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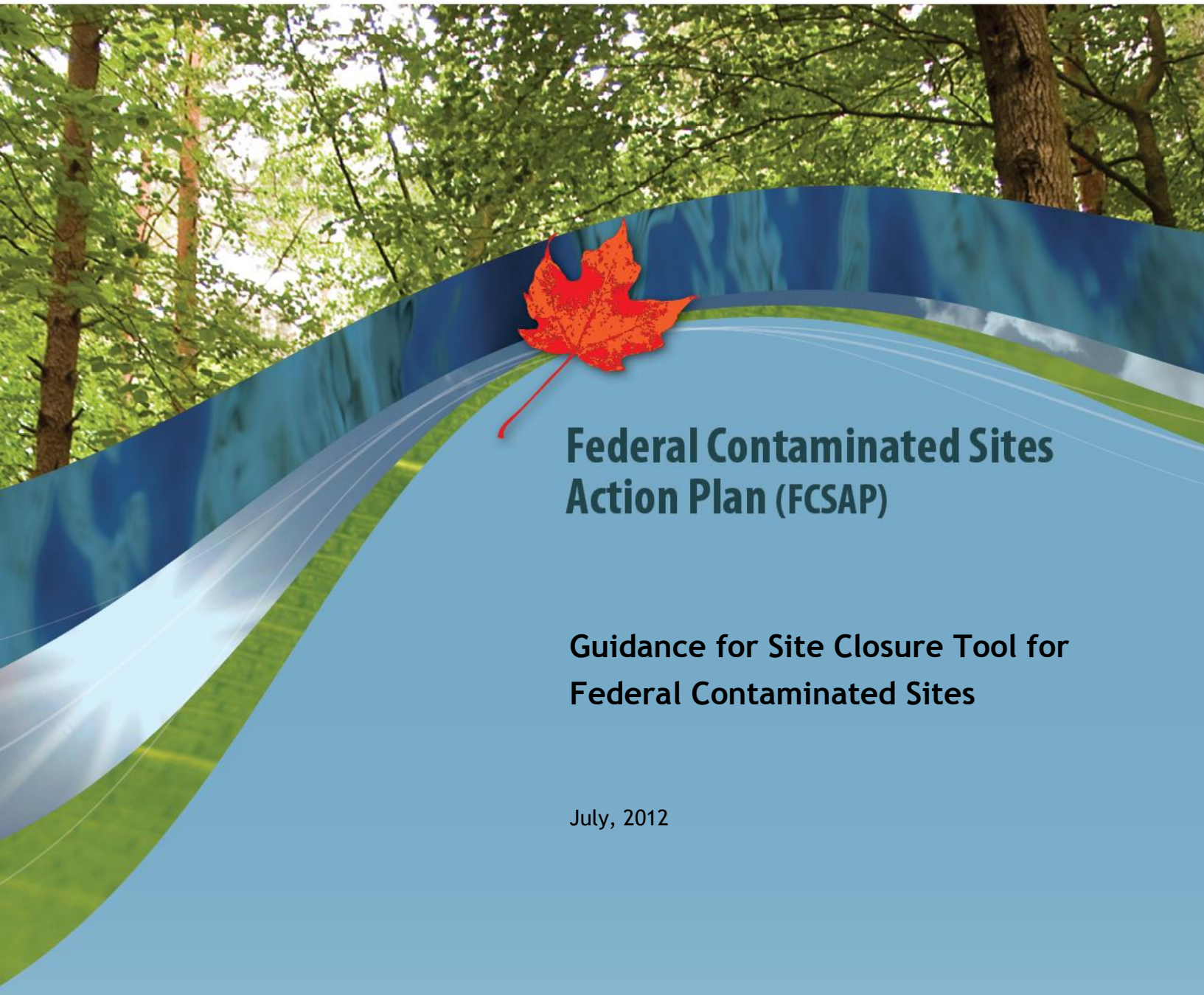

Federal Contaminated Sites Action Plan (FCSAP)

Guidance for Site Closure Tool for Federal Contaminated Sites

July, 2012

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1.0 INTRODUCTION

1.1 Purpose

The objective of this document is to provide guidance on site closure, and specifically use of the Site Closure Tool (SCT) and integrated Tool for Risk Assessment Validation (TRAV), for federal contaminated sites.

Every year, assessment and remediation or risk management work occurs on thousands of contaminated sites under the supervision of departments, agencies and Consolidated Crown Corporations (Custodians) of the federal government, mostly through funding provided by the Federal Contaminated Sites Action Plan (FCSAP). The ten-step process outlined in A Federal Approach to Contaminated Sites (FACS) provides guidance on the pathway from identification of suspect sites to long-term monitoring of sites that have been remediated or risk managed. The SCT has been developed in order to guide and demonstrate the successful closure of federal contaminated sites.

The SCT is composed of the Microsoft Excel worksheets within an Excel workbook, including a subset of worksheets that constitute the Tool for Risk Assessment Validation (or TRAV) that is recommended to be completed for all quantitative risk assessments completed on federal properties under FCSAP. Guidance for using TRAV is provided in Appendix A.

The SCT serves several purposes:

- It provides guidance through steps 6-10 of the ten-step FACS process to help standardize the remediation/risk management and closure process;
- It includes a tool to validate a risk assessment (TRAV), if a risk assessment was completed ;
- It evaluates whether your site can be considered closed or is still active depending on whether you meet minimum requirements;
- It demonstrates progress on risk managed sites, even if they are still active;
- It documents and summarizes the activities that were conducted to close the site for reporting purposes.

The TRAV worksheets are indicated by those worksheets starting with a roman numeral I through VII. The TRAV is strongly recommended to be completed for any detailed risk assessment that is being used to either close a site, or to develop site specific target levels (SSTL) in support of risk management measures. In addition, the TRAV is a valuable planning resource during the development of risk assessments.

Based on data provided by the user, the outcome of the SCT is a documented description of the site status, and a determination of whether the site is closed or active, and if active, at what point the site has reached in the closure process. The closure evaluation process, summarized in the SCT Summary tab, will ultimately indicate one of two possible status outputs for your site:

- Closed, or
- Active

The assignment of a closed status represents the culmination of the achievement of all of the applicable stages through the FACS process; closed status is assigned when:

- No further work is required based on the results of assessment work (i.e., closure based on no exceedances of applicable criteria found in ESA or RA)
- Remedial objective have been confirmed to have been met (i.e., FACS Step 9 is complete)
- LTM was required and LTM termination criteria have been met (i.e. FACS Step 10 (LTM) is complete)

A site will be assigned an active status when one or more of the steps through the FACS process have either not met minimum requirements or have not been completed. This will be indicated by yellow formatting of the cell output messages for the applicable stage of progress in the SCT Summary tab. Active status may be the result of:

- Additional site assessment, risk assessment or R/RM planning work being required
- Construction of remediation/risk management infrastructure, if required, is not yet complete
- Operation and Maintenance of remediation/risk management infrastructure, if required, is not yet complete
- Remediation or risk management objectives have not been met, or
- Long-Term Monitoring, if required, is underway and LTM termination criteria have not yet been met.

1.2 Background/Context

1.2.1 Federal Contaminated Sites Action Plan (FCSAP)

The Federal Contaminated Sites Action Plan (FCSAP) is a cost-sharing program that helps federal custodians to address higher risk contaminated sites for which they are responsible (the term ‘site’ refers to the area of land and waterlots associated with a specific Federal Contaminated Sites Inventory (FCSI) number). The primary objectives of FCSAP are to reduce the risks that these sites pose to human health and the environment and to reduce the associated federal financial liability.

1.2.2 Federal Approach to Contaminated Sites

Contaminated site management encompasses activities that are designed to define the human health and environmental risks posed by the contaminated site, and then take action to reduce or mitigate that risk. In the federal context, the federal Contaminated Sites Management Working Group (CSMWG) document: *A Federal Approach to Contaminated Sites* (1999; http://www.federalcontaminatedsites.gc.ca/publications/fa_af/fa_af-eng.pdf) describes a 10-step process that generally encompasses the activities that might be included in the management of a contaminated site:

Step 1:	Identify Suspect Sites
Step 2:	Historical Review
Step 3:	Initial Testing Program
Step 4:	Classify Contaminated Site Using the Canadian Council of Ministers of the Environment (CCME) National Classification System (NCS)
Step 5:	Detailed Testing Program
Step 6:	Reclassify the Site Using the CCME NCS
Step 7:	Develop Remediation/Risk Management Strategy
Step 8:	Implement Remediation/Risk Management Strategy
Step 9:	Confirmatory Sampling and Final Reporting
Step 10:	Long-Term Monitoring

Existing federal contaminated site management guidance tends to encompass the technical/managerial activities associated with assessing and remediating and/or risk managing contaminated sites (Steps 1 through 8 of the *Federal Approach to Contaminated Sites*); however, a consistent contaminated site closure process (upon completion of Steps 9 or 10) is currently lacking in the FCSAP program. Both are critical elements to demonstrate the success of the FCSAP program and site-level achievements. Consistent and adequate site closure reporting will serve both the FCSAP program and custodians.

1.3 Benefits of following a Site Closure Process

The benefits of following a consistent site closure process can be summarized as follows.

- Site closure is one of the primary reasons the FCSAP program exists. Site closure reporting documents that FCSAP objectives have been met, i.e., the risks that these sites pose to human health and the environment have been reduced to acceptable levels and that there is a reduction in the associated financial liability.
- Consistent procedures and proper documentation, and the transparency this represents, increases public confidence in the overall management of federal contaminated sites and at individual sites.

- Canadian taxpayers want to know what they have received for their tax dollars in terms of environmental cleanup, that they have obtained value for money, and that it was beneficial to Canada. In this regard, the SCT is integral to demonstrating program performance.
- While a few federal custodians have a closure process and required documentation already, this guidance standardizes the process to allow program-level aggregation of results and demonstration of program performance.
- Sound project management requires proper and consistent closure practices.

1.4 Scope of Site Closure Tool (SCT)

This SCT focuses on undertaking a standardized contaminated site closure process and its appropriate documentation in the Canadian federal context only, for sites which will remain under federal control. It is not intended to provide regulatory or technical guidance on contaminated sites subject to provincial or territorial jurisdictions. Furthermore, the SCT is not intended to provide guidance on technologies and strategies for remediation or risk management of contaminated sites (for the latter, the user is referred to the Government of Canada's *Guidance and Orientation for the Selection of Technologies* http://gost.irb-bri.cnrc-nrc.gc.ca/home.aspx).

The SCT:

- Consists of mandatory requirements for documenting the closure of remediated or risk managed federal contaminated sites funded by the FCSAP program.
- Provides consistent evaluation criteria or conditions that determine when a site can be considered to be closed.
- Consists of recommended (optional) site closure considerations beyond those which are mandatory under the FCSAP program that allow custodians to tailor the report to suit their information needs depending on circumstances at individual sites.

1.5 Intended Users

This guidance is intended for use by both federal contaminated site remediation/risk management project managers, managers of contaminated site programs (groupings of projects) and project sponsors (the organization that has management responsibility for the contaminated property).

1.6 FCSAP Requirements for Use of the Site Closure Tool

The SCT will be a key program accountability mechanism for FCSAP since it provides a consistent set of evaluation criteria that must be met before a FCSAP-funded site can be closed

following remediation or risk management. Custodians committed to begin reporting on the closure of FCSAP sites when the FCSAP program was renewed for Phase II (2011-2015).

Custodians are required to fill in certain mandatory sections and submit the SCT to the FCSAP Secretariat for all FCSAP-funded remediation/risk management sites that will be closed beginning in 2012-13. Alternatively, custodians may submit a site closure report that has been developed for use within their organization and that has been deemed equivalent by agreement between the custodian and the FCSAP Secretariat. A closed site following remediation or risk management is one where the highest step completed is 9 or 10 (if long-term monitoring was required), where no further action is required and where the federal financial liability equals zero. This is also consistent with the definition of site closure on the FCSI.

Mandatory sections of the SCT include the “Site Data and COCs worksheets (or tabs) “Closure Evaluation” tab and section 4 of the “Documentation” tab. The remaining portions of the SCT are considered optional but their completion is highly recommended to ensure thorough documentation of the site closure process.
Although sections of the SCT can be used for documenting the closure of sites that have been assessed and require no remediation action, there is no FCSAP requirement to fill-in and submit the SCT in this case.

The structure of the SCT follows the main steps of the remediation process and therefore the SCT will be most useful if it is filled-in by custodians (or their designate, e.g. a consultant) as each step of the remediation or risk management project is completed. In doing so, the SCT provides a quality evaluation check as each step of the remediation or risk management proceeds through to closure. The SCT should not be filled-in for the first time once the custodian is ready to close a site since problems or issues could be identified by filling-in the SCT, which could be difficult to address at this stage.

Custodians should submit the completed SCT for each site on the FCSAP Interdepartmental Data Exchange Application (IDEA). It will be stored here along with other information about the site. The FCSAP Secretariat will review the information provided in the completed SCTs to ensure that the FCSAP objective of reducing environmental and human health risks at higher risk federal contaminated sites is being achieved.

1.7 Scaling Closure Reporting Activities to Meet Custodial and FCSAP Requirements

While there are minimum mandatory FCSAP requirements for site closure reporting, the level of additional detail that should be included in any site closure reporting must be scaled to meet the requirements of the project and contaminated sites program. Project sponsors/leaders, project team members and custodian organizational requirements will all influence the level of detail

that will be required in site closure reporting. In scaling the level of effort for site closure, the following should be considered:

- A minimum set of data/information is required under one cover for any closed site, regardless of the capacity of custodian, to ensure information is not dispersed or lost over time. This will include site identification information, identified sources of contamination, contaminants of concern, a description and evaluation of closure activities, comparison of remaining site concentrations to remedial standards/objectives, and a statement on permissible land uses and site restrictions.
- The policy-driven requirements of the sponsor and project delivery organizations to document site closure should be considered. Some organizations may require specified levels of detail as part of an accountability framework. The SCT provides a documentation worksheet (tab) to capture key information, some which will be mandatory (comparison of residual contaminants of concern (COC) concentrations to objectives/standards), with other parts optional (such as lessons learned and accounting information).

Experience shows that the better documented a site closure is, the better are the chances that the site will not be reopened in the future and that repeat assessment and characterization work at the site will not be required.

1.8 Development Process for Guidance

This guidance was developed by Franz Environmental Inc. for PWGSC Environmental Services, as Expert Support function to FCSAP, on behalf of Environment Canada (FCSAP Secretariat).

The guidance integrates information from relevant Treasury Board policies, the CSMWG *Federal Approach to Contaminated Sites*, and existing documentation from FCSAP, PWGSC, and other federal custodians. This guidance also incorporates input from a federal site closure working group which included representatives from PWGSC, Environment Canada, Health Canada, Department of National Defence, Aboriginal Affairs and Northern Development Canada, Transport Canada, Department of Fisheries and Oceans, as well as Franz Environmental Inc.

1.9 Structure of User Guide

This User Guide is consists of six sections:

- Section 1: Introduction – outlines the purpose, background, benefits, scope, intended users, and a description of the SCT development process
- Section 2: Key Concepts Used in SCT – provides an overview of typical site closure activities, discusses contaminated site closure versus project closure, describes common approaches to close or risk manage sites, describes operation and maintenance (O&M)

compared to long-term monitoring (LTM), describes the concept of *construction completion*, provides guidance on how to apply the SCT to sites with multiple areas of concern, and discusses how monitored natural attenuation (MNA) is linked to long term monitoring, and site closure in general.

- Section 3: Site Closure Process – This section describes and flowcharts the site closure process for three common scenarios: i) an ex-situ remediation with off-site disposal; ii) in situ remediation or ex situ on site remediation involving construction completion and O&M; and iii) Closure of a risk managed site.
- Section 4: Description of Site Closure Tool – This section provides basic definitions for closed versus active sites; the structure and timing of use of the SCT; how the SCT integrates with the 10-Step federal Approach to Contaminated Sites; a description of each of the worksheets (tabs) within the SCT; and a description of TRAV and how it is integrated into the SCT.
- Section 5: Examples of the Use and Timing of the SCT – This includes 5 examples of how and when the SCT would be completed for various steps in the site closure process: i) excavation and off-site disposal, ii) excavation and on-site land treatment, iii) installation and operation and maintenance of a groundwater remediation system, iv) risk managed site through capping and LTM, v) risk assessed site with no unacceptable risks.
- Section 6: References
- Appendix A – Detailed TRAV user guide
- Appendix B - Recommended Content for Consultants' Remediation/Risk Management Action Report

2.0 KEY CONCEPTS OF SITE CLOSURE AND RISK MANAGEMENT USED IN SITE CLOSURE TOOL

2.1 Site Closure Activities

The activities associated with remediation/risk management site closure must meet the needs of the sponsor organization, the project delivery organization and the project funding authority (e.g., FCSAP). Remediation/risk management site closure requirements should be defined early in the project and remedial action/risk management planning phases, and should be agreed upon between the project sponsor and project delivery organization. In the context of federal contaminated site management, remediation/risk management site closure activities/processes might typically include:

- Activities that document the attainment of remediation/risk management objectives, and their acceptance by appropriate authorities;
- Performance reporting to internal and external organizations, e.g., sites funded by FCSAP are required to report on progress/completion on an annual basis;
- Updating informational databases to reflect changes in the status of the contaminated site, e.g., custodian organization databases, Public Accounts, and the TBS Federal Contaminated Sites Inventory; and
- Activities that document and archive the site closure for future reference.

To date, individual custodians have been responsible for determining what steps they require to satisfy their specific requirements for contaminated site closure. The CSMWG document: *A Federal Approach to Contaminated Sites* and Treasury Board policy documents do not provide specific guidance on contaminated site closure requirements.

In some cases (e.g., off-site contamination) compliance to non-federal contaminated site closure requirements may be necessary. In these cases, non-federal guidelines and/or regulations may set out detailed and specific requirements for site closure. If custodians determine that they are subject to non-federal contaminated site closure requirements, appropriate stakeholders and site closure processes should be engaged.

The SCT outlines the FCSAP requirements for site closure activities and documentation, while offering suggestions for additional specific custodian department needs.

2.2 Contaminated Site Closure versus Project Closure

In order to effectively describe site closure for federal contaminated site/risk management, it is useful to make a distinction between:

- Contaminated site closure issues; and
- Project closure issues (i.e., contract closure and project administrative closure).

Project closure is a series of activities/processes that formally close a project or a project phase. Closure of contaminated site remediation/risk management projects will generally encompass activities associated with:

- Contaminated site closure – those activities associated with formalizing/documenting the achievement of contaminated site remediation/risk management objectives (the purpose of the SCT) ; and
- Project Administrative Closure – those activities associated with closing the project in a consistent, repeatable and manageable way, including the capture of relevant lessons learned.

Project closure guidance is provided in PWGSC's *Project Management Tools for Federal Contaminated Sites Remediation & Risk Management Projects* (PM Tools). Contaminated site closure can be considered as one aspect of contaminated site project closure, along with contract closure, administrative closure and project evaluation. Proper project closure and contaminated site closure are both important to the success of any remediation or risk management project.

Contaminated site closure documentation activities are often an integral part of communication processes with external stakeholders (e.g., FCSAP, regulatory authorities and affected land users). Most project closure documentation activities, however, are specifically designed for the internal management use by custodians and project delivery organizations.

2.3 Common Approaches Used to Close or Risk Manage Contaminated Sites

Contaminated sites are typically remediated or risk managed, and subsequently closed, following three basic approaches:

- *Ex Situ* Remediation with Offsite Disposal or Treatment – This includes primarily excavation or dredging and off-site disposal of contaminated soils, sediments or other materials at an off-site facility. This approach typically entails high initial costs, short time frames for implementation and completion, and limited post-remediation monitoring. Confirmatory sampling to ensure the contamination was removed is required.
- On Site *In Situ* or *Ex Situ* Remediation – This includes remediating contaminated media on the site in place, or in treatment cells located on site, with a view to reducing/eliminating contaminant concentrations to meet clean up targets. Technologies would include landfarming, bioremediation (in situ and ex situ), soil venting, free product

recovery, groundwater pump and treat, permeable reactive barrier walls, on site incineration, and monitored natural attenuation (MNA) (see section 2.7 for a more detailed discussion of MNA). This approach requires significant initial capital costs for system construction/installation and extended periods (typically years) of on-going operation and maintenance (O&M), including monitoring to track and confirm contaminant reduction, of the remedial system.

- Risk Management – This typically entails conducting a risk assessment and based on the outcomes, leaving contaminants in place and not attempting to reduce contaminant concentrations, but rather cutting off exposure pathways or limiting site access for human or ecological receptors. This often requires construction of a cap or a barrier wall or other works to block exposure pathways, and long term monitoring to demonstrate that the constructed works are functioning as intended and/or the conditions on which the risk calculations are based have not changed.

Figure 2-1 below is derived from information provided by Environment Canada on the number of FCSAP-funded sites remediated or risk managed in 2008-09. The most popular approach was risk management (43% of sites), followed by *ex situ* remediation and off-site disposal (35%), followed by *in situ* or *ex situ* on site remediation (19%), with other unspecified approaches at 3%. The site closure, and closure reporting, process for each of these approaches is different, as described in the following sections.

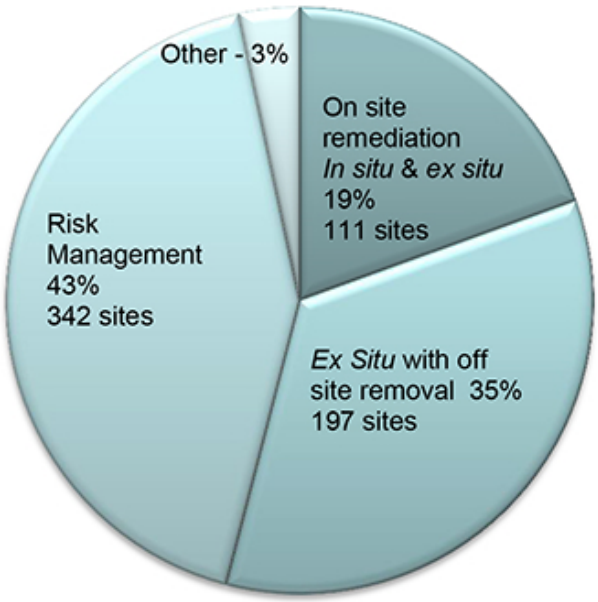


Figure 2-1 Breakdown of Remediation / Risk Management of FCSAP Sites 2008/2009 (source: Environment Canada)

2.4 Operation & Maintenance (O&M) vs. Long-Term Monitoring (LTM)

O&M typically involves the operation of soil, groundwater or surface water remediation measures that are meant to reduce contaminant concentrations to pre-established clean up goals within a reasonable time frame (e.g., 10 years). In the SCT, O&M is considered to be part of Step 8 (Implement Remediation/Risk Management Strategy) in the *Federal Approach to Contaminated Sites* (FACS). It can include *in-situ* soil remediation measures such as soil vapour extraction and *in-situ* bioremediation, and *ex-situ* bioremediation. MNA should be considered as a special case of *in-situ* remediation strategy requiring O&M, provided it is expected to result in contaminant concentrations being reduced to clean up targets.

According to the FACS 10-Step process guidance, the objective of LTM is to confirm that the nature and extent of the remediation activities have been carried out as per the site management goals. The FACS 10-Step process also states LTM may or may not be required for a site; however, LTM is "always required in cases where remediation used containment, *in situ* or isolation techniques". This latter statement is not entirely accurate in the case of *in situ* remediation, in that LTM will not be required if the *in situ* technique is confirmed to result in reducing contaminant concentrations/levels to meet remedial targets. In any event, LTM is typically an integral part of a Risk Management strategy and allows the implementation of a contingency plan.

According to the FACS, LTM may consist of:

- Inspection of on-site containment and treatment facilities;
- Groundwater, surface water, sediment, soil and atmospheric sampling and analyses;
- Inspection of stabilized structures; and
- Inspection of restricted site access measures.

Assessment of LTM results should include the following.

- Are there exceedances of the remediation objectives?
- Is there a general trend of increasing contamination concentration over time?
- Have site-specific conditions varied, which could increase contaminant migration?
- Will proposed site redevelopment create an additional receptor or exposure pathway that must be considered?

In the context of the FACS 10-Step process, LTM appears to be more applicable to cases where contaminant concentrations are not expected to be reduced, but rather exposure pathways are mitigated, i.e., through construction of landfill caps, containment walls, etc.

Additional detailed guidance on long-term monitoring is provided in Environment Canada's *FCSAP Long Term Monitoring Planning Guidance* (March, 2012),

2.5 Remedial Works Construction Completion vs. Site Closure

A site should be considered closed if assessment or remedial activities have demonstrated the following:

- Clean-up goals at all areas of concern (AECs) have been met and there are no remaining areas of potential environmental concern (APECs) to be assessed.
- All remedial action reporting (i.e., by site consultant) has been completed.
- The site is protective of human health and the environment in accordance with federal guidelines and criteria (Tier I, II, or III).

Contamination at many federal sites is addressed through excavation and off-site disposal strategies for which a final closure report can follow shortly after the remedial works are completed. From start to finish, the remediation phases of contaminated site management may only take a matter of months.

On the other hand, many other sites will require installation of *in situ* or *ex situ* treatment systems to remediate soil, groundwater and other contaminated media, or construction of capping or barrier walls as part of risk management measures. These installation/construction activities are typically characterized by intense initial activity and higher costs over relatively short periods of time, followed by longer term operation of treatment systems and/or periodic inspection of constructed works supported by environmental data collection. Completion of construction of these capital-intense measures marks a significant milestone in the federal 10-Step process, and it is important to capture technical and financial information about, and recognize the accomplishment of, these constructed works.

To this end, the SCT provides the option of completing an interim Construction Completion report, to be completed when there has been substantial construction and likely subsequent reduction of risk to human health and the environment at the site, but the site does not yet meet all the requirements for site closure. A "construction completion" site is a contaminated site where physical construction of all remedial/risk management actions are complete, all immediate threats have been addressed, and all long-term threats are under control. It may be useful to custodians to document and communicate this stage of progress within their organizations; however, there is no requirement to submit the SCT to the FCSAP Secretariat at this stage of the remediation or risk management project.

For sites where ground or surface water remedial actions require a lengthy continuous operation phase after the system has been constructed, *construction completion* is accomplished when

physical construction of the remedial works (e.g., construction of the groundwater treatment plant, installation of pumps and extraction wells) is completed, a final inspection of installed systems has been undertaken, and any future modifications to the system are expected to be minimal (e.g., well replacement). The *construction completion* designation should also be applicable to the installation of longer term soil remediation methods such as soil vapour extraction (once extraction wells, blowers and collection units have been installed), *in-situ* bioremediation (after installation of injection wells and surface equipment) and *ex-situ* bioremediation (e.g., after construction and placement of soils in biopiles or land treatment units, with only tilling activities (O&M) to follow).

In some cases additional works to make adjustments or modifications to constructed remedial works may be required at *construction completion* sites. Provided these adjustments are routine the construction completion status should not change. Examples include:

- Maintaining a landfill cap
- Making service/repair/adjustments to in situ ground water, soil or sediment treatment systems
- Clearing drainage systems (i.e., in land treatment facilities) and settling ponds
- Modifying the sampling and analysis program as part of monitoring a constructed remedy

2.6 Sites with Multiple Areas of Concern (AECs)

At some federal sites there may be multiple *areas of environmental concern* or AECs. Each AEC represents a geographically isolated area, sometimes with unique historic activities where contaminant levels exceed generic or risk based remedial targets, usually defined by the CCME Environmental Quality Guidelines, Canada-Wide Standards for Petroleum Hydrocarbons in Soil, or provincial/other jurisdiction guidelines/standards if none exist at federal levels.

For some custodians, a “site” is considered an entire property which may consist of multiple AECs. For other custodians, each AEC represents a “site”. The SCT is structured so as to be completed for each site having a unique Federal Contaminated Site Inventory (FCSI) number. This could mean that for a large complex property or area with multiple sites, each with its own FCSI numbers (e.g. mines, airports) multiple SCT Excel workbooks will be completed.

2.7 Natural Attenuation vs. Long Term Monitoring

Natural attenuation describes a variety of physical, chemical, or biological processes that, under favourable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil or ground water. These processes include

biodegradation; dispersion; dilution; sorption; volatilization; and chemical or biological stabilization, transformation, or destruction of contaminants[1].
Monitored natural attenuation refers to the reliance on these natural processes to achieve site-specific remedial objectives. Where it is identified to be a viable remedial approach, MNA should be used within the context of a carefully controlled and monitored site cleanup approach. To be considered an acceptable remedial strategy, MNA should be expected to achieve site remedial objectives within a reasonable time frame comparable to that offered by other more active methods. MNA may be used in combination with source control, i.e., removal of the source of the contamination to the degree practicable, but can be used without any other form of remediation if it is determined to be a reasonable approach[2].

In order to implement natural attenuation in meeting site remediation goals, very detailed site investigations should be carried out. The requirements for site characterization, in terms of effort and cost, for determining the applicability of natural attenuation may be as expensive and time consuming, if not more so, than for another site remediation technology. However, the long-term costs for natural attenuation (if natural attenuation is able to achieve most of the site remediation goals) may be less than for other remedial technologies[3]. Another advantage of MNA is that it can be used where disruption (excavation, recovery well installations, etc.) of the site is not feasible for technical or ecological reasons.

MNA is comparable to any other technology that requires detailed design, implementation and operation and maintenance, such as *in situ* or *ex situ* on-site remedial actions, in order reduce contaminant concentrations to target levels. As such, MNA should be considered an *in situ* remedial technology which follows the closure process for that type of approach. MNA should not be considered a form of long-term monitoring (LTM). LTM is considered applicable only once remediation or risk management objectives have already been confirmed to have been met (Step 9), and monitoring is required to ensure contaminant concentrations are stabilized and continue to meet clean up targets, and that potential receptors and transport pathways remain consistent with those used in developing the remediation/risk management plan objectives in the long-term.

[1] http://www.epa.gov/landscience/quickfinder/mna.htm
[2] ibid
[3] ibid

3.0 SITE CLOSURE PROCESS

3.1 Site Closure Definitions

Examples of remediation/risk management (R/RM) actions and how they would close a site using the FCSAP site closure process are described below. More than one of the R/RM approaches below could occur at any one site.

Example R/RM	Actions Taken	Site Status
Excavation and off-site disposal of contaminated soils	All contaminated soils have been excavated and removed from the site to another approved location; site has been backfilled, re-graded and restored to current or intended federal land use; remedial goals have been achieved; remedial action and confirmation sampling reporting completed, and no LTM is required. No further action is required and federal financial liability equals zero.	Closed
In situ or ex situ on-site treatment of contaminated soils or sediment, including bio-venting, bioremediation, in situ chemical oxidation	Clean up goals have been achieved (meeting appropriate federal guidelines/standards/criteria including risk-based standards); site has been restored to current or intended federal land use; and final consultant remedial action and confirmatory sampling RM report are complete and accepted by custodian. No further action is required and federal financial liability equals zero. Note: If on-going treatment activities are required in order to reduce contaminant levels to remedial target levels (e.g. tilling of landfarmed soils, operation of blowers and pumps) or if LTM is required, site is NOT closed until remedial targets have been achieved and confirmed (Step 9) or, in the case of LTM, termination criteria have been defined and achieved.	Closed
Containment	After construction of the designed containment works is complete, risk management goals (e.g., containment) have been achieved and the consultant's final remedial action report has been reviewed and accepted by the custodian. LTM is required to confirm RM actions are working.	Active: LTM Required or Underway

Groundwater (and surface water) remediation strategies that require active treatment to reduce contaminant concentrations to meet remediation goals	Construction or installation of remedial system infrastructure is complete. The system was confirmed to be operating as planned, contaminant concentrations/levels meet the remedial clean up targets based on confirmatory monitoring and sampling, remedial action and confirmation sampling reporting are completed, and no LTM is required. No further action is required and federal financial liability equals zero. If system continues to operate in order to ensure COCs continue to meet targets, the status must be active with O&M / performance monitoring. The site cannot be closed until system no longer needs to be operating, is decommissioned, and is followed by confirmatory sampling without LTM.	Closed
Groundwater (and surface water) remediation strategies that require active treatment to reduce contaminant concentrations to meet remediation goals	Construction or installation of remedial system infrastructure is complete. The system is confirmed to be operating as planned, but contaminant concentrations/levels do not yet meet the remedial clean up targets.	Active: Construction Complete
Monitored natural attenuation used to reduce contaminant concentrations to meet cleanup goals.	MNA is underway, but numeric cleanup goals (defined as contaminant concentrations meeting pre-specified target concentrations) are not yet achieved.	Active: RM Objectives Not Achieved

As described in Section 2.0, contaminated sites are typically remediated or risk managed, and subsequently closed, following three basic approaches:

- *Ex Situ* Remediation with Offsite Disposal
- On Site *In Situ* or *Ex Situ* Remediation
- Risk Management

The general approach and unique features of each strategy are described below.

3.2 Closure Process for *Ex Situ* Remediation with Offsite Treatment and/or Disposal

Figure 3-1 indicates the general process of closing a site remediated by removal of contaminated media from the site. The most common example of this is excavation and off-site treatment and/or disposal of contaminated soils.

The site closure process for this scenario is fairly straightforward:

i. Contaminated media (soil or sediment typically) are removed and disposed of off-site, either with or without pre-treatment by contractor under the supervision of an independent engineer. This is Step 8 of 10-Step Federal Approach to Contaminated Sites.

ii. The limits of excavation are sampled by the independent supervising engineer (typically a consultant reporting directly to the federal project manager) to ensure remaining media meet remedial targets and samples are analyzed by a specialized environmental laboratory.

iii. Confirmatory sampling results are compared to cleanup criteria and if samples still exceed remedial targets, additional contaminated media is removed, and confirmatory sampling repeated. This cycle is repeated until the limits of excavation are confirmed clean or further removal is not technically feasible (e.g., from underneath structures).

iv. Remedial activities and confirmatory results are documented in a report (Consultant's Remedial Action Report) by an independent engineer. This is Step 9 of 10-Step Federal Approach to Contaminated Sites.

v. The information from iii and iv are summarized in the SCT, which should include, amongst other information:
    - A statement on whether remedial/risk management goals were met
    - Narrative on FCSAP reporting (annual reporting of step number in 10-step FACS, expenditures, liability).
    - Rationale & goals of remedial strategy
    - A description and chronology of remedial actions
    - Additional custodian requirements
        - stakeholder issues summary
        - other specific information to custodian

Once steps i through v have been completed, the site can be considered technically closed; however, additional tasks (steps vi and vii) are recommended to ensure proper project closure and capturing of lessons learned, which will lead to better performance of future projects, as follows:

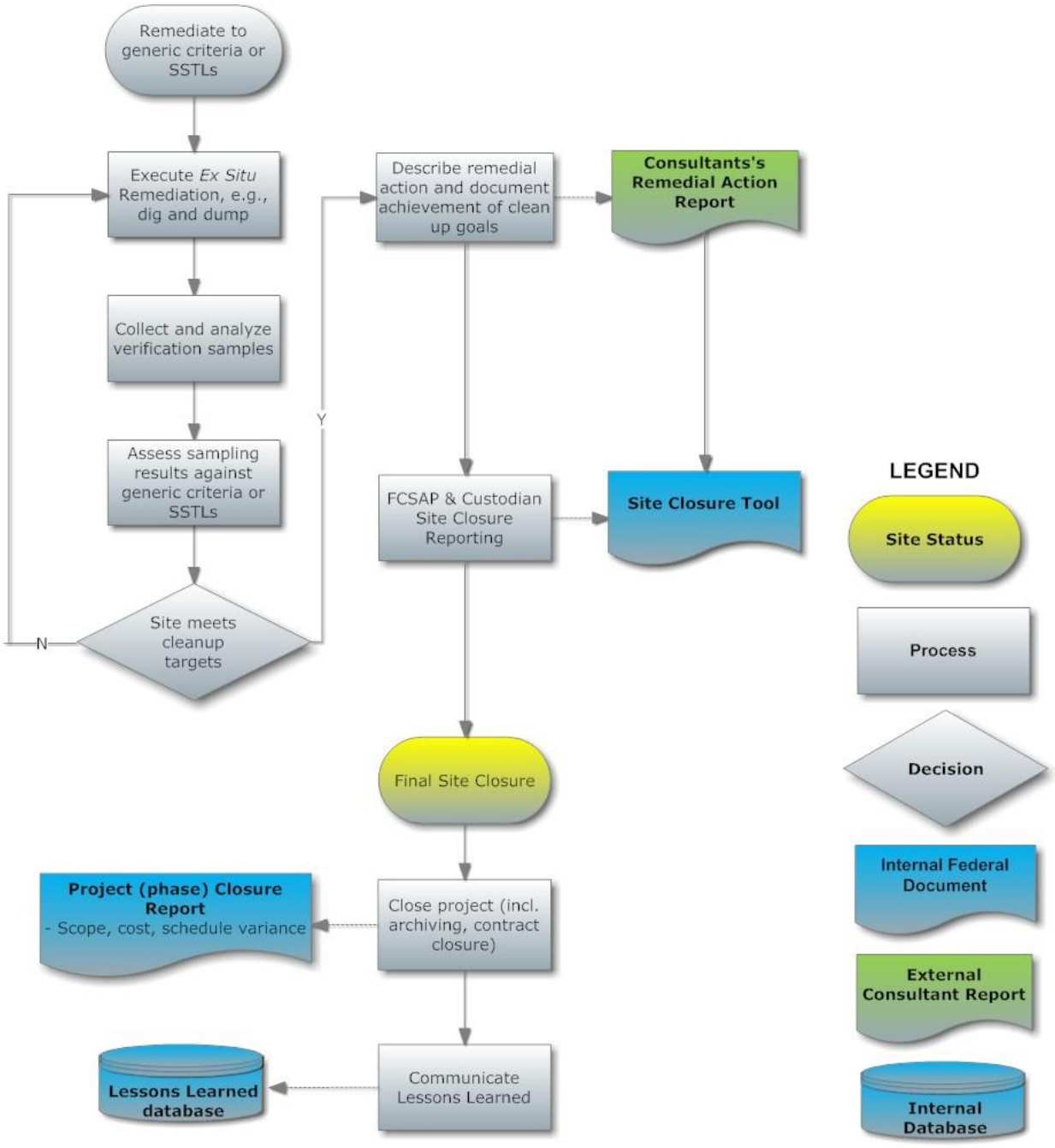
vi. Close the project. Complete project closure activities and documentation using *Project Management Tools for Federal Contaminated Site Remediation & Risk Management Projects*. Typical project closure activities include contract closure, project administrative closure, project team evaluations, and reporting and analysis on changes in project scope, cost, schedule, risk, quality and other project aspects.

vii. Documenting lessons learned. Focus of lessons learned should be on identifying project and technical successes and failures, and recommendations to improve future performance on similar projects. Capturing lessons learned is especially applicable to remedial technologies and cost information. Guidance for identifying, documenting and communicating lessons learned is provided in the PWGSC guidance titled *Project Management Tools for Federal Contaminated Site Projects.* PWGSC is currently developing a federal lessons learned framework for capturing and sharing cost and technical lessons learned with all federal departments.

The documented outputs of the site closure process for the simple scenario of *Ex Situ* Remediation with Offsite Disposal scenario can be summarized as:

1. Consultant's Remedial Action Report
2. Completed *Site Closure Tool*
3. *Project Closure Report (optional, but recommended)*
4. Input into a *Lessons Learned database (optional, but recommended)*

Figure 3-1 Site Closure Process for Ex-situ Remediation and Off-site Disposal



3.3 Closure Process for In Situ Remediation or Ex Situ On-Site Remediation

Figure 3-2 outlines the typical approach required to close a federal site which has undergone a longer term remediation strategy such as *in situ* remediation, or *ex situ* on-site remediation. Technologies would include landfarming, bioremediation (*in situ* and *ex situ*), soil venting, free product recovery, groundwater pump and treat, permeable reactive barrier walls, and monitored natural attenuation, among others.

The site closure process for these scenarios is somewhat more complex than for a simple "dig-and-dump" scenario outlined in Section 3.2. This is because after initial construction or installation of a remedial works, there will be a period of operation and maintenance (O&M) of the system which could take a matter of months, or years, to bring the contaminant concentrations/levels down to remedial targets. The steps in this process are as follows:

i. Once remedial targets, consisting of either generic criteria or site specific target levels established through a risk assessment, have been established in the remedial action plan, a remediation treatment strategy is designed and constructed/installed (Step 8 of FACS 10 - Step process).

ii. Once the remedial works have been constructed or installed, they should be inspected and a construction inspection checklist completed. As-built drawings should also be prepared.

iii. System O&M requirements should be defined, including start up requirements, monitoring, equipment and infrastructure maintenance, a system operation schedule, record keeping, system modification/optimization, trouble shooting, O&M protocol.

iv. Document constructed works. Include a step by step summary description of activities completed to install and implement the remedial works (e.g., mobilization and site fencing and surface water collection and control; system O&M; and sampling activities). This can be documented in the site consultant's Remediation/Risk Management Action Report (see Appendix B).

    For internal reporting purposes, the SCT can be used to report construction completion, with the following difference:

    - Construction completion does not require that site-specific target levels or generic criteria have been achieved, so this does not need to be reported

    By using the SCT to document the construction completion milestone, minimal additional work should be required once step 9 or 10 have been completed to update the Tool into a finalized SCT for submission to the Secretariat.

v. The construction phase of the remedial action should be closed as a project. Complete project closure activities and documentation using *Project Management Tools for*

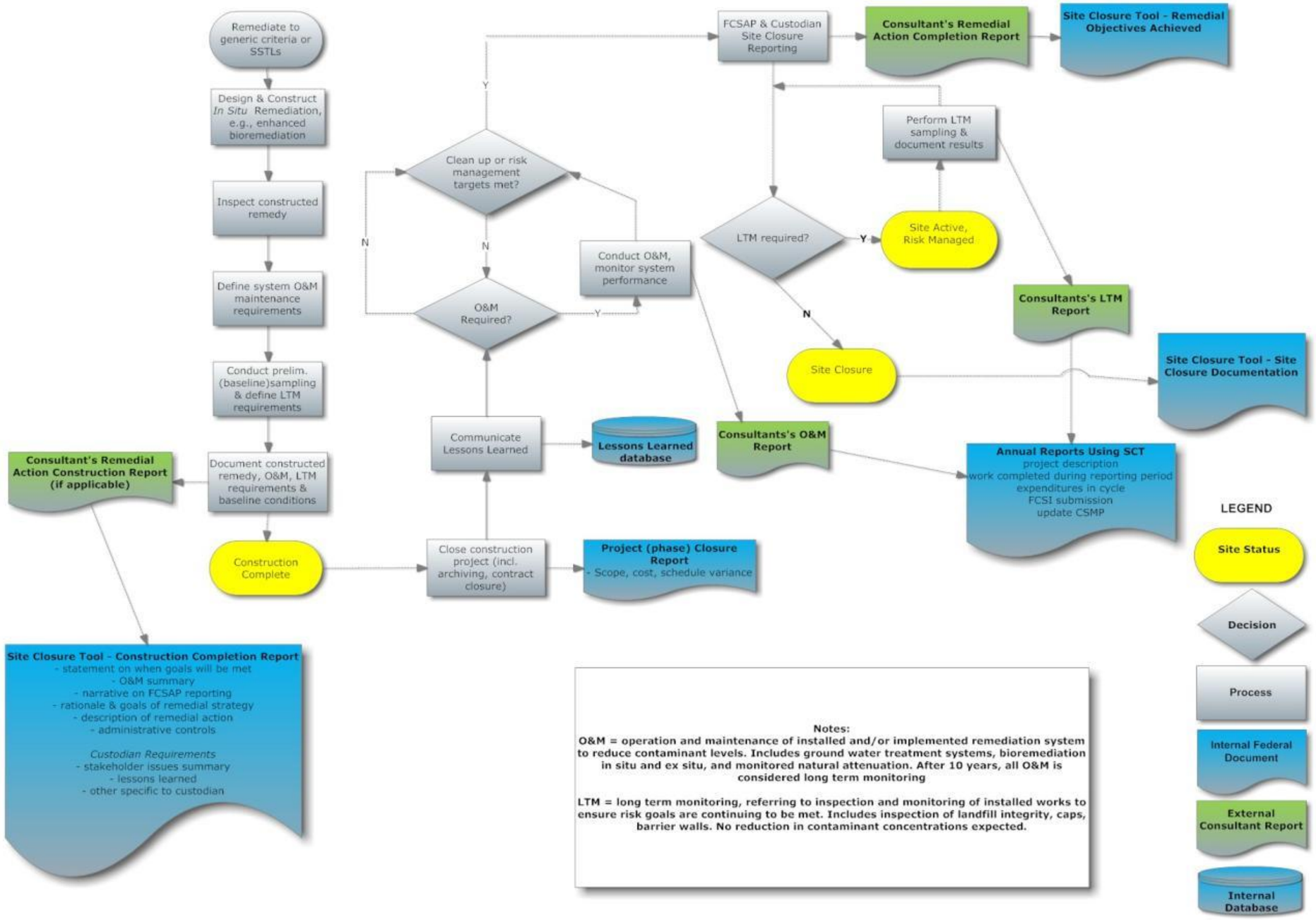
Federal Contaminated Site Remediation & Risk Management Projects. Submission of documentation of these activities to the Secretariat is not required.

vi. Document lessons learned from construction/installation activities. The "Documentation" tab in the SCT includes a section to capture lessons learned. Submission of lessons learned to the Secretariat is not required. The lessons learned should be focussed on identifying project and technical successes and challenges, and recommendations to improve future performance on similar projects. Capturing lessons learned is especially applicable to remedial technologies and cost information. Guidance for identifying, documenting and communicating lessons learned is provided in the PWGSC guidance titled *Project Management Tools for Federal Contaminated Site Remediation and Risk Management Projects.* PWGSC is currently developing a federal lessons learned framework for capturing and sharing lessons learned with all federal departments. The "Documentation" tab in the SCT also includes a section to identify and evaluate any innovative or sustainable technologies used on the project. Submission of this information to the Secretariat is not required.

vii. With most *in situ* or *ex situ* treatment systems, some form of O&M is required. If this is the case O&M requirements should have been documented in the Consultant's Remedial Action Report; these should also be summarized in the applicable sections of the SCT Documentation tab. In many cases a separate O&M manual will have been produced. These O&M activities should now be carried out as planned until remediation or risk management targets have been met. It is common practice to have the operator of the remedial system report on system performance on a pre-established periodic basis, typically annually, although this may be more frequent in the initial stages of system ramp up.

viii. Once remedial targets have been met, e.g., groundwater meets pre-established target concentrations based on sampling of key monitoring wells over several events (step 9 is complete), then the site can be considered ready for closure reporting.

Figure 3-2 Closure Process for In Situ and Ex Situ On-Site Remediation



3.4 Closure Process for Risk Management

In many respects, the process for closing a site that has been risk managed is very similar to that used for *in situ* and *ex situ* on-site remediation. In both cases there is often an initial installation or construction of a remedial or risk management measure, followed by O&M (for active remediation techniques) and long-term monitoring (for risk management measures). **Figure 3-3** shows the conceptual closure process for risk management of a contaminated site.

The steps in this process are as follows:

i. Once risk management targets, consisting of either removing contaminant pathways or removing or restricting access for receptors, have been established in a risk management plan, a risk management measure is designed and implemented/constructed/installed (Step 8 of FACS 10 - Step process).

   Typical risk management measures include installing a cap on contaminated sediments or soils, installing a barrier wall or diversion trench to control/inhibit contaminated groundwater movement, implementing LTM on stabilized contamination, or imposing administrative controls to limit site access and potential exposure to contaminants.

ii. Once the risk management measures have been constructed or installed (where applicable), they should be inspected and a construction inspection checklist completed. As-built drawings should also be prepared and archived so they can be easily retrieved (by persons other than just the project manager at the time of construction).

   If only LTM is required, conduct baseline sampling/monitoring/inspection and define LTM requirements with triggers for re-evaluation of the risk management measures.

   If administrative controls are to be used as a risk a management measure, these should be defined and responsibilities assigned.

iii. Document any implemented risk management measures, including constructed works, LTM monitoring requirements, baseline conditions, and administrative controls. Include a step by step summary description of activities completed to install and implement any risk management works (e.g., mobilization and site preparation work, installation of any capping or barriers, associated site work such as fencing and surface water collection and control; inspection activities). This can be documented in the site consultant's Remedial Action Report and then summarized in the SCT (i.e., in Section 4.2 of the Documentation tab).

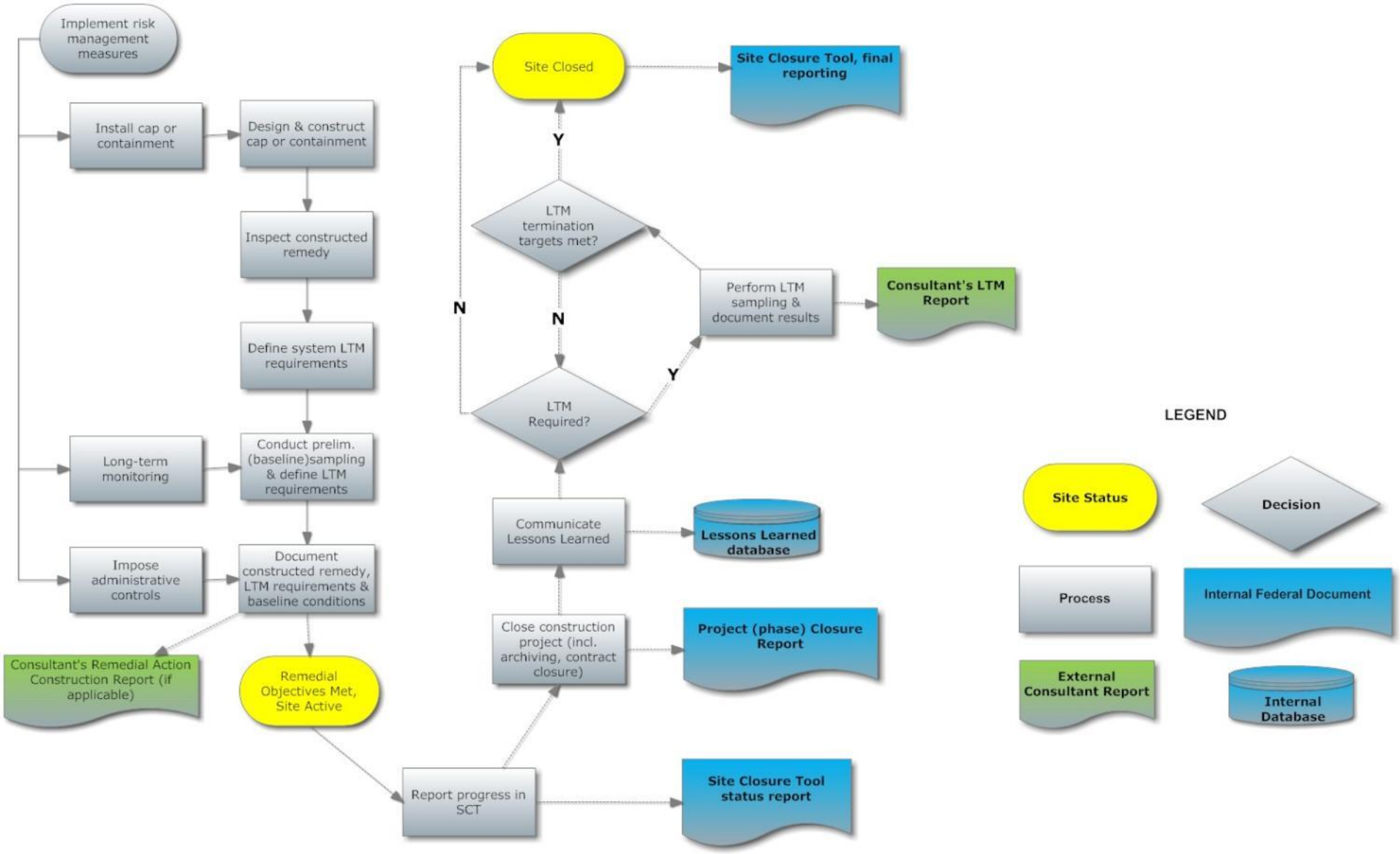
iv. While not part of the SCT requirements, the construction phase of the remedial action should be closed as a project. Complete project closure activities and documentation using *Project Management Tools for Federal Contaminated Site Remediation & Risk Management Projects*.

v. While not part of the SCT requirements, documentation of lessons learned from construction/installation or implementation of other risk management measures should be completed. This should be focussed on identifying project and technical successes and failures, and recommendations to improve future performance on similar projects. Refer to *Project Management Tools for Federal Contaminated Site Remediation & Risk Management Projects.* The SCT Documentation tab includes a section (Section 8) to capture lessons learned.

For most risk management strategies, even though RM targets may have been met, some long-term monitoring (LTM) will usually be required to ensure that contaminant concentrations do not "rebound", new pathways have not been created and new potential receptors have not been (re-)introduced. The SCT can indicate that the risk management objectives for the site have been achieved, but the overall site status will remain active if LTM is required to confirm the conditions remain stable and/or are continuing to improve.

The LTM plan should define the necessary criteria to be met for termination of LTM activities. In addition to termination criteria, it is important that the LTM plan has defined triggers for action, i.e., contingency planning. If LTM indicates degradation in soil, groundwater, surface water, sediment or air quality; or degradation in containment measures; or lack of enforcement of administrative controls, then the site continues to remain active, and should be reassessed and additional remedial measures implemented as necessary. Typically LTM is reported in annual reports prepared by consultants undertaking the LTM activities. Once LTM termination criteria have been met, LTM can cease, the SCT can be finalized and the site status will be closed. However, depending on the specific site circumstances (e.g. contaminants, risk management measures) LTM may be required in perpetuity though the scope and/or frequency may decrease, unless the contaminants themselves are removed.

Figure 3-3 Site Closure Process for Risk Management Strategy



4.0 DESCRIPTION OF SITE CLOSURE TOOL

4.1 Definition of Closed vs. Active Sites

The SCT highlights the achievement of closing a site as defined by FCSAP (i.e., that no remaining financial or environmental liability is associated with the site); however, the SCT has also been developed to communicate progress towards site closure for active (i.e., some remaining liability exists) sites where key remediation and/or risk management steps (e.g., remediation/risk management planning, construction of engineered works) have been achieved or are underway (long-term monitoring). In this way, the SCT can document progress and demonstrate the achievement of "value for money" even when site closure has not yet been achieved.

There are two prime categories of site status that are output by the SCT: "Closed" and "Active". A site is closed when it has successfully completed Step 9 or Step 10 (if long term monitoring was required at any point) and the Closure Evaluation tab in the SCT has been completed and the Summary tab indicates the site is closed. Active sites are sites that are not closed.

Closed status refers to sites where remedial objectives have been achieved and no further action is required. All risks to human and ecological receptors at the site have been shown to be acceptable either by meeting generic guidelines, through risk assessment or by removing or mitigating any contamination that exceeded remedial objectives. There is no further action required and no future environmental financial liability associated with the site, including LTM obligations. Sites eligible for closure will have completed either step 9 or step 10 of the ten-step process.

Active status refers to sites which continue to represent either a financial or environmental liability to the crown. Sites that have not completed the 10-Step FACS process are Active, but the Active status does not necessarily indicate that remedial objectives have not been met, or that concrete progress in the remediation or risk management of a site has not been achieved.

4.2 Submission Process

Custodians are required to submit a completed SCT to the FCSAP Secretariat through IDEA for sites with a status of "Closed". This applies to any site that is funded by FCSAP remediation funding in 2012-13 and in future years. Sites that have been closed before 2012-13 do not need to complete and submit and SCT. In addition to documenting closure at sites with exceedances of criteria requiring further R/RM action, the SCT can be used to document closure of sites that require no further action based on the results of a Phased ESA, note that documentation of closure with the SCT at such sites is not a FCSAP program requirement.

Custodians should ensure that all FCSAP-funded sites with a closed status as indicated in the SCT are also noted as closed on the FCSI (by checking the 'site closed' flag).

4.3 Structure and Timing of Use of SCT

Consideration of the SCT should commence in the early stages of the FACS 10-Step process. Once Step 5 of the FACS has been completed (detailed testing of the site to delineate contamination), sections of the SCT including the Site Data tab and Contaminants of Concern (COC) tab can be populated with data even before the remediation or risk management activities begin.

The SCT is divided into six main sections, as follows:

Closure Evaluation: Completed for all sites, determines whether site can be closed following minimum requirements. The Closure Evaluation tab is a series of true/false questions laying out the minimum requirements for R/RM planning, implementation and site closure.

Site Data / Contaminants of Concern (COCs) Tabs: Regardless of whether remediation to generic standards or risk assessment/risk management was used, the User provides basic information about the site. The Site Data tab also provides a baseline evaluation of the Site Assessments.

Tool for Risk Assessment Validation (TRAV) Tabs: If a risk assessment is part of the R/RM strategy, Worksheets I through VII should be completed. TRAV validates the quality of the risk assessment to ensure findings are reliable and defensible.

Documentation Tab (Site Status): Not mandatory (except for recording maximum contaminant concentrations versus remedial targets in Section 4). Recommended to be completed based on custodian requirements for closure reporting. Provides a closure narrative that can be used for future reference and as a communication tool.

SCT Summary Tab: Collects the information provided in other tabs to provide an "at-a-glance" summary of site conditions at closure.

Reference—Contaminant Sources & Reference Material Tabs: The Reference-Contaminant Sources tab gives the user the opportunity to define contaminant sources and associated contaminants in addition to those appearing in the Site Data tab drop down lists; the Reference Materials tab contains additional information regarding contaminant fate, transport, bioaccumulation, degradation, etc. It is intended to assist in completion of the TRAV.

4.4 Integration of the SCT into the Federal Approach to Contaminated Sites

Figure 4.1 below shows how the SCT is integrated into Step 7 of the FACS, and Figure 4.2 shows how the SCT is integrated into Steps 8-10.

4.5 Description of Tabs

4.5.1 Site Data and Contaminants of Concern Tabs

The SCT should be first accessed when initiating Step 5 of the 10-Step process. The SCT includes a Site Data worksheet (or "tab") and Contaminants of Concern (COCs) worksheet. For all sites, these tabs should be completed to ensure all contaminant sources and their associated COCs have been identified, and all environmental media have been addressed. Also included are several queries related to data quality. Finally there are a number of questions related to how COCs were screened into any risk assessments completed.

The COC Tab prompts the user to list all COCs, their sources, and in which media they were found (surface soil, subsurface soil, groundwater, surface water, sediment, indoor air etc.). The user can select potential contaminant sources from the drop down menus, or sources and COCs typically associated with these sources can be defined by the user in the Reference-Contaminant Sources tab. This information will feed into subsequent worksheets.

The Site Data tab returns a value to the Site Closure Evaluation of Yes or No to the question of whether major deficiencies were noted. If no major deficiencies are noted then the user can initiate the remediation/risk management strategy development. If there are major deficiencies, these need to be addressed before any R/RM planning can proceed, as this indicates a source and certain COCs have not been addressed, or addressed inadequately.

4.5.2 Closure Evaluation Tab

This tab consists of approximately 50 questions that ensure that various best practices have been followed throughout the remediation or risk management project. These questions are broken down into the following subsections as follows:

- Steps 1 through 6, including risk assessment: Questions 1-7
- Step 7 Remediation/risk management planning: Questions 8-17,30
- Step 7 Long term monitoring planning: Questions 18-29, 30
- Step 8 Construction completion: Questions 31-37
- Step 8 Operations and Maintenance: Questions 38-41
- Step 9 Confirmatory Sampling and Final Report: Question 42
- Step 10 Long term monitoring: Questions 43-49
- Step 10 Closure after LTM is complete: Question 50

Each of these subsections or groups of related questions has an associated summary evaluation output that is automatically returned based on the responses to the questions. In

general these outputs indicate whether or not the group of questions is relevant to the site being evaluated, if minimum requirements for site closure have been met or whether revisions to assessment or planning actions are necessary, and whether construction, O&M or LTM is required or completed.

Figures 4.1 and 4.2 indicate where in the 10-Step process the key questions should be answered, and the decision points.

4.5.3 Tool for Risk Assessment Validation

FCSAP commissioned the development of the Tool for Risk Assessment Validation (TRAV) to be integrated into the SCT. TRAV was developed by Golder Associates Ltd. (Golder). The TRAV is embedded in the SCT and can be completed as part of the site closure process for federal contaminated sites in cases where risk assessment has been conducted.

For sites that have undergone a risk assessment, the TRAV is, first, a quality assurance tool that describes the expectations of Environment Canada, Fisheries and Oceans Canada (DFO) and Health Canada with respect to how risk assessments should be conducted. The TRAV also serves to evaluate if the risk assessment has been conducted according to prescribed guidance. Although the TRAV is not a mandatory tool, its use is strongly encouraged by the FCSAP Secretariat. If the TRAV is used, federal custodians will be expected to complete and submit the tool to the FCSAP Secretariat to close a site. The TRAV is intended to be a self-assessment tool (i.e., to be completed by the site custodian).

There are two main outcomes that can result from the analysis embedded in the TRAV tool that are then relayed back to the SCT.

- The first main outcome is that no major deficiencies are identified. With this outcome, either: a) risks are acceptable and no further work is required; or b) there are unacceptable risks in either the human health or ecological risk assessment requiring further assessment or remediation; and,
- The second major outcome is that there is insufficient information (i.e., major deficiencies exist in the risk assessment). In this case, the deficiencies assessed by the TRAV should be examined and resolved by the risk assessment practitioner and the site custodian. Ideally this resolution would occur prior to the implementation of remediation or risk management activities. With this outcome, the site cannot proceed to a final site closure classification (i.e., no further work required).

Purpose of the Tool for Risk Assessment Validation

By electing to use the TRAV at federal contaminated sites, custodians can document that program objectives have been achieved. Specifically, the TRAV can be used by federal custodians and the FCSAP Secretariat as a key mechanism to:

- Document program accountability & quality assurance,
- Set a benchmark for conducting risk assessments, and confirm that risk assessments are following guidance for federal contaminated sites,
- Demonstrate that sites are meeting the FCSAP objective of reduced environmental and health risk; and,
- Strengthen public confidence in the management of federal contaminated sites by verifying and documenting actions taken at federal contaminated sites.

Uses of the Tool for Risk Assessment Validation

Federal custodians will be encouraged to complete and submit the TRAV (if risk assessment has been completed for a site) to the FCSAP Secretariat once a site is closed. Ideally, the custodian would fill in the TRAV in conjunction with the completion of the risk assessment. This will provide an opportunity to address potential deficiencies in the risk assessment in a timely manner (e.g., prior to remediation or risk management) for successful site closure (e.g., no major deficiencies would require resolution). Although optional, the TRAV is intended to be used at sites which are currently receiving FCSAP remediation and risk management funds and is not intended to be applied retroactively to closed sites when different guidance documents may have been in use. A sub-set of submitted TRAVs will be reviewed through a third-party process to confirm that the self-assessment model is effective.

A secondary goal of the TRAV is to increase the consistency and robustness of the risk assessments that are produced for FCSAP sites. Guidance documents from Health Canada, Environment Canada and DFO form the basis of the TRAV framework which will assist in the development of sound and reliable risk-based decisions at federal contaminated sites. Specifically, the TRAV is based on these guidance documents:

- Guidance on Human Health Preliminary Quantitative Risk Assessment, Health Canada, 2009;
- Guidance on Human Health Detailed Quantitative Risk Assessment for Chemicals, Health Canada, 2010; and,
- Federal Contaminated Sites Action Plan (FCSAP) Ecological Risk Assessment Guidance, Environment Canada, 2012.

It is expected that risk assessments will be completed following the guidance provided in the above documents, and others as they are developed for the FCSAP program, and that rationale will be provided for deviations from the guidance.

4.5.4 Documentation Tab

This worksheet provides a means for custodians to report key information about a closed or active site. It acts as a standardized recording function, so that important information about remediation / risk management is summarized concisely and consistently across sites, across programs and across departments. Some sections are mandatory for submission of the SCT to the Secretariat (i.e., Section 4.1 final contaminant concentrations vs. Targets and Section 4.3, allowable land uses) while completion of other sections is discretionary but highly recommended.

The sections included in this Tab include:

- Section 1- Basic Site information (Site Data/COC tabs, etc)
- Section 2- Background (list of reports, QC, etc.)
- Section 3 – Description of R/RM activities and objectives
- Section 4 - Comparison of objectives to achievements
- Section 5 - Costs: planned versus actual
- Section 6 - Long-term monitoring narrative
- Section 7 - Communications (incl. stakeholders)
- Section 8 - Lessons Learned summary
- Section 9 - Innovative and sustainable technologies summary

4.5.5 SCT Summary Tab

This worksheet is automatically populated through completion of the other worksheets comprising the SCT. It is meant as a quick reference to the key site information, acting as a “dashboard” for the Site, whether is active or closed.
The fields reported included:

- Reporting date
- Property identification (site name, DFRP#, FCSI#)
- Acceptable property uses
- Land use restrictions
- Applicable standards
- Site status
- Final site conditions for all media and COCs investigated
- Risk management measures in place
- Long term monitoring summary

- Sign off and approvals (not automatic - to be manually input)

4.5.5.1 SCT Summary Tab Outputs

The Site Status section in the SCT Summary tab presents the status (active or closed) based on the answers to the questions in the Site Data and Closure Evaluation tabs. The various outputs for each of the main steps of the project which are summarized in the SCT Summary tab are listed below.

- **Steps 1-6 ESA Complete & Step 7 Risk Assessment Complete (if applicable)**: "Achieved" or "Not Achieved". If the ESA or RA is incomplete or inadequate (i.e., an output of "Revisions Required" is displayed on the Closure Evaluation tab for the summary evaluation of questions 1-7), the SCT Summary output for these steps will be "Not Achieved" and the site requires additional assessment. Alternatively, if the responses to questions 1-7 indicate that minimum requirements have been met, the output for this step will be "Achieved".

- **Step 7 Remediation/Risk Management Plan (R/RM) Complete**: "Not Required", "Achieved" or "Not Achieved". If the site is closed based on the results of a Phase II ESA, the output for this step will be "Not Required". If responses to questions 8-17 (if LTM is not required), or questions 8-29 (if LTM is required) on the Closure Evaluation tab result in minimum requirements being met, the output for this step on the SCT Summary tab will be "Achieved". If the summary evaluation for these questions on the Closure Evaluation tab indicates that revisions are required, the SCT Summary tab output for this step will be "Not Achieved". "Revisions Required" is an output on the SCT Closure Evaluation tab which indicates that deficiencies were found at one or more of the stages preceding or during the remediation or risk management planning activities. The SCT can identify deficiencies with the environmental site assessment(s), risk assessment (using the Tool for Risk Assessment Validation (TRAV)) or with actual remediation or risk management action plans. This status output of the SCT Closure Evaluation tab would indicate that additional work may be required to address the deficiency identified.

- **Step 8 Construction of R/RM Measures Completed:** "Constructed Works Not Required", "Construction Complete" or "Construction Not Complete". Depending on the responses to questions 32-37 on the Closure Evaluation tab, one of these three outputs will be generated for this step in the SCT Summary tab. "Construction Complete" applies to sites at which the remedial measures described in a remediation/risk management plan are substantially implemented, but remedial objectives may not have been achieved yet. This describes the completion of the major capital expenditures at a site (e.g., installation of a barrier treatment wall, construction of land treatment facility or biocell, installation of an in situ groundwater

treatment system, construction of a water treatment plant). Active operations and maintenance, including performance monitoring, will be required. (This is separate from long-term monitoring, which may be required later in the project life cycle after the remediation or risk management objectives have been met.) In terms of the FACS ten-step approach, this status would usually occur part of the way through step 8.

- **Step 8 Remedial Action & Step 9 R/RM Objectives**: "Not Required", "Achieved" or "Not Achieved". Again, if the site is closed based on the results of a Phase II ESA the output for this step will be "Not Required". An "Achieved" output for this step indicates that previous steps have been achieved (i.e., ESA and/or RA, R/RM Planning, Construction Complete or not required, and O&M is completed or not required) and the R/RM objectives have been met this applies to sites at which previous stages of remediation have been completed in accordance with minimum requirements. If the output for this step is "Not Achieved", either the ESA and/or RA, or the R/RM and/or LTM plan need additional work or revision, construction may not be complete, or O&M on completed constructed works is ongoing. Note that although the output for R/RM objectives may be "Achieved", the site is not necessarily closed, as LTM may still be required.

- **Step 10 Long Term Monitoring (LTM)**: "Not Required", "LTM Completed" or "LTM Required or Underway". "LTM Required or Underway" refers to sites where remediation or risk management measures have been implemented at the site and have been confirmed to meet risk management objectives. Risks to human health and ecological receptors have been removed or mitigated; however, long-term monitoring is required to confirm that the measures continue to operate effectively. As a result, there is federal financial liability (for future monitoring costs) associated with the site. For example, a site where a landfill has been constructed to segregate and contain impacted soils will require LTM on a regular schedule over a specific period. This status would correspond to a site that has completed step 9 and but is in step 10 and therefore is not closed. An output of "LTM Completed" will only be returned when the LTM termination criteria have been met (question 50 on the Closure Evaluation tab), otherwise the output will be "Not Required" or "LTM Required or Underway", depending on the need for LTM.

4.5.6 Reference—Contaminant Sources Tab

The Reference—Contaminant Sources worksheet contains a table of potential sources of COCs that are commonly associated with past or present site use and activities typically conducted at contaminated sites. A list of contaminants of concern associated with each is provided in column B. This table is the source data for the drop down menus in Question 1.A of the Site Data tab. If the source of contamination at a particular site does not appear in the list, the user

can define up to four additional sources and associated COCs by entering the relevant information in rows 6-9 of the table. A list of acronyms used in the lists of typical COCs is presented in a second table in this worksheet.

4.5.7 Reference Materials Tab

The last worksheet of the SCT workbook contains reference information intended to facilitate the completion of both the SCT and especially the TRAV. The materials are presented as tables in six sections. Each of the six sections and their contents are described below.

Contaminant Fate and Transport Considerations: This table presents exposure media and typical fate and transport mechanisms (volatilization, erosion, leaching, sorption, migration, sedimentation/precipitation, dissolution, re-suspension, and aerial deposition) for contaminants in primary media (soil, groundwater, surface water, sediment and air).

QA/QC Reference Material: This table presents a list of program elements (e.g., quality standards, QA/QC plans, sampling plans, data validation, etc.) and examples of QA/QC components for each program element.

Examples of Surrogate Ecological Receptors: This table presents a list of example surrogate receptors of concern for receptor groups in both aquatic ecosystems (primary producers, pelagic invertebrates, benthic invertebrates, fish, mammals, birds, amphibians and reptiles) and terrestrial ecosystems (invertebrates, mammals, birds, amphibians and reptiles).

Examples of Persistent and/or Bioaccumulative Substances: A list of COCs known to be persistent or bioaccumulative is presented in this section of the Reference Materials tab. Criteria for determination of chemical persistence in various media and bioaccumulation factors, based on the Canadian Environmental Protection Act are also provided in this section.

Examples of Degradation Products: An example of the degradation products for Tetrachloroethylene (PCE) is presented as a flow chart in this section of the Reference Materials Tab.

Examples of Assessment and Measurement of Endpoints for an ERA: Examples of measurement endpoints, for example: presence of brook trout based on fishing effort using multiple gear types, or observations of fish health (e.g., deformities, lesions, size, tumours) for a list receptor group(s) and based on various assessment endpoints are presented in this section. This information is derived from the document *FSCAP Supplemental Guidance for Ecological Risk Assessment*, Azimuth Consulting Group Inc., January 27, 2010.

Figure 4-1 Annotated CSMWG Federal Approach to Contaminated Sites - Step 7

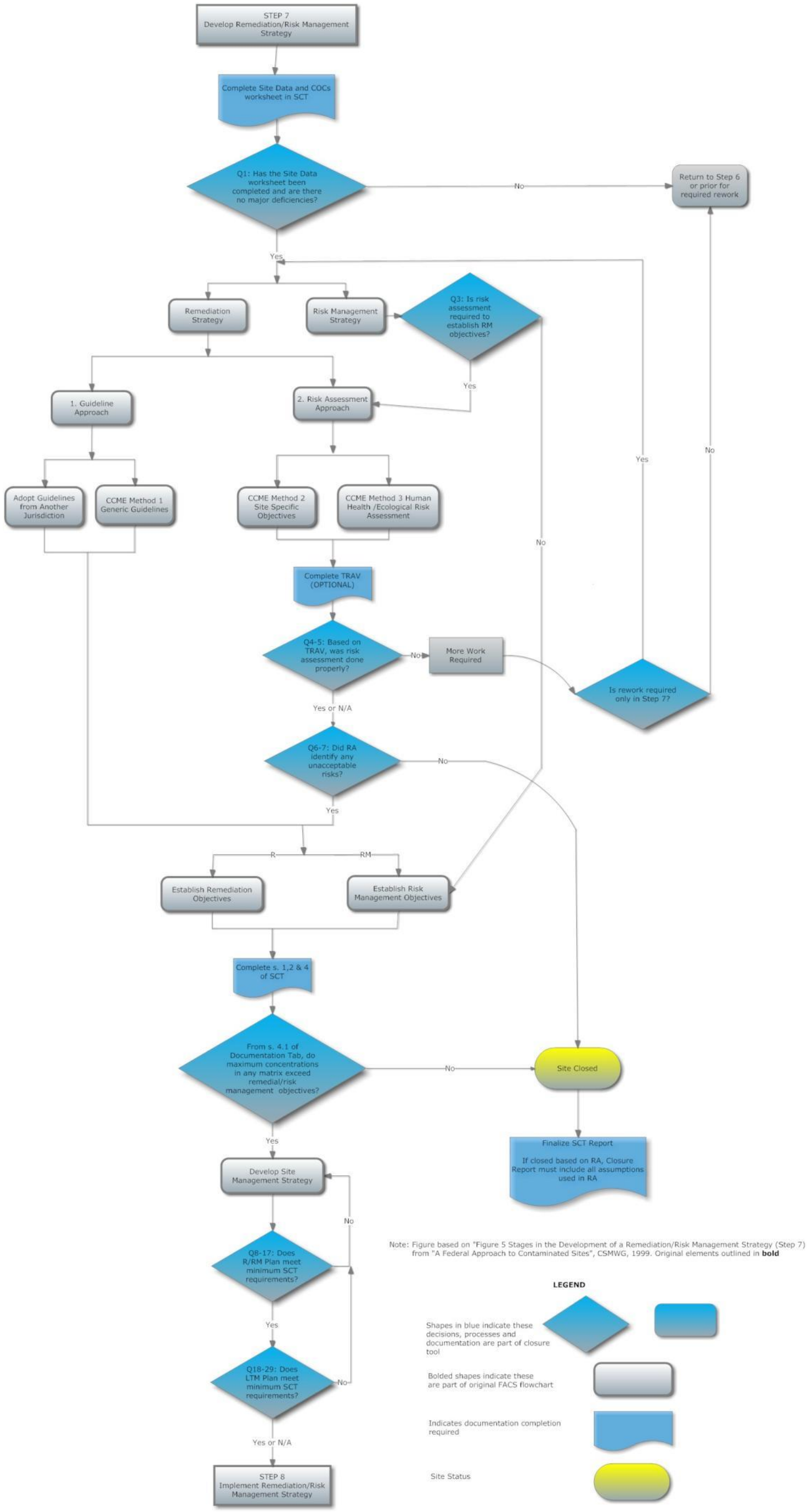
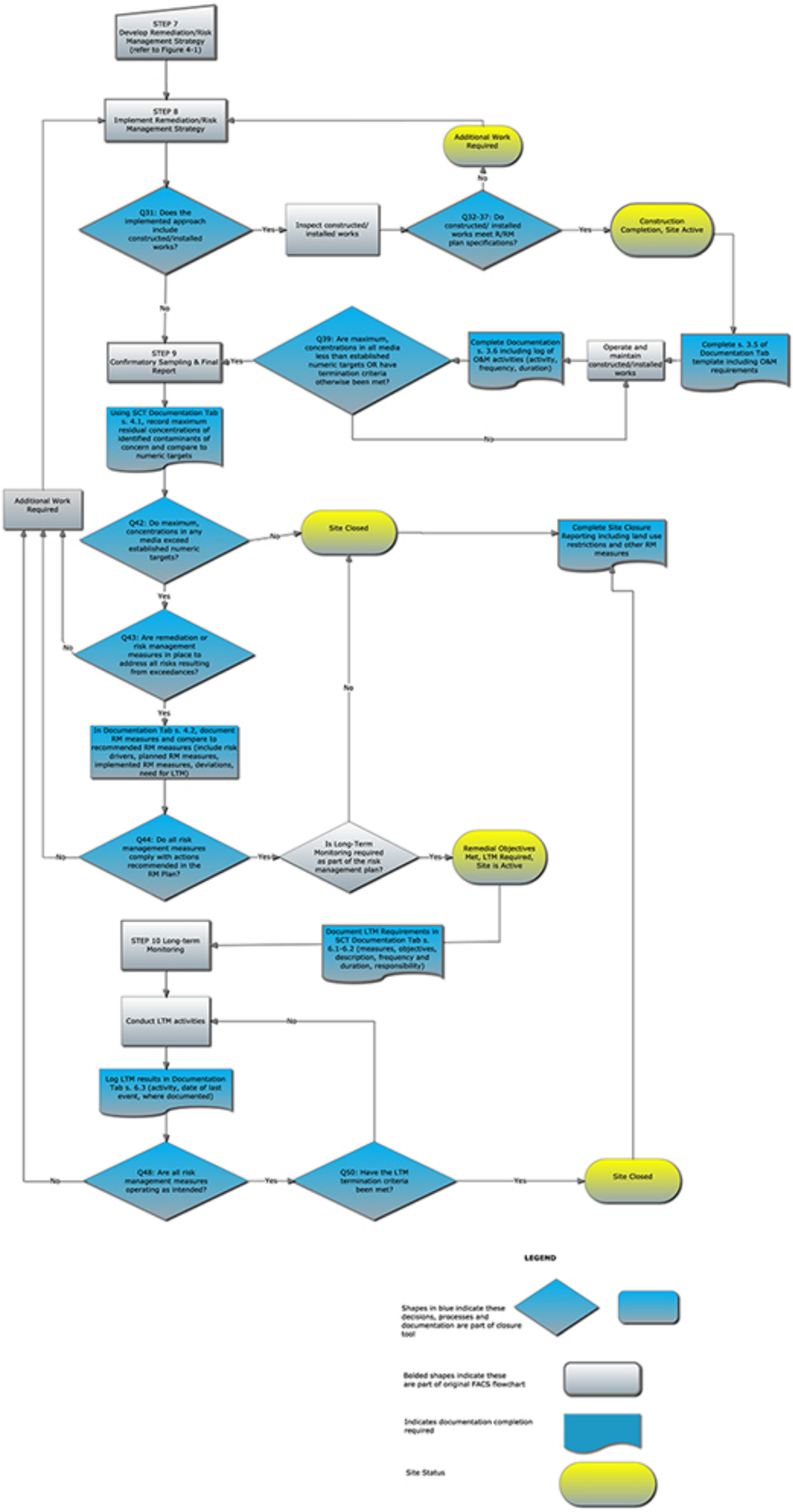


Figure 4-2 Annotated CSMWG Federal Approach to Contaminated Sites - Steps 8-10

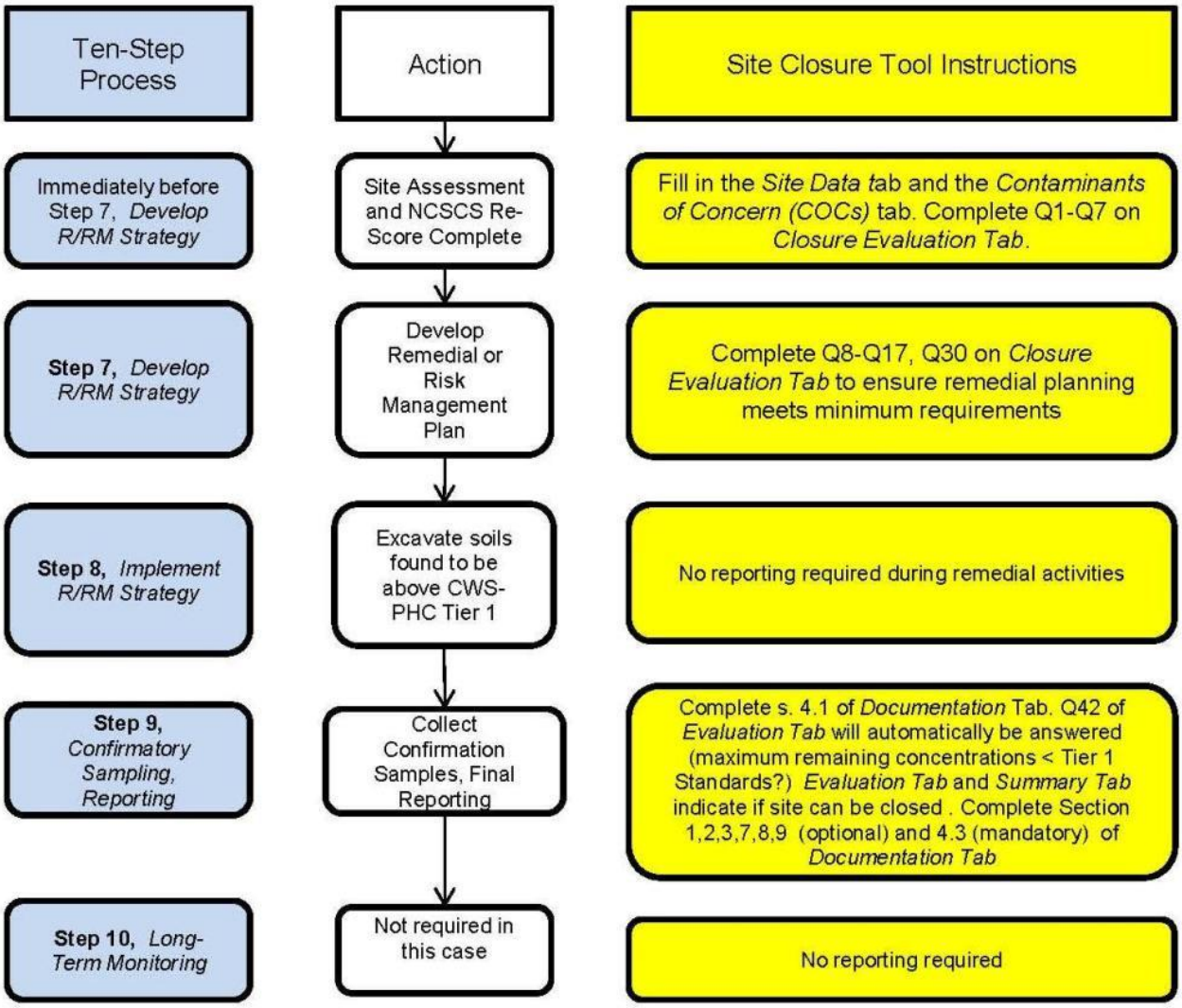


5.0 EXAMPLES SHOWING THE USE AND TIMING OF THE SCT

5.1 Example 1: Excavation and Off-Site Disposal of Petroleum Hydrocarbon Contaminated Soils

This example project is a site with petroleum hydrocarbon impacts in soil. Clean up is to Tier 1 Canada Wide Standards for Petroleum Hydrocarbons in Soils. A risk assessment was not conducted. The impacted soil is removed to an off-site approved landfill. After excavation, confirmatory sampling is conducted, the excavation is restored/revegetated, and a final report completed, at which point no further risk exists and the site can be closed.

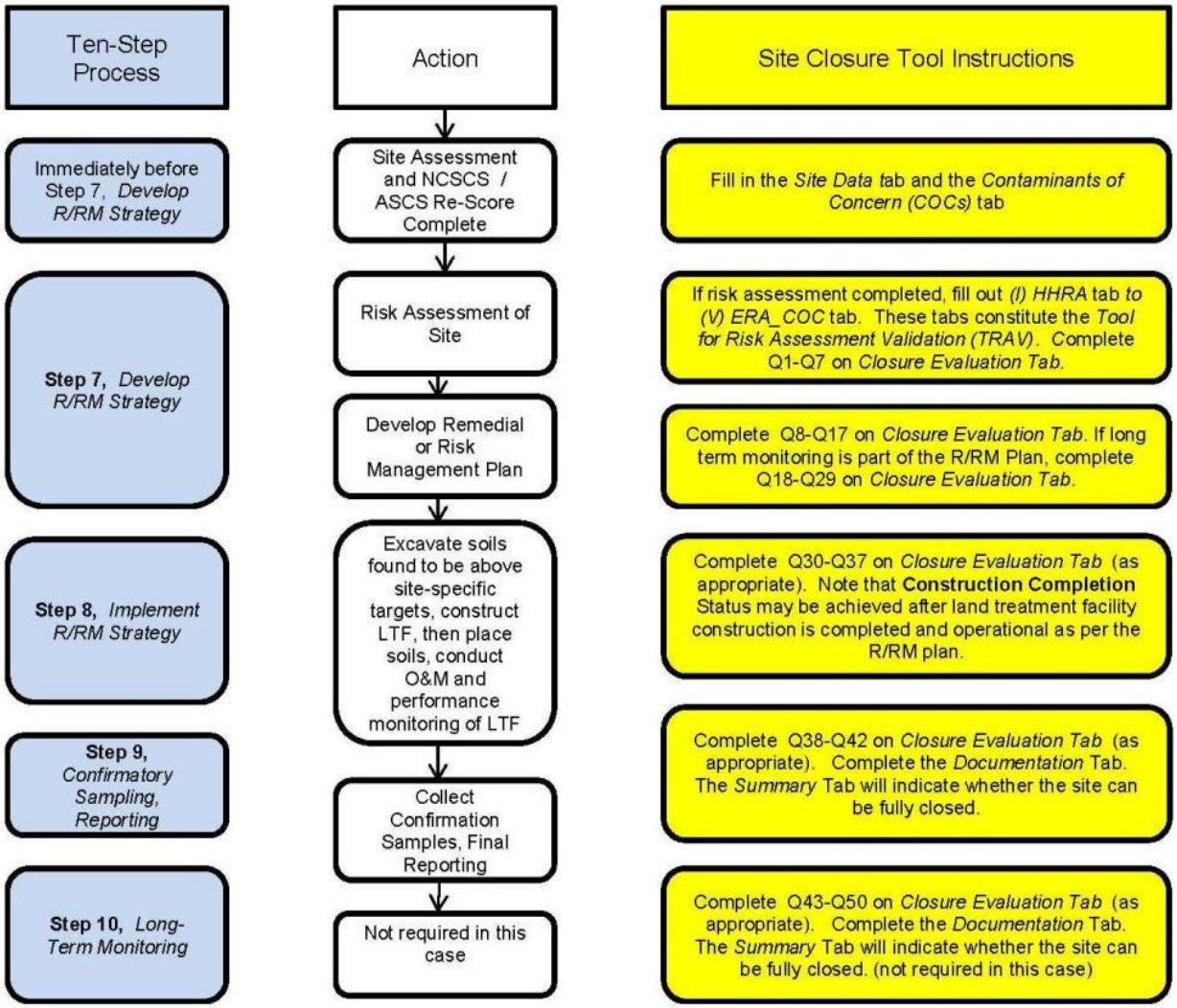
Figure 5-1 Excavation and Off-Site Disposal of Petroleum Hydrocarbon Contaminated Soils



5.2 Example 2: Excavation and On-site Land Treatment of Petroleum Hydrocarbon Contaminated Soils

This example project is a site with petroleum hydrocarbon impacts in soil. A risk assessment is completed in an attempt to reduce the volume of soil excavation required. Some soil remains above risk-based site-specific target levels after the risk assessment. The impacted soil is removed to a land treatment facility (LTF) constructed on-site. After LTF construction is complete, performance monitoring is specified in the risk management plan to determine when the risk management objectives have been achieved. When performance monitoring indicates the objectives have been met, a round of confirmatory sampling is completed to demonstrate that all previously impacted soils remain below risk management targets, at which point no further risk exists, the LTF is restored/revegetated and the site can be closed.

Figure 5-2 Excavation and Treatment in On-site Land Treatment Facility



5.3 Example 3: Installation and Operation & Maintenance of a Groundwater Remediation System

In this example, COCs in groundwater have been identified above Tier 1 levels. A risk assessment demonstrates that unacceptable risks are present and site specific target levels are developed. The risk assessment is validated using TRAV. A remedial action plan based on achieving the SSTLs is developed. Construction Completion can be claimed after the remediation system has been installed, inspected, commissioned and is shown to be operating as intended. The system is operated for several years until remedial objectives (SSTLs) are met.

Figure 5-3 In-situ Groundwater Remediation System

5.4 Example 4: Risk Managed Site through Capping and Long Term Monitoring (LTM)

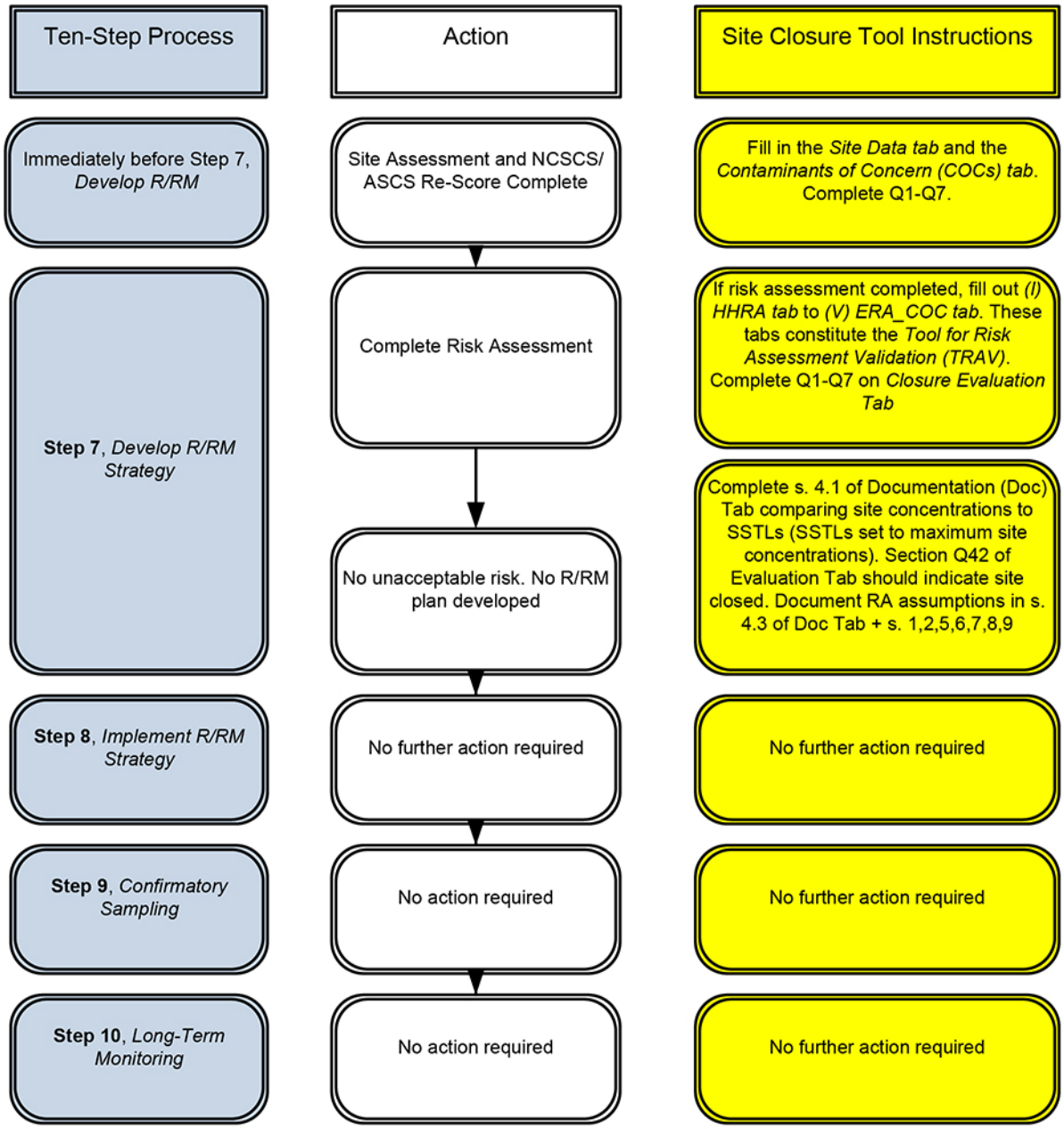
In this example, COCs in are identified in soil and groundwater. A risk assessment shows potentially unacceptable risk. A risk management plan is developed to address surface soils (by capping), groundwater (by supplying alternate water supply) and potential vapour intrusion (through indoor air sampling). These measures are long term and therefore require LTM. Construction Completion can be claimed after the cap is installed and the alternate water supply provided. Site cannot be closed as long as COC concentrations exceed SSTLs; however site is being successfully risk managed with only long term monitoring required.

Figure 5-4 Example of Risk Managed Site

5.5 Example 5: Risk Assessed, No Unacceptable Risks

In this example, COCs are identified in soil and groundwater. A TRAV-validated risk assessment shows no potentially unacceptable risk. Site can be closed as long as RA assumptions hold.

Figure 5-5 Example of Site Closed by Risk Assessment



6.0 REFERENCES

A Federal Approach to Contaminated Sites, Contaminated Sites Management Working Group, 1999.
http://www.federalcontaminatedsites.gc.ca/publications/fa_af/fa_af-eng.pdf

Federal Contaminated Sites Action Plan Web Portal
http://www.federalcontaminatedsites.gc.ca/fcsap_pascf/index-eng.aspx

Policy Framework for the Management of Assets and Acquired Services
http://www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=12022

Treasury Board Policy on Management of Real Property
http://www.tbs-sct.gc.ca/pubs_pol/dcgpubs/aas-gasa/pmrp-pgbi/pmrp-pgbi_e.asp

Treasury Board Reporting Standard on Real Property
http://www.tbs-sct.gc.ca/pubs_pol/dcgpubs/aas-gasa/rsrp-nerbi/rsrp-nerbi_e.asp

Treasury Board Secretariat Guide to the Management of Real Property
http://www.tbs-sct.gc.ca/rpm-gbi/gmrp-ggbi/gmrp-ggbi_e.asp

FCSAP Long Term Monitoring Planning Guidance (2012)
No URL at present.

Developing Long-term Monitoring Programs that Lead to Site Closure for FCSAP Aquatic Contaminated Sites: State of Science Review and Technical Guide (2011 Draft)
No URL at present.

Appendix A – User's Guide for the Tool for Risk Assessment Validation (TRAV), v. 3.1

June 2012

User's Guide for the Tool for Risk Assessment Validation (TRAV)

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APPENDICES

APPENDIX A
Major Deficiencies Where Rationale is Not Applicable

ACRONYMS

AEC	Area of Environmental Concern
CCME	Canadian Council of Ministers of the Environment
COC	Contaminant of concern
CSM	Conceptual site model
DFO	Fisheries and Oceans Canada
ERA	Ecological Risk Assessment
ERA_COC	Ecological Risk Assessment contaminants of concern (TRAV worksheet)
ERA_ROC	Ecological Risk Assessment receptors of concern (TRAV worksheet)
FCSAP	Federal Contaminated Sites Action Plan
HHRA	Human Health Risk Assessment
HHRA_COC	Human Health Risk Assessment contaminants of concern (TRAV worksheet)
QA/QC	Quality assurance/quality control
Reference_Materials	Reference materials worksheet (TRAV worksheet)
ROC	Receptor of concern
TRAV	Tool for Risk Assessment Validation
SAR	Species at risk
SCT	Site Closure Tool
SSTL	Site-specific target level
TRV	Toxicity reference value

INTRODUCTION

Background

One of the primary objectives of the Federal Contaminated Sites Action Plan (FCSAP) program is to address risks that contaminated sites pose to human health and the environment. Once this objective has been satisfied no further work is required on a site. In order to document the site closure process and verify that the work done on the site does, in fact, reduce risks to human health and the environment to an acceptable level, FCSAP has commissioned the development of site closure tools, including the Tool for Risk Assessment Validation (TRAV), which has been developed by Golder Associates Ltd. (Golder) and the Site Closure Tool (SCT), which has been developed by Franz Environmental Inc. (Franz). The TRAV is embedded in the SCT and can be completed as part of the site closure process for federal contaminated sites in cases where risk assessment has been conducted.

For sites that have undergone a risk assessment, the TRAV is, first, a quality assurance tool that describes the expectations of Environment Canada, Fisheries and Oceans Canada (DFO) and Health Canada with respect to how risk assessments should be conducted. The TRAV also serves to evaluate if the risk assessment has been conducted according to prescribed guidance. Although the TRAV is not a mandatory tool, its use is strongly encouraged by the FCSAP Secretariat. If the TRAV is used, federal custodians will be expected to complete and submit the tool to the FCSAP Secretariat to close a site. The TRAV is intended to be a self-assessment tool (i.e., to be completed by the site custodian).

There are two main outcomes that can result from the analysis embedded in the TRAV tool that are then relayed back to the SCT.

- The first main outcome is that no major deficiencies are identified. With this outcome, either: a) risks are acceptable and no further work is required; or b) there are unacceptable risks in either the human health or ecological risk assessment requiring further assessment or remediation; and,
- The second major outcome is that there is insufficient information (i.e., major deficiencies exist in the risk assessment). In this case, the deficiencies assessed by the TRAV should be examined and resolved by the risk assessment practitioner and the site custodian. Ideally this resolution would occur prior to the implementation of remediation or risk management activities. With this outcome, the site cannot proceed to a final site closure classification (i.e., no further work required).

Purpose of the Tool for Risk Assessment Validation

- By electing to use the TRAV at federal contaminated sites, custodians can document that program objectives have been achieved. Specifically, the TRAV can be used by federal custodians and the FCSAP Secretariat as a key mechanism to:
- Document program accountability & quality assurance;
- Set a benchmark for conducting risk assessments, and confirm that risk assessments are following guidance for federal contaminated sites;

- Demonstrate that sites are meeting the FCSAP objective of reduced environmental and health risk; and,
- Strengthen public confidence in the management of federal contaminated sites by verifying and documenting actions taken at federal contaminated sites.

Uses of the Tool for Risk Assessment Validation

Federal custodians will be encouraged to complete and submit the TRAV (if risk assessment has been completed for a site) to the FCSAP Secretariat once a site is closed. Ideally, the custodian would fill in the TRAV in conjunction with the completion of the risk assessment. This will provide an opportunity to address potential deficiencies in the risk assessment in a timely manner (e.g., prior to remediation or risk management) for successful site closure (e.g., no major deficiencies would require resolution). Although optional, the TRAV is intended to be used at sites which are currently receiving FCSAP remediation and risk management funds and is not intended to be applied retroactively to closed sites when different guidance documents may have been in use. A sub-set of submitted TRAVs will be reviewed through a third-party process to confirm that the self-assessment model is effective.

A secondary goal of the TRAV is to increase the consistency and robustness of the risk assessments that are produced for FCSAP sites. Guidance documents from Health Canada, Environment Canada and DFO form the basis of the TRAV framework which will assist in the development of sound and reliable risk-based decisions at federal contaminated sites. Specifically, the TRAV is based on these guidance documents:

- Guidance on Human Health Preliminary Quantitative Risk Assessment, Health Canada, 2009;
- Guidance on Human Health Detailed Quantitative Risk Assessment for Chemicals, Health Canada, 2010; and,
- Federal Contaminated Sites Action Plan (FCSAP) Ecological Risk Assessment Guidance, Environment Canada, 2012.

It is expected that risk assessments will be completed following the guidance provided in the above documents, and others as they are developed for the FCSAP program, and that rationale will be provided for deviations from the guidance.

INSTRUCTIONS TO THE USER/CUSTODIAN

Users of the Tool for Risk Assessment Validation

The user of the TRAV should be an experienced professional with appropriate technical expertise and experience in risk assessment and site investigation work.

Description of the Tool for Risk Assessment Validation

The TRAV electronic tool is composed of the following nine worksheets which are described in greater detail in Section 3.0:

- Site Data;
- Contaminants of Concern (COC);
- Human Health Risk Assessment [(I) HHRA];
- Human Health Contaminants of Concern [(II) HHRA_COC];
- Ecological Risk Assessment [(III) ERA];
- Ecological Risk Assessment Receptors of Concern [(IV) ERA_ROC];
- Ecological Risk Contaminants of Concern [(V) ERA_COC];
- Summary Part I [(VI) Summary]; and,
- Summary Part II [(VII) Summary_2].

Information Required to Use the Tool

The worksheets are intended to be completed in the order presented above, as completely as possible. There are two reference worksheets (Contaminant Sources and Reference Materials) which are described in greater detail in Section 3.3 and are located at the end of the workbook. These references may assist users as they work through the completion of the TRAV electronic tool. Contaminants are considered to be contaminants of concern (rather than contaminants of potential concern) for the purposes of the TRAV electronic tool as a risk assessment and/or remediation/risk management measures have already been completed at the site. There are several general items that users should be familiar with including:

- Cells which are orange require input from the user;
- Once an orange cell has been filled in, the user is generally prompted to provide additional rationale. The additional rationale should be provided to minimize deficiencies in the TRAV classification;
- Grey cells do not require a response. Cells may automatically become grey based on a response to a previous question;
- Pull down menus are provided for efficiency and to standardize responses;
- The following keystrokes - “y” for yes and “n” for no can also be used to facilitate completion of the worksheets;

- For contaminant sources, user defined parameters can be added. User defined parameters must be entered on the Contaminant Sources tab (both sources of contamination and typical chemicals associated with each source can be entered here) and then they become available on the pull down menu on the Site Data worksheet;
- It is recognized that some risk assessments are completed for numerous scenarios. The TRAV should be completed for the scenario upon which risk management/remediation is based. If that decision has not been made, then the scenario with the highest resulting risk should be used to complete the tool; and,
- Many of the questions ask if a topic was "considered". While it is preferable that there is written documentation in the risk assessment on the topic, it is recognized that this is not always the case and the consideration may be implicit in the risk assessment. In these cases, rationale should be provided in the TRAV to explain and document the user's assumptions.

Deficiencies - The Basis for Risk Assessment Validation

The assignment of deficiencies forms the basis of the validation portion of the tool. The questions are designed to determine if the risk assessment followed guidance on conducting risk assessments at federal contaminated sites. In cases where guidance was not followed, a deficiency is assigned.

There are two types of deficiencies: major and minor. Any deficiencies assessed during the completion of the TRAV indicate that guidance was not followed with a secondary purpose of providing a road map of what is expected in the risk assessment. The minor deficiencies are those where the resulting risk management decisions made based on the risk assessment would not likely change if the guidance was not followed. The major deficiencies indicate that major elements of the risk assessment are missing and it is possible that the resulting risk management decisions made could be affected based on these omissions. In most cases, rationale can be provided in the tool to explain why guidance was not followed, which negates the deficiency.

Major deficiencies where rationale does not negate the deficiency are listed in Appendix A. Additionally, when the tool is being competed, if the user answers a question in such a way that a major deficiency is triggered, this is indicated in the instructions column of the tool.

Both major and minor deficiencies that are triggered upon completion of the tool are listed in the Summary worksheet, as described in Section 3.2.6.

Information Required for Custodian Validation

- It is expected that in many cases, a custodian will include completion of the TRAV as part of the scope of work of the risk assessment. There are specific areas of the tool that require custodian verification and input.
- For major deficiencies that are negated by the provision of rationale, a green dot appears to the right of the table in a column called "Flag (for Review)". This is an indicator that the custodian should carefully review the rationale provided to verify that appropriate justification has been provided to deviate from prescribed guidance.

- Input is required from custodians in the Summary sheet. If major deficiencies are assigned based on the completion of the worksheets, the custodian should review the major deficiencies and determine whether the automatic result is accurate or not. This process is described in more detail in Section 3.2.6.

THE TOOL FOR RISK ASSESSMENT VALIDATION WORKSHEETS

General instructions for completion of the TRAV electronic worksheets are provided below (for each worksheet in the workbook). The TRAV has detailed line by line instructions embedded in the worksheets.

6.1 Site Data Worksheet

The main sections included on the Site Data worksheet are:

- Sources of Contamination;
- Media with COCs;
- Additional Site Data Considerations; and,
- Screening COCs.

Each section is described in greater detail below.

6.1.1 Sources of Contamination

The Site Data page allows for input of up to five contaminant source areas and includes a pull-down list of major sources of contamination as well as the suggested chemicals of concern that are typically associated with these sources. The user can provide additional sources of contamination that are not provided in the dropdown list in the "Contaminant Sources" worksheet. These sources can then be selected from the menu in the SiteData worksheet. The user is then required to confirm whether the suggested chemicals of concern were included in the site investigation and risk assessment. If the COCs were not considered in the site assessment, a major deficiency is assigned.

Media with COCs

The user is required to indicate which of the following media have COCs by selecting "Considered and present", "Considered and not present", "Not considered" or "na" from a drop-down menu:

- Surface soil (0 to 1.5 metres below ground surface [mbgs]);
- Subsurface soil (> 1.5 mbgs);
- Groundwater;
- Surface water (including seawater);
- Sediment;
- Outdoor Air;
- Indoor Air;
- Other Media, 1; and,
- Other Media, 2.

- For a given medium with measured or modeled COCs, the user should select “Considered and COCs present” from the drop-down menu. If it is known or assumed that the media is not impacted with COCs based on direct measurement or consideration of contaminant fate and transport mechanisms, the user should select “Considered and COCs not present”. If the medium was not considered in the assessment, the user would select “Not considered“. The tool requires that a rationale be provided if a media was not considered in the assessment. If the medium was considered not applicable in the assessment, the user would select “na”. Rationale is required to explain why the medium was considered not applicable. Additional questions in this section require the user to provide a description of contaminant release and transport at the site and whether all the appropriate media have been sampled and COC concentrations documented.

Additional Site Data Considerations

The additional site data considerations section includes questions for the user related to the adequacy of the site investigations and data quality assurance/quality control (QA/QC). This section asks the user to comment as to whether the areas of environmental concern (AECs) have been delineated horizontally and vertically and if a sufficient number of samples were collected from known/suspected AECs to reflect maximum concentrations.

The questions regarding the QA/QC program focus on whether QA/QC elements have been incorporated into the risk assessment to provide confidence in the data and scientific approach. The user is required to indicate whether the site assessment testing program is described and whether rationale was provided for the selection of samples for analytical testing. The user is also asked to indicate whether all sampling locations have been identified on site plans and in data tables. References to resources are provided to assist the user in assessing whether the site investigation and data quality are adequate for the purposes of a risk assessment.

Screening COCs

The Screening COCs section provides a series of questions for the user related to the screening process utilized to identify COCs if a risk assessment was conducted. The questions focus on whether maximum concentrations were used to identify COCs and if federal guidelines were used (e.g., Canadian Council of Ministers of the Environment (CCME) Canadian Environmental Quality Guidelines (CEQGs), Canadian Drinking Water Quality Guidelines (CDWQGs)). A rationale needs to be provided in cases where federal guidelines were not used (e.g., in the absence of federal guidelines for a particular substance, screening values may have been selected from another jurisdiction). A major deficiency will be identified if maximum measured concentrations were not used to identify COCs as the purpose of the screening is to compile a conservative list of chemicals for further evaluation. A statistic other than the maximum measured concentration can be used provided that justification (rationale) is provided. Lastly, this section prompts the user to indicate whether consideration has been given to substances for which there are no guidelines, substances that are persistent, bioaccumulative or biomagnifying as well as degradation products.

6.2 Contaminants of Concern (COCs) Worksheet

This worksheet includes a matrix table to list COCs that are present in the media identified in Section 3.1.1.1 (of this guidance document). The COC matrix table provides space for 15 COCs. If the site has more than 15 COCs, the user is advised to list COCs that are drivers of the risk assessment and remediation. Additional COCs can be included in the "Others" row, for record keeping purposes. A "notes" section is also provided for the user's records. COCs entered in the "Others" row are not carried forward to the other worksheets in the TRAV. Additionally, Other Media 1 and Other Media 2 listed in Section 3.1.1.1 are not carried forward in other worksheets in TRAV. Notes can be added, if required, to describe COCs in these Other Media.

The cells in the table will grey out based on the answers provided in the "Media with COCs" section of the Site Data worksheet. The user should fill in the orange cells by selecting "y" or "n" from the drop down list to indicate if the COC is present in each applicable medium. On this worksheet, a blank cell in this table is equivalent to selecting "n" from the drop down list.

6.2.1 Human Health Risk Assessment (HHRA) Worksheet

This worksheet consists of questions grouped into the following sections:

- Pre-Screening;
- Problem Formulation;
    - Objectives;
    - Receptors, Pathways and Conceptual Site Model (CSM);
- Exposure Assessment;
- Toxicity Assessment; and,
- Risk Characterization.
- Each section is described in greater detail below.

Pre-Screening

This section is intended to assess if an HHRA is required and if so, what type of HHRA has been conducted and with what restrictions. The first question assesses whether an HHRA is necessary. If an HHRA is not necessary (i.e., concentrations measured in site media do not exceed human health guidelines or check values) the user can skip the HHRA related tabs (HHRA and HHRA_COC) and proceed to the ERA worksheets as indicated by the message provided in Section 1A of the HHRA worksheet. In this case, the cells in the remainder of the HHRA worksheet will become grey indicating that data entry is not required.

Another "off-ramp" in the TRAV occurs if the HHRA was conducted qualitatively. For the purposes of the TRAV, a qualitative HHRA is one where there may be exceedances of human health guidelines or check values, but there are no complete exposure pathways. Another qualitative risk assessment

example is one where risks were discussed qualitatively, but no numerical calculations were performed. If this is the case, the user should answer "yes" to the question: "Was the HHRA qualitative?" and provide rationale. The user will also have to answer if risks in the qualitative HHRA were acceptable. If not, a major deficiency will be assessed unless rationale is provided. It is assumed that if there are unacceptable risks then a tiered approach should have been applied and a more detailed risk assessment should have been conducted. If a qualitative risk assessment was conducted, the remainder of the cells in the HHRA-related worksheets will become grey indicating that data entry is not required.

There are also questions provided to ascertain whether Health Canada Expert Support has reviewed the risk assessment and whether their comments have been incorporated or considered in the final risk assessment. The user is required to provide rationale if either 1) the risk assessment has not been reviewed by Health Canada Expert Support or 2) it has been reviewed by Health Canada Expert Support, but the review comments have not been incorporated into the risk assessment report or were not considered when finalizing the risk assessment report.

The final questions in this sections aim to characterize the HHRA. The user is required to identify limitations regarding site characterization data that might limit the conclusions of the HHRA. If limitations were identified, the user is required to indicate whether the risk assessor addressed these limitations in the conclusions of the risk assessment. If the limitations were not addressed, a rationale must be provided. There are also questions provided to input the land use the risk assessment was based on as well as any site use restrictions that were identified in the risk assessment.

Problem Formulation

The questions in the remainder of this worksheet generally follow Health Canada guidance for conducting HHRAs at federal contaminated sites. The purpose of these questions is to assess whether the HHRA is generally consistent with the Health Canada risk assessment guidance (Health Canada, 2009; 2010).

Objectives

The user is required to indicate whether the study objectives are clearly stated, whether it is clear how the HHRA supported the study objectives and to provide a reference within the HHRA document to the study objectives.

Receptors, Pathways and Conceptual Site Model (CSM)

This section focuses on the identification of receptors groups (general public, Aboriginal Communities, commercial/industrial workers, recreational users) and specific age groups (infant, toddler, adolescent, and adult) and sensitive receptor populations that might be present on or utilize the site. Further rationale is required for those questions regarding receptors for which the answer is "no". There are also questions regarding the exposure pathways that were included in the risk assessment and the

robustness of the conceptual site model to confirm it sufficiently documents the linkages between the receptors, COCs and exposure pathways.

Exposure Assessment

The Exposure Assessment section focuses on the data and quality of the data used to conduct the exposure assessment. The user is required to confirm whether the correct exposure point concentrations were utilized. If modeling was used to predict exposure point concentrations, the user is required to indicate whether the correct inputs were utilized and appropriate justification has been provided for the selection of the model inputs. There are also a series of questions related to "groundtruthing" the model results (i.e., do the modeled predictions make sense in comparison to measured concentrations at the site). The user is required to comment on whether statistical analyses were used to calculate exposure concentrations and if so, whether they are defensible given the number of samples and distribution of contamination (i.e., is the contamination representative of data from a single population?).

This section requires that the user indicate whether the receptor exposure characteristics and exposure equations were selected from Health Canada guidance and if not, was adequate rationale/justification provided for using alternative sources. The user is required to confirm whether a value for bioavailability other than 100% was utilized and if so, was the value supported by bioavailability testing or literature studies. In addition, the user is required to indicate if consideration has been given to relative versus absolute bioavailability. There is a question regarding the use of relative absorption factors from Health Canada or other defensible sources if the dermal exposure pathway is operable at the site. There are several questions on the appropriate use of exposure amortization, particularly for acute and sub-chronic exposures as well as developmental toxicants. Additionally, the user is asked to confirm if Health Canada's recommended procedures to account for different cancer risks based on life stage of exposure were followed.

The last questions in this section relate to whether a probabilistic risk assessment was conducted and if the input parameters and probability distributions have been justified.

Toxicity Assessment

The Toxicity Assessment section of the worksheet focuses on the selection of toxicity reference values (TRVs). The first question relates to whether the TRVs have been provided for each chemical/pathway combination with references. If TRVs have been utilized from sources other than Health Canada, the user is required to indicate whether the TRVs selected were defensible and justified. The preferred Health Canada (2009) hierarchy for selection of TRVs from other jurisdictions is provided for user reference. The user is required to confirm whether any TRVs were extrapolated from the oral to inhalation route and if this is the case, to assess whether bioavailability between the exposure routes was considered as well. The provision of health effects associated with each COC and the basis of the TRV are also required.

The development of *de novo* TRVs is the focus of another question and the reference to Health Canada guidance on this topic is provided (Health Canada – Guidance for the Development of Toxicity Reference Values (TRVs) for Federal Contaminated Site Risk Assessments, in the Absence of Published Regulatory TRVs). The user is also required to confirm if acute and sub-chronic TRVs have been adequately described and properly referenced. For carcinogens, the user is prompted to confirm if both non-carcinogenic and carcinogenic endpoints have been provided.

Risk Characterization

The Risk Characterization section of this worksheet focuses on the presentation of the risk estimates and comparison to target risk levels for carcinogens and non-carcinogens. The user is required to indicate if the results of the risk assessment are presented clearly and if all risks that are greater than established target levels are defined as unacceptable. The following questions are related to the interpretation of risks and are geared towards confirming that Health Canada guidance was followed with respect to this interpretation.

6.2.2 Human Health Contaminants of Concern (HHRA_COC) Worksheet

On this worksheet, the user is required to provide information regarding the list of COCs previously entered on the COC worksheet. For each COC, the user is required to indicate if the COC was carried forward in the HHRA. If the COCs were not carried forward in the HHRA, a rationale needs to be provided. If the COC is retained for evaluation in the HHRA, then the user must indicate whether unacceptable risks were identified for that COC in any of the media assessed (i.e., surface soil, subsurface soil, groundwater, surface water, sediment, indoor air and outdoor air).

In the second table, the user is required to identify receptor/exposure pathway combinations for COCs for which unacceptable risks were identified and provide site-specific target levels (SSTLs) for these COCs in the appropriate media. Confirm that the units are compatible with those provided in the table.

6.2.3 Ecological Risk Assessment (ERA) Worksheet

This worksheet consists of questions grouped into the following sections:

- Pre-screening;
- Problem Formulation;
    - Objectives;
    - Habitat Assessment;
    - Species at Risk;
    - Conceptual Site Model (CSM);
- Exposure Assessment;
- Effects Assessment; and,

- Risk Characterization.
- Each section is described in greater detail below.

Pre-screening

This section is intended to assess if an ERA is required and if so, whether an ERA has been conducted. If an ERA is not necessary (i.e., concentrations measured in site media do not exceed environmental health based guidelines) the user can skip the ERA related worksheets (ERA, ERA_ROC and ERA_COC) and proceed to the Summary worksheets. In this case, the cells in the remainder of the ERA-related worksheets will become grey indicating that data entry is not required.
This section also establishes if the ERA considers aquatic or terrestrial receptors, or both. The user is required to indicate if the site includes, or is close to, a water body. For the purposes of TRAV, "close to a water body" is considered to be within 500 m.

The Pre-screening section establishes if aquatic and/or terrestrial receptors were assessed qualitatively. For the purposes of TRAV, this means that the majority of the risk assessment is based on discussion with little or no numerical calculations performed. If risks were assessed qualitatively, rationale should be provided. The user will also have to answer if risks in the qualitative assessment were acceptable. If not, a major deficiency will be assessed unless rationale is provided. It is assumed that if there are unacceptable risks then a tiered approach should have been applied and a more detailed risk assessment will be conducted. If both aquatic and terrestrial receptors were assessed qualitatively, the remainder of the cells in the ERA-related worksheets will become grey indicating that data entry is not required.
There are also questions provided to ascertain whether Environment Canada and/or Fisheries and Oceans Canada Expert Support have reviewed the risk assessment and whether their comments have been incorporated into the final risk assessment. The user is required to provide rationale if either 1) the risk assessment has not been reviewed by Expert Support or 2) it has been reviewed by Expert Support, but the review comments have not been incorporated or considered in the risk assessment report.
The final questions in this section aim to characterize the ERA. The user is required to identify limitations regarding site characterization data that might limit the conclusions of the ERA. If limitations were identified, the user is required to identify whether the risk assessor addressed these limitations in the conclusions of the risk assessment. If the limitations were not addressed, a rationale must be provided. There are also questions provided to input the land use that the risk assessment was based on as well as any site use restrictions that were identified in the risk assessment.

Problem Formulation

Objectives

The user is required to indicate whether the study objectives are clearly stated, whether it is clear how the ERA supported the study objectives and to provide a reference to the study objectives. The user is

also required to indicate if the assessment endpoints and measurement endpoints have been clearly identified and if measurement endpoints support the assessment endpoints.

Habitat Assessment

This section asks the user to indicate whether a habitat assessment has been conducted for the site and adjacent area. If a habitat assessment has been completed the user is required to provide a summary of the assessment results. There are also questions relating to whether all habitats identified on the site were considered in the risk assessment and if both on-site and off-site receptors were considered in the assessment. The user is also required to indicate if the ERA included a comparison to a reference site, a gradient design or background conditions to establish that adverse effects are related to contamination.

Species at Risk Assessment

The user is required to identify whether a species at risk (SAR) assessment has been completed and if so, were the SAR identified as potential or actual receptors of concern (ROCs) and have the results of the SAR assessment been incorporated into the ERA.

Conceptual Site Model

The user is required to identify whether a CSM was developed that incorporates all elements of the problem formulation (i.e., the linkages between the COCs, receptors and exposure pathways and also include fate and transport of COCs).

Exposure Assessment

This section focuses on the exposure assessment considerations such as home range size, receptor characterization and use of modeling to determine exposure concentrations. Generally the tool asks if these elements were considered, documented and justified.

Effects Assessment

The effects assessment focuses on whether the lines of evidence applied in the ERA were compatible with the measurement endpoints that were identified in the problem formulation and if potential contaminant interactions were discussed in the effects assessment. The user is also required to identify if site-specific TRVs were derived for the ERA and if they were derived in accordance with EC guidance. If TRVs were not derived in accordance with EC guidance, the user is required to provide a reference for the guidance used.

Risk Characterization

The risk characterization section queries the user to indicate whether the results of the risk assessment are clearly presented including the identification of COCs for which risks were found to be unacceptable (as applicable) and also whether the objectives of the study were addressed. If the objectives were not addressed a rationale is required in addition to identification of any further actions that may be required. The user is also required to indicate whether a weight of evidence approach was

utilized and if so, a series of questions is provided to describe how the multiple lines of evidence were used in the ERA.
There are also questions provided to identify if SSTLs were proposed and if uncertainty was addressed in the risk assessment.

6.2.4 Ecological Receptors of Concern (ERA ROC) Worksheet

This worksheet contains a detailed table used to document the aquatic and terrestrial receptors and receptor groups considered in the ERA. The user is required to indicate whether various receptor groups were included in the ERA. If the receptor group was not included in the ERA, the user is required to provide rationale as to why this is the case. If the receptor group was considered further, the user is required to provide the surrogate(s) chosen to represent this receptor group. Note that "community", or other receptor of concern categories, can be listed, in addition to specific species. Up to three surrogate receptors can be provided for each receptor group. Assessment endpoints are required for each receptor of concern identified. The user is directed to the Reference Material worksheet for examples of assessment endpoints. The media to which each ROC is potentially exposed is then identified and the user is also required to provide the lines of evidence used to assess each ROC in the ERA. The media to which the ROCs are exposed must be filled in for future use on drop-down lists in the ERA COC worksheet. If the ROC is exposed to a given medium, the user can select "y" from the drop-down list. If the ROC is not exposed to a given medium, the user can select "n" from the drop-down list or leave the cell blank.

6.2.5 Ecological Contaminants of Concern (ERA COC) Worksheet

This worksheet includes three tables for the user to complete. On the first table the user is required to provide information regarding the list of COCs previously entered on the COC worksheet. For each COC, the user is required to indicate if the COC was carried forward in the ERA. If the COCs were not carried forward in the ERA, a rationale needs to be provided. If the COC is retained for evaluation in the ERA, then the user must indicate whether unacceptable risks were identified for that COC.
The second table is used to identify ROCs and pathways for which unacceptable risk was identified. The user selects the ROC from a drop-down list (based on data entered in the ERA ROC worksheet). The user then types in the exposure pathway driving the risk for that COC and ROC. There is space to accommodate three ROC/pathways for each COC. It is recommended that the ROC/pathways that are driving risks at the site are entered. There is also an additional column that allows any additional ROC/pathway combinations to be entered.
The third table is used to document SSTLs that have been derived for the COCs in each applicable medium for which unacceptable risk has been identified. Confirm that the units are compatible with those provided in the table.

6.2.6 Summary

The summary worksheet summarizes the results of the risk assessment validation as well as an overview of the information entered in previous worksheets.

In the first section, “Summary of results of RA validation”, there are three categories:

- Summary of Major Deficiencies;
- Summary of Unacceptable Risks; and,
- Summary of Land Use and Site Use restrictions.

In the summary of major deficiencies, the TRAV automatically indicates if any major deficiencies were noted. This is based on how the questions were answered in previous worksheets and whether rationale was provided for instances where responses indicate that guidance was not followed. The next three cells are orange and are required to be completed by the custodian project manager if major deficiencies were noted. It is expected that the custodian project manager will review any major deficiencies (as listed at the bottom of the summary worksheet) and will discuss these with the consultant and/or Expert Support, if there are questions or concerns about the major deficiencies. The custodian manager should fill in the three cells indicating if they have reviewed the major deficiencies, and if the risk assessment does in fact have major deficiencies upon review and/or consultation. Based on the answers provided, the overall TRAV result (i.e., Pass or Fail) will be automatically populated. This result will be fed to the SCT.

The second category is the summary of unacceptable risks. The tool automatically indicates if unacceptable risks were identified in the HHRA or ERA. This information is also fed to the SCT to determine if further action is required associated with site closure.

The third category provides the land use considered in the HHRA and ERA as well as any site use restrictions based on assumptions made in the HHRA and ERA.

The next sections summarize the HHRA and ERA, specifically the COC, receptors and pathways of concern and SSTLs. A summary table is provided for the HHRA followed by a summary table for the ERA.

The last sections of the summary sheet list any major and minor deficiencies noted during the completion of the TRAV. The deficiencies are listed as well as the worksheets and cells where the deficiencies were noted. This allows the user to verify the data entry. If the TRAV is completed in conjunction with the completion of the risk assessment, a thorough review of the deficiencies provides an opportunity to address any potential issues prior to remediation or risk management. A list of blank cells is also provided, if applicable. The TRAV should be filled in as completely as possible.

6.2.7 Summary of SSTLs and/or Maximum Allowable Concentrations (Summary_2)

The worksheet “Summary_2” provides a table of COCs originally entered in the COC worksheet. The media where these COCs were considered present are indicated with orange cells. For each

COC/media combination, either the SSTL derived in the risk assessment or the maximum allowable concentration should be entered in the table. This information will be used to inform the SCT and will form part of the record of what allowable concentrations are on the site (in excess of generic guidelines).

There are four buttons on the right hand side of the table to facilitate data entry:

- Populate with minimum SSTL from HHRA/ERA;
  - This button takes the lower value previously input in the HHRA_COC and ERA_COC worksheets.
- Populate with HHRA SSTLs;
  - This button takes only the SSTLs input in the HHRA_COC worksheet.
- Populate with ERA SSTLs;
  - This button takes only the SSTLs input in the ERA_COC worksheet.
- Clear Overall SSTLs;
  - This button clears the table.

The following should be noted when completing this table:

- When a button is pressed, the table is cleared and re-populated;
- Any value can be manually overwritten; and,
- If SSTLs have not been calculated and entered in previous worksheets, then the maximum allowable value should be manually entered into the table.

Reference Materials

Reference materials are provided in the TRAV workbook to provide additional guidance with respect to specific topics:

- Reference Sources (Contaminant Sources) – this worksheet provides a partial list of the activities conducted at commercial/industrial sites that may result in contamination and the contaminants frequently associated with these activities; and,
- Reference Materials (Reference Materials) – this worksheet provides reference materials on the following topics:
    - Contaminant fate and transport considerations;
    - QA/QC reference material;
    - Examples of surrogate ecological receptors;
    - Examples of bioaccumulative substances;
    - Examples of degradation products; and,
    - Examples of assessment and measurement endpoints.

CONCLUSIONS

The TRAV is an electronic tool to be used by federal custodians and the FCSAP Secretariat as a quality assurance tool to evaluate whether risk assessments conducted for federal contaminated sites have been conducted according to guidance. The TRAV is intended to be a self-assessment tool and forms part of the SCT for sites where risk assessments have been conducted.

REFERENCES

Health Canada (HC). 2009. Federal Contaminated Site Risk Assessment in Canada. Preliminary Quantitative Risk Assessment (PQRA). Version 2.0. May 2009.

Health Canada, 2010. Federal Contaminated Site Risk Assessment in Canada, Part V: Guidance on Human Health Detailed Quantitative Risk Assessment for Chemicals ($DQRA_{Chem}$). September 2010.

Environment Canada, 2012. Federal Contaminated Sites Action Plan (FCSAP) Ecological Risk Assessment Guidance.

APPENDIX A

Major Deficiencies Where Rationale is Not Applicable

The list below provides major deficiencies in TRAV that are assigned if the answer is “no”, even if rationale is given. These are provided below by Worksheet. There are other questions that could lead to the assignment of a major deficiency, however in those cases rationale can be provided to explain the methodology used in the risk assessment, which then eliminates the assignment of the major deficiency.

Site Data Worksheet

1. Were the typical contaminants associated with a selected source considered in the site assessment?
2. Have all potential contaminant release and transport mechanisms been described?
3. Does the lack of sufficient QA/QC measures compromise the results of the risk assessment?

HHRA Worksheet

1. Was a robust CSM developed that incorporates all elements of the problem formulation?
2. For each complete exposure pathway/COC combination identified in the CSM were exposure point concentrations accounted for either using measured data or estimated data (simulated, predicted or modeled)?
3. Are the selected TRVs clearly stated, with references for each chemical and pathway combination?
4. Was Health Canada guidance with respect to *de novo* TRVs followed?

ERA Worksheet

1. Was an on-site habitat assessment completed? Provide a brief description of on-site habitat in the rationale box.
2. Was a CSM included in the ERA?

Appendix B – Recommended Content for Consultants Remediation/Risk Management Action Report

Appendix B – Recommended Content for Consultants' Remediation/Risk Management Action Report

For sites that have been remediated or subjected to risk management, confirmatory sampling is typically completed to demonstrate that the contamination has been removed or stabilized effectively and that the clean-up objectives have been attained. A final remediation/risk management report documents all activities carried out during site decommissioning and clean-up, and includes drawings, records, and monitoring data (relevant in program and confirmatory data).

Examples of the content of a final remediation/risk management consultant report should be available in previous reports on similar projects and in successful Statements of Work (available from contaminated site project delivery organizations). Appendix 7-B of the Quality Management Tool provides a reviewer checklist for Remediation/Risk Management Closure Reports which can be used as a basis for identifying the contents of an R/RM consultant report.

The minimal recommended Final Remediation/Risk Management Consultant Report content is as follows:

Executive Summary (2-3 pages maximum)

- Project background
- Consultant, client and contract no.
- Remediation/Risk Management (R/RM) goals
- Modifications to original RAP/RMP
- Summary of actions
- Summary of final conditions at each AEC addressed by media
- Statement whether R/RM goals met
- Remaining AECS/APECs to be addressed at site

1. Introduction
    - R/RM objectives
    - Scope of work including
        - Planned R/RM activities
        - Planned deliverables
        - Variances from original planned scope of work

2. Site Description & History
    - FCSI number and name (mandatory)
    - Site and AEC location including key plan

- Facility name, municipal address, city/town
- Brief history of site and sources of contamination
- General conditions
    - Structures, vegetation, topography, surface water, etc.
- Applicable generic criteria or site-specific target levels
- List of AECs, media impacted, extent, volume
- Contaminants of Concern

3. Description of R/RM Activities
    - Process Description: system design, photos, O&M procedures, system monitoring requirements
    - Chronology of events: design, CEAA screening, permitting, installation, start up, termination
    - Confirmatory sampling methodologies
    - Progress of remediation activities: decrease in concentrations, comparison to criteria, mass removal/reduction
    - Problems, emergencies or unforeseen circumstances, etc. that arose during implementation of R/RM activities and approach to resolution.

4. Confirmatory Sampling Results
    - Description of post-remediation conditions:
        - Figures and tables showing max. remaining concentrations, residual contamination, free product
    - Demonstration that site meets R/RM objectives
    - Requirements for long-term monitoring
        - Is it required? Scope? Responsibilities?
    - Record of Site Condition completed and attached to appendices?
    - If R/RM completed, describe system and remediation infrastructure decommissioning

5. Conclusions & Recommendations
    - R/RM activities summarized
    - Final environmental conditions at each AEC, each media
    - Statement on whether R/RM have been met
    - For RM, restrictions on site use
    - Are long-term monitoring requirements stated?
    - Are Conclusions and Recommendations consistent with ES and main body of text

www.ec.gc.ca

Additional information can be obtained at:

Environment Canada
Inquiry Centre
10 Wellington Street, 23rd Floor
Gatineau QC K1A 0H3
Telephone: 1-800-668-6767 (in Canada only) or 819-997-2800
Fax: 819-994-1412
TTY: 819-994-0736
Email: enviroinfo@ec.gc.ca