIVE OF THE DEMONSTRATION

Describe the overarching objective(s) of the demonstration, such as to validate the technology in the field at the appropriate scale of operation (pilot, prototype or full-scale), or to transfer the technology to an end user.

1.3 REGULATORY DRIVERS

State the existing or anticipated federal, state, or local regulations, or DoD directives that have resulted in a need for this innovative technology.

2.0 TECHNOLOGY

This section is intended to provide an overview of the technology that was demonstrated. Reference to existing papers and reports is highly encouraged.

2.1 TECHNOLOGY DESCRIPTION

- Describe the technology in sufficient detail to provide an accurate and factual understanding of its theory, functionality, and operation.
- Provide an overall schematic diagram of the technology.
- Provide a chronological summary of the development of the technology to date.
- Describe expected applications of the technology.

2.2 TECHNOLOGY DEVELOPMENT

Provide a detailed description of all technology development conducted prior to the field demonstration under the ESTCP project. (*Note: Treatability and laboratory confirmation studies should be reported in Section 5.0.*) If the development work has been published in a separate technical report, provide a brief summary and reference that report. If not, the section should be sufficiently detailed to fully describe the work. As appropriate, detailed data sets and design information should be provided in appendices, but a summary of the results should be provided in this section. Liberal use of graphics is encouraged to aid the reader in understanding the results.

2.3 ADVANTAGES AND LIMITATIONS OF THE TECHNOLOGY

State the advantages and limitations of the technology and compare these with the advantages and limitations of alternative technologies. Name any prominent alternative technologies.

This section should be updated from that provided in the Demonstration Plan to include any advantages or disadvantages as noted during the demonstration.

3.0 PERFORMANCE OBJECTIVES

Performance objectives are the primary criteria established by the investigator for evaluating the innovative technology. They provide the basis for evaluating the performance and costs of the technology. Meeting these performance objectives is essential for successful demonstration and validation of the technology. This section should provide an accurate summary of the performance objectives and whether they were met and, if not met, the principal reason for failure.

Performance objectives may be related to qualitative or quantitative parameters (i.e., reduction in mass flux, reduction in point source contaminant concentrations, etc.) These should include, but are not limited to, such things as end-point criteria, remediation time, and analytical sensitivity.

Performance objectives may be presented in two ways, ***qualitative and quantitative***, and should be summarized in Table 1 (sample provided).

Table 1. Performance Objectives
[SAMPLE ONLY–Performance objectives must be specific to the technology being demonstrated.]

Performance Objective	Data Requirements	Success Criteria	Results
Quantitative Performance Objectives			
Determine remediation effectiveness	Pre- and post-treatment contaminant concentrations in soil and groundwater	• >90% reduction considered successful • Student t-test or ANOVA for statistical analysis	
Analytical field sensitivity	Matrix-specific field samples	Concentrations between 2x-5x reporting limit are detected	
Qualitative Performance Objectives			
Ease of use	Feedback from field technician on usability of technology and time required	A single field technician able to effectively take measurements	

The following information should be included in the detailed description of each performance objective:

- A full explanation of the objective
- A statement as to what data were collected to evaluate the performance objectives
- A statement as to how the data were interpreted and to what extent the success criteria were met.

Please note that equivalent subsections should be provided for each performance objective. It is recognized that related performance objectives may have similar data acquisition needs. As a result, reference can be made to earlier sections rather than repeating all information.

4.0 SITE DESCRIPTION

This section should provide a concise summary of the demonstration site(s) and should include all site information that is relevant to the technology. Specific subsections below are intended to capture relevant information; however, please include other site information that had immediate bearing on the performance of the technology.

4.1 SITE LOCATION AND HISTORY

Describe the history of operations at the test site(s). Describe any existing operations that may have impacted the demonstration (i.e., pump-and-treat, etc.). Provide a map showing the location of the site where the technology demonstration took place.

4.2 SITE GEOLOGY/HYDROGEOLOGY

Provide information that was relevant for the technology demonstration. Describe the site geology and any relevant matrix effects (soil type, particle size distribution, etc.). Provide cross-sections of the site geology as appropriate. Describe the hydrogeology and any relevant matrix effects (pH of groundwater, dissolved oxygen, etc.).

4.3 CONTAMINANT DISTRIBUTION

Provide site maps and/or tables illustrating the concentration and distribution of contaminant(s) prior to the demonstration. Identify the date the data were collected. Identify all injection, extraction, and monitoring wells as appropriate.

5.0 TEST DESIGN

This section provides the detailed description of the system design and testing conducted during the demonstration(s). Descriptions here should be sufficiently detailed that a reader can fully understand the demonstration and all data collected.

5.1 CONCEPTUAL EXPERIMENTAL DESIGN

Provide a broad overview of the experimental design used to evaluate the performance objectives, including a discussion of controls, various operational phases, and/or other means used to evaluate the technology performance. Specific details should be provided in the following sections.

5.2 BASELINE CHARACTERIZATION

Describe the baseline characterization activities that were conducted as part of this demonstration. Include a subsection on each relevant site characterization activity, such as measurements of depth to groundwater, hydraulic conductivity, and contaminant concentrations. Provide a level of detail on sampling methods equivalent to that provided in the Demonstration Plan. Provide the results of the baseline characterization. As appropriate, detailed data sets should be provided in appendices, but a summary of the results should be provided in this section. Liberal use of graphics is encouraged to aid the reader in understanding the results.

5.3 TREATABILITY OR LABORATORY STUDY RESULTS

Provide the results of any treatability or laboratory confirmation studies. If the results have been published in a separate technical report, provide a brief summary and reference that report. If not, the section should be sufficiently detailed to fully describe the results. As appropriate, detailed data sets should be provided in appendices, but a summary of the results should be provided in this section. Liberal use of graphics is encouraged to aid the reader in understanding the results.

5.4 DESIGN AND LAYOUT OF TECHNOLOGY COMPONENTS

This section should provide a thorough description with accompanying schematic diagrams of all technology components as deployed. Provide a subsection for each significant technology component describing its design and location. Provide a level of detail equivalent to that provided in the demonstration plan. For example, if demonstrating a groundwater remediation technology, include subsections on construction and installation of monitoring wells, injection wells, injection equipment, utilities installation, etc. If a characterization technology was demonstrated, include subsections on construction and installation of monitoring wells, installation and setup of the sampling device, etc. Include details on the specifications for all materials. Provide detailed site maps showing the location(s) of all equipment. Schematic diagrams of equipment showing construction details must be provided.

5.5 FIELD TESTING

Provide a description of each significant phase of operation and the activities that were conducted during that phase at a level of detail equivalent to that provided in the Demonstration Plan. Activities may include system start-up, system operation under different operating parameters

(provide a subsection on each operating parameter condition), and system shutdown and demobilization. Provide a description for the method of disposal of any investigation-derived waste (IDW), if applicable.

Also provide a Gantt chart that shows the actual schedule for each phase of testing and how the various operational phases were related. Identify any key decision points on this chart.

Please note that when describing system shutdown and demobilization, decommissioning of equipment (including wells) must be defined. If equipment was left in place, please provide written permission from the facility for doing so in a separate memorandum.

5.5 SAMPLING METHODS

Provide a description of the samples collected during each phase of the project and summarize the number and type of samples collected in Table 2, and the analytical methods in Table 3. Sample tables are provided. Analytical methods that are not standard must be described in detail in the text.

In addition, the following information must be provided as an appendix to the Final Report.

- *Calibration of analytical equipment.* Provide a description of the calibration procedures for any equipment that was used as part of the project, except for equipment operated by a contract laboratory. If calibration procedures follow manufacturer guidelines, it is not necessary to repeat the procedure in this report; a reference can be provided.
- *Quality assurance sampling.* Provide a description of the quality assurance (QA) samples that were collected, such as field duplicates, equipment blanks, trip blanks, and field blanks.
- *Decontamination procedures.* Describe the decontamination procedures used prior to entering and leaving the site, as well as between samples, if applicable.
- *Sample documentation.* Describe the components of the sample documentation program, including sample labels, custody seals, field logbooks, photographs, chain-of-custody forms, and laboratory logbooks.

5.6 SAMPLING RESULTS

Provide a detailed summary of all sampling results in terms of both temporal and spatial dependence as appropriate. Liberal use of graphics and tables is encouraged. The Final Report serves as the archived document for all data gathered during the demonstration. All results should be reported in this section or summarized and provided in detail in appendices.

S A M P L E

Table 2. Total Number and Types of Samples to Be Collected

Component	Matrix	Number of Samples	Analyte	Location
Pre-demonstration sampling	Soil	100	BTEX, MTBE, TPH	All monitoring wells (1 per ft from 1 to 22 ft)
	Soil	5	Physical/chemical parameters[1]	One monitoring well (1 per 3 ft from 3 to 22 ft)
	Soil gas: Laboratory measurement	7	BTEX and TPH	From a subsurface monitoring device to be determined in field based on high TPH and low O_2
	Soil gas: Field measurement	1 per monitoring point	O_2, CO_2, TPH	All subsurface monitoring devices
	Groundwater	10	Organics & inorganics[2]	All monitoring wells
Technology performance sampling	Soil gas: Field measurement	Weekly samples	O_2, CO_2, TPH	All subsurface monitoring devices
	Soil gas: Laboratory measurement	Quarterly 1st year, semi-annually thereafter	BTEX and TPH	Same subsurface monitoring devices selected for initial sampling
	Surface emissions	Quarterly	BTEX and TPH	Center of test plot, outside radius of influence
	Groundwater	Per test requirement	SF_6, dissolved O_2	All subsurface monitoring devices
Post-demonstration sampling	Soil	100	BTEX, MTBE, TPH	Locations near monitoring wells (1 per ft from 1 to 22 ft)
	Groundwater	10	Organics and inorganics[2]	All monitoring wells
	Soil gas: Laboratory measurement	7	BTEX and TPH	Same subsurface monitoring devices selected for initial sampling

[1] Physical and chemical parameters to be measured include alkalinity, iron, moisture content, particle size, pH, sulfate, sulfide, TKN, and total phosphorous.

[2] Organic and inorganic parameters to be measured include alkalinity, BTEX, carbon dioxide, conductivity, dissolved oxygen, iron (II), methane, MTBE, nitrate, oxidation/reduction potential (E_H), pH, sulfate and sulfide sulfur, temperature, and TPH.

S A M P L E

Table 3. Analytical Methods for Sample Analysis

Matrix	Analyte	Method	Container	Preservative[1]	Holding Time
Soil	TPH	8015	Brass sleeve[2]	None	14 days
	BTEX	8240	Brass sleeve[2]	None	14 days
	Total phosphorous	CSTAPA	Brass sleeve[3]	None	28 days
	TKN	351.4	Brass sleeve[3]	None	28 days
	Alkalinity	CSTAPA	Brass sleeve[3]	None	28 days
	pH	150.1	Brass sleeve[3]	None	28 days
	Total iron	200.7	Brass sleeve[3]	None	28 days
	Particle size	11 sieve	1 L glass jar	None	28 days
	Sulfates/sulfides	ICAP	Brass sleeve	None	28 days
	Moisture content	ASTM	Brass sleeve[3]	None	28 days
Groundwater	Organics and inorganics	Methods will follow Wiedemeier et al., 1995			
Soil gas	BTEX		Summa canister	None	28 days
	TPH		Summa canister	None	28 days
Carbon sorbent (surface emissions sampling)	BTEX and TPH	TO14	Sorbent tube	None	28 days

[1] Preservatives are not required for these samples; however, all samples will be stored and shipped at 4EC.
[2] One brass sleeve holds sufficient soil for analyses of BTEX and TPH.
[3] One brass sleeve holds sufficient soil for analyses of alkalinity, iron, moisture content, pH, TKN, and total phosphorous.

6.0 PERFORMANCE ASSESSMENT

A summary of all data analysis in support of the assessment of performance objectives should be provided in this section. At a minimum, provide a subsection for each performance objective. Substantive analyses of data obtained during the demonstration that supports the conclusions summarized in Section 3.0 should be provided. Reference to information provided in the preceding section rather than repeating information should be done as appropriate.

Please note that equivalent subsections should be provided for each performance objective. It is recognized that related performance objectives may have similar data analysis. As a result, reference can be made to earlier sections rather than repeating all information.

7.0 COST ASSESSMENT

This section should provide sufficient cost information such that a remediation professional could reasonably estimate costs for implementation at a given site. In addition, this section should provide a discussion of the cost benefit of the technology. The following subsections with detailed discussions and examples should be provided.

7.1 COST MODEL

A simple cost model for the technology should be presented so that a remediation professional may understand costing implications. The cost model should reflect all cost elements that would be required for implementing the technology at a real site. For each cost element, list the cost data that was tracked during the demonstration and the associated cost as incurred during the demonstration. Please note that some cost elements may not be able to be tracked during a demonstration (i.e., long-term monitoring) or are standard practice and as such were not tracked (i.e., soil disposal). The cost element should be included in the table, but no cost data is required. A sample of cost elements for a project is provided in Table 4. Please modify this table to illustrate the cost elements that are relevant for the technology.

For each cost element unique to the technology, provide a subsection that includes the following information:

- A description to briefly explain the cost element and the need for it in the implementation of the technology
- A description and, if appropriate, supporting analysis as to what data supports the listed cost estimate or range

A description as to how the costs should be interpreted and how issues of scale are addressed.

S A M P L E

Table 4. Cost Model for a Permeable Reactive Wall

Cost Element	Data Tracked During the Demonstration	Costs	
Treatability study	• Personnel required and associated labor • Materials • Analytical laboratory costs	Lab technician, 80 h Project engineer, 15 h	$4,000 $1,500
		Materials[1]	$15,000
		Analytical laboratory[1]	$15,000
Baseline characterization	• Detailed hydraulic assessment required, costs associated with labor and materials tracked	Field technician, 120 h Project engineer, 15 h	$6,000 $1,500
		Materials[1]	$15,000
Material cost	Unit: $ per pound for reactive material Data requirements: • Initial amount of material required based on recommended width and depth of wall • Reapplication necessary – assessed via laboratory testing	•	
Installation	Unit: $ per linear foot of wall Data requirements: • Recommended installation method • Mobilization cost • Time required	•	
Waste disposal	Standard soil disposal, no cost tracking	NA	
Operation and maintenance costs	• No unique requirements recorded	NA	
Long-term monitoring	• Standard groundwater monitoring, no cost tracking	NA	

[1] Detailed list of materials and analytical costs provided in Final Report

7.2 COST DRIVERS

Discuss anticipated cost drivers that should be considered in selecting the technology for future implementation. Highlight any site-specific characteristic that will significantly impact cost. Provide examples of how these cost drivers will impact the implementation cost of the technology.

7.3 COST ANALYSIS

This section should provide realistic estimates for the costs of the technology when implemented operationally and should include the following information:

- Provide a basic site description assumed for the cost analysis.
- Provide a list of any assumptions made for the basis of the cost analysis.
- Describe the approach for developing an estimated life-cycle cost for the technology. Life-cycle costs should be estimated using real discount rate as provided by the Office of Management and Budget (OMB).
- State the remediation time frame. A typical remediation time frame of 30 years can be assumed for long-term remediation technologies. If other time frames are chosen, they should be justified.
- A table similar to Table 4 that lists each cost element and the associated cost breakdown for that element.

As appropriate, comparison should be made between the innovative technology and the traditional technology that it is intended to replace. In some cases, the technology does not replace an existing technology, but instead improves on existing technologies or methodologies. In such instances, cost savings or cost avoidances that the technology provides should be discussed. If a cost comparison to an existing technology can be conducted, provide an additional table for the existing technology that lists the same cost elements with the same assumptions so a direct comparison can be made.

8.0 IMPLEMENTATION ISSUES

This section should provide information that will aid in the future implementation of the technology. A brief description and references for other documents such as guidance or protocols should be provided. Lessons learned during the demonstration and other pertinent issues, as appropriate, such as those listed below should be provided.

- Identify potential regulations that may apply to the use of the technology. Provide a list of pertinent environmental regulations and any necessary permits required to implement the technology.
- Highlight end-user concerns, reservations, and decision-making factors. Discuss how the demonstration addressed these concerns.
- Describe any relevant procurement issues (whether equipment required for implementation is standard commercial off-the-shelf [COTS], a custom-built prototype, or newly commercialized).

9.0 REFERENCES

Use a standard format for literature citations such as:

Author name(s). Year. *Title.* Publication. Publication number. Page number.

APPENDICES

Appendix A: Points of Contact

List all the important points of contact (POC) involved in the demonstration, such as co-investigators, sponsors, industry partners, and regulators. The list should include the following information: (1) full name; (2) complete mailing and/or FedEx addresses (if different); (3) telephone number, fax number, and e-mail address; and (4) the role of the individual in the project.

Use the tabular format below:

POINT OF CONTACT Name	ORGANIZATION Name Address	Phone Fax E-mail	Role in Project

Additional Appendices

As needed, provide additional appendices to fully define methodologies identified in Section 5.0, Test Design, and to archive sampling results summarized in the body of the report.