Guidelines for Designing and Implementing Aquatic Effects Monitoring Programs for Development Projects in the Northwest Territories

Recommended Procedures for Documenting and Verifying Conceptual and Detailed Designs of Aquatic Effects Monitoring Programs

AEMP Technical Guidance Document
Volume 5

Indian and Northern Affairs Canada
Yellowknife, Northwest Territories

June 2009 Version

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List of Acronyms

AEMP	-	Aquatic Effects Monitoring Program
CCME	-	Canadian Council of Ministers of the Environment
CEAA	-	Canadian Environmental Assessment Act
DQO	-	data quality objective
EEM	-	Environmental Effects Monitoring
EQG	-	environmental quality guideline
EQO	-	environmental quality objective
FSP	-	field sampling plan
GIS	-	geographic information system
GLWB	-	Gwich'in Land and Water Board
HSP	-	health and safety plan
INAC	-	Indian and Northern Affairs Canada
K_{oc}	-	organic carbon partition coefficient
K_{ow}	-	octanol water partition coefficient
LWB	-	the Land and Water Board
MRP	-	Management Response Plan
MVEIRB	-	Mackenzie Valley Environmental Impact Review Board
MVLWB	-	Mackenzie Valley Land and Water Board
MVRMA	-	Mackenzie Valley Resource Management Act
NWTWA	-	Northwest Territories Water Act
NWTWB	-	Northwest Territories Water Board
NWT	-	Northwest Territories
QAPP	-	quality assurance project plan
QA/QC	-	quality assurance/quality control
SLWB	-	Sahtu Land and Water Board
TK	-	Traditional Knowledge
USEPA	-	U.S. Environmental Protection Agency
VEC	-	valued ecosystem component
WLWB	-	We'eezhii Land and Water Board
WQG	-	water quality guideline
WQO	-	water quality objective

1.0 Introduction

The data quality objectives process, described in Aquatic Effects Monitoring Program (AEMP) Technical Guidance Document Volume 3, provides a systematic basis for developing a series of alternative sampling designs and evaluating the alternatives to select a conceptual design for the AEMP that directly meets the goals and objectives established by the AEMP Working Group (see the AEMP Guidelines Overview Report for more information on the recommended use of an AEMP Working Group). In AEMP Technical Guidance Document Volume 4, a variety of topics were presented and discussed to enable practitioners to further develop the AEMP design (i.e., select the most appropriate monitoring program design for the study area, characterize reference conditions, and select sample locations, intensity, frequency, and timing). The fifth step in the AEMP development process involves the documentation and verification of the sampling program design. This Technical Guidance Document briefly describes the process for documenting the design of the AEMP and providing sampling and analytical personnel with the information that they need to implement the AEMP correctly, comprehensively, and safely.

2.0 Documentation of the Conceptual Aquatic Effects Monitoring Program Design

The first four steps of the AEMP development framework are intended to enable the project proponent to design an AEMP that will explicitly meet the requirements identified by the responsible regulatory board and the expectations of participants in the AEMP development process (for a description of the framework, see the AEMP Guidelines Overview Report). The results that emerge from these activities need to be documented in a Conceptual AEMP Design document, which provides an overview of the AEMP design, presents the detailed rationale for the AEMP design, and discusses the key assumptions underlying the selected design. The Conceptual AEMP Design document should include the following sections:

- ***Introduction*** - This section should describe the purpose of the document and provide an overview of the report contents. It should also describe the general process that was employed to develop the AEMP and the linkages between the Conceptual AEMP Design document and other documents that are developed to support the program (e.g., Problem Formulation Document, Data Quality Objectives Document, Field Sampling Plan, Quality Assurance Project Plan).
- ***Project Description*** - This section should provide readers with a clear and concise description of the project and reference additional documentation that can be accessed for more detailed information. This description should highlight activities that have the potential to affect the quality or quantity of resources in the aquatic ecosystem. The expected characteristics of any effluent, wastewater, and runoff from the facility should be described. The location and size of the initial dilution zone should also be described.
- ***Regulatory History*** - This section should describe where the project is within the overall regulatory process (e.g., environmental assessment, land use permitting, water licencing).
- ***Study Area*** - This section should present a detailed and fully integrated description of the environment within the study area, highlighting what is known about the aquatic ecosystem and associated uses by aquatic-dependent wildlife and humans. Both traditional knowledge (TK) and western scientific information must be used to prepare the integrated description of the water environment in the study area. This section of the document should summarize data on habitats in the area (classification and inventory), natural resources (inventory), and aquatic environment (chemistry, hydrology, limnology, etc.). Key data gaps should also be identified in this section of the document. Summaries of relevant data and information should be included as appendices to the Conceptual AEMP Design document.
- ***Overview of Problem Formulation*** - This section should present a brief summary of the problem formulation, highlighting the conceptual site

model, assessment endpoints, testable hypotheses, and measurement endpoints that were established. The problem formulation document should be included as an appendix to the Conceptual AEMP Design document.

- ***Overview of Data Quality Objectives (DQOs)*** - This section should present a brief summary of the DQOs that were established for the study. The detailed DQOs should be included as an appendix to the Conceptual AEMP Design document.
- ***Overview of the AEMP Design and Associated Rationale*** - This section should provide an overview of the AEMP design. More specifically, the type of design that has been selected should be identified (e.g., before-after-control-impact, gradient). In addition, key areas of concern (e.g., edge of initial dilution zone, near-field area, mid-field area, far-field area) and reference areas should be identified. The number and location of sampling stations, the variables that will be measured, and sampling frequency should be described, along with the rationale for their selection and any assumptions that were made during the design process. This section should provide the reader with a clear understanding of the work that will be undertaken under the AEMP and why the work is being conducted.
- ***Detailed Design of the AEMP*** - This section should provide more detailed information on the AEMP design. This section should include information on sampling methods, methods for preparing, handling, and transporting samples, methods for holding and analysing samples, sample archiving procedures, and quality assurance/quality control (QA/QC) provisions. This section should also provide maps, figures, and tables that summarize the decisions on where and when sampling will be conducted and what types of samples will be collected at each location on each sampling date. Any information potentially relevant methods or procedures may be appended to the Conceptual AEMP Design document.
- ***AEMP Analysis Plan*** - This section should present the detailed analysis plan that is developed for the AEMP (this will be an updated and expanded

version of the preliminary AEMP Analysis Plan presented in the problem formulation document). The Action Levels that will be used to interpret the results of the AEMP should be tabulated and included in this section of the document (these Action Levels will also be presented in the Management Response Plan). Procedures for defining reference/background conditions should also be described in this section.

- ***AEMP Reporting*** - This section should describe the proposed frequency, timing, structure, and content of the various reports that will be prepared to disseminate the results of the AEMP, including database development and dissemination, data reports, annual reports, detailed interpretive reports, and plain language reports. In addition, the frequency and timing of workshops that will be convened to explain the results of the AEMP to Aboriginal governments/organizations and other interested parties should be identified.
- ***References*** - All of the references that were used to design the AEMP should be referenced in the Conceptual AEMP Design document.

Upon completion, the AEMP Design document should be submitted to the responsible regulatory board for approval. The responsible regulatory board will distribute the document to Aboriginal governments/organizations and other interested parties for review and comment. It is recommended that the project proponent develop a detailed response to comments document (i.e., responsiveness summary) that describes how each of the comments offered by reviewers was addressed in the revised AEMP Design document. The rationale for any changes to the AEMP design that are made in response to reviewers comments should also be provided in the responsiveness summary. The project proponent may also want to schedule one or more workshops to describe the design of the AEMP, any changes that were incorporated to address reviewers comments, and other related issues to ensure that participants fully understand how their concerns have been addressed.

The authors of the Conceptual Field Sampling Plan Design document should be explicitly identified on any title pages of this document.

3.0 Preparation of a Sampling and Analysis Plan

A Sampling and Analysis Plan is required to translate the Conceptual AEMP Design and associated AEMP Analysis Plan into more tangible procedures that can be followed by staff involved in field sampling, laboratory analysis, and data validation, compilation, and interpretation. The Sampling and Analysis Plan typically consists of three elements, including:

- Field Sampling Plan (FSP);
- Quality Assurance Project Plan (QAPP); and,
- Health and Safety Plan (HSP).

The recommended structure and content of each of these documents is presented in the following sections of this document. A planning process could also be developed to address Traditional Knowledge (TK) acquisition on a project-specific basis to support evaluation of project-related effects. Please refer to the AEMP Guidelines Overview Report for a discussion on the need for TK in the AEMP development process.

3.1 Field Sampling Plan (FSP)

An FSP is needed to describe how the AEMP will be implemented by field personnel. The FSP must include sufficient detail to enable field personnel to fully understand their responsibilities regarding the collection, preparation, handling, and transportation of the environmental samples that are required to support assessment of project-related effects on the aquatic ecosystem and on the associated uses of aquatic resources (CCME 1993; OMEE 1996; CNSC 2004). In addition, the FSP must clearly identify the information that must be collected during the collection of such environmental samples. The FSP should include the following sections:

- ***Introduction*** - This section should describe the purpose of the document and provide an overview of the report contents. It should also describe the general process that was employed to develop the AEMP and the linkages between the FSP and other documents that are developed to support the program (e.g., AEMP Design Document, Problem Formulation Document, DQOs Document, QAPP).
- ***Objectives of the AEMP*** - This section should briefly describe the objectives of the AEMP. In addition, the more specific objectives of the sampling program should be described.
- ***Sampling Program Design*** - This section should provide an overview of the design of the sampling program. More specifically, it should identify the areas of concern and reference areas that will be sampled, the environmental media that will be sampled, the frequency and timing of sampling for each media type and area, and related information. The purpose of this section is to ensure that field personnel fully understand the design of the program and the rationale for its design.
- ***Sampling Locations, Frequency, and Timing*** - This section should provide detailed information on the locations, frequency, and timing of sample collection for each media type and each area of concern (e.g., near-field area, mid-field area, far-field area)/reference area. This information should be compiled in tables and figures in a manner that fully articulates sampling requirements (i.e., so that sampling personnel understand what is expected). A checklist of samples that need to be collected on each sampling data should also be prepared. Any additional information that needs to be collected along with the samples should be described in this section (e.g., climatic data, hydrological data, water chemistry data obtained using hand-held devices, visual observations).
- ***Roles and Responsibilities of Sampling Team*** - This section should identify all of the members of the sampling team and describe their roles and responsibilities relative to the sampling program.

- ***Sample Designation*** - This section should describe how each sample will be named (e.g., SED-2008-LDG-NF1) to facilitate subsequent identification by laboratory personnel, database developers, data users, and other participants in the process. In addition, chain-of-custody procedures need to be described.

- ***Sampling Equipment and Methods*** - This section should identify all of the equipment that will be required to support the sampling program. In addition, sampling methods should be briefly described. Procedures for decontaminating sampling equipment and for avoiding sample contamination should also be described. Importantly, procedures for avoiding or minimizing exposure to contaminated environmental media should be identified (i.e., to ensure that the sampling program can be implemented safely). Contingency plans for dealing with unexpected circumstances should be included in this section of the document. Whenever possible, such contingency plans should include decision trees that enable field personnel to consistently address unexpected circumstances that may arise during sampling (e.g., sediment sampler will not penetrate into the bottom substrate at the designated sampling location, no water present in stream at designated sampling location, stream has ice to bottom at designated sampling location). More detailed standard operating procedures for sample collection should be included as appendices to the FSP.

- ***Sample Handling and Preparation*** - This section should describe the procedures that will be used to handle and prepare environmental samples in the field. More detailed standard operating procedures for sample handling and preparation should be included as appendices to the FSP.

- ***Sample Transportation and Shipping*** - This section should describe the procedures that will be used to transport samples from sampling locations to the field laboratory and to ship samples from the field laboratory to the various analytical laboratories that will support the AEMP. More detailed standard operating procedures for sample transportation and shipping should be included as appendices to this document.

- ***Stressors of Potential Concern and Other Hazards*** - This section should identify the stressors of potential concern that apply to the site. Any other hazards associated with the sampling program should also be described in this section of the document In this way, field personnel will be able to understand the hazards associated with conducting the sampling program and to take the steps necessary to assure their safety (also see Section 3.3).
- ***Quality Assurance*** - This section should briefly describe the QA/QC measures that have been integrated into the AEMP design. Any quality assurance procedures that field personnel need to follow should be described (e.g., calibration of equipment, specialized bottle washing). Importantly, any quality assurance samples that need to be collected and/or prepared by field personnel should be identified in this section, including instructions for submission to laboratories (i.e., blind). This section should also reference that QAPP that was prepared to support the AEMP.
- ***References*** - This section should cite all of the documents that were used to prepare the FSP.

The authors of the FSP should be explicitly identified on the title pages of the document.

3.2 Quality Assurance Project Plan (QAPP)

A comprehensive QAPP should be prepared to document all of the quality assurance and quality control procedures that will be performed to prevent, detect, and correct problems that may occur during implementation of the AEMP (CCME 1993; OMEE 1996; CNSC 2004). These procedures will be of fundamental importance for ensuring that the AEMP results are defensible. Detailed guidance on the development of QAPPs that will meet or exceed the requirements of responsible regulatory board in the NWT is provided below (USEPA 2001):

- ***Introduction*** - This section should describe the purpose of the document and provide an overview of the report contents. It should also describe the general process that was employed to develop the AEMP and the linkages between the QAPP and the other documents that are developed to support the program (e.g., AEMP Design Document, Problem Formulation Document, DQOs Document, FSP).
- ***Goal of the AEMP*** - This section should briefly describe the goal of the AEMP and the more specific objectives of the sampling program.
- ***Project Management*** - This section should include descriptions of the project/task organizational structure (including roles and responsibilities of each member of the project team), the problem that needs to be solved, the work to be performed, the quality objectives for the project and the performance criteria that are established to achieve them, any training or certifications that are needed by personnel, and the documents and records that apply to the project.
- ***Data Generation and Acquisition*** - This section should address all aspects of data generation and acquisition to ensure that appropriate methods for sampling, measurement, and analysis, data collection or generation, data handling, and quality control activities are used and documented (USEPA 2001). Accordingly, the sampling design, sampling methods, sample handling and custody, analytical methods, quality control, instrument/equipment testing, inspection, and maintenance, instrument/equipment calibration and frequency, inspection/acceptance of supplies and consumables, non-direct measurements, and data management should be described in this section of the QAPP.
- ***Assessment and Response Actions*** - This section is prepared to describe the approach that will be used for assessing the effectiveness of project implementation and associated QA/QC activities (i.e., to ensure that the QAPP is implemented as prescribed; USEPA 2001). Accordingly, assessment and response actions, as well as reports to management, are to be described.

- ***Data Validation and Usability*** - This section should describe the tasks that will be completed to determine if the data generated under the AEMP conform to the specified criteria and meet the project objectives. Accordingly, descriptions of the following tasks are needed: 1) data review, verification, and validation; 2) verification and validation methods; and, 3) reconciliation with user requirements.
- ***References*** - This section of the document should cite all of the documents that were used to prepare the QAPP.

The authorship of the QAPP should be explicitly identified on the title page and fontis page of this document. In addition, the document should include an approval page, that provides the name, title, organization, signature, and approval date for the designated representative of each organization that is involved in the implementation of the AEMP. Signature of the approval page signifies that the designated representative has reviewed the QAPP, is aware of its contents, and agrees to conduct the study in accordance with the provisions of the QAPP. The QAPP should include (as appendices) the standard operating procedures that describe the methods that will be used to generate or acquire the requisite data and information under the AEMP. Further guidance on QA/QC is available in CCME (1993), OMEE (1996), USEPA (1998; 2001), and CNSC (2004).

3.3 Health and Safety Plan (HSP)

An HSP should be prepared prior to initiating any sampling activities under the AEMP. The plan should be designed to identify, evaluate, and control health and safety hazards associated with sampling activities and to provide for emergency response. The HSP should include the following elements:

- ***Introduction*** - This section should describe the purpose of the HSP.

- ***Applicability*** - This section of the document should describe who the HSP applies to and identify the mandatory health and safety requirements for the program.
- ***Site Characterization and Analysis*** - This section should characterize and evaluate the hazards that exist within study area.
- ***Site Description*** - This section should provide a description of the site, including identification of sampling timing, of the locations of sampling activities, and of the known or potential hazards associated with sampling activities.
- ***Objectives of Sampling Program*** - This section should briefly describe the objectives of the sampling program, the types of samples that will be collected, the sampling equipment that will be used, and the procedures that will be used to process the samples.
- ***On-site Organization and Coordination*** - This section should identify the project team leader, the site safety officer, field team leaders, and field team members.
- ***On-site Control*** - This section should identify the individual who has been designated as the on-site control coordinator.
- ***Hazard Evaluation*** - This section should identify the substances that could be encountered during sampling activities and summarize the available hazard information for each substance. Other hazards that may be encountered during sampling activities should also be described.
- ***Personal Protective Equipment*** - This section should describe the protective equipment that members of the sampling team are required to employ to assure their health and safety.
- ***On-site Work Plan*** - This section should describe all tasks that must be performed during the sampling program, identify the person(s) performing each task, and the precautions that need to be taken while performing these tasks.

- ***Communication Procedures*** - This section should describe the procedures that will be used to maintain voice communications with sampling crews during field sampling. In addition, the hand signals that will be used in the absence of verbal communication should be described.
- ***Decontamination Procedures*** - This section should describe the procedures that will be used by field personnel to ensure that they are thoroughly decontaminated before leaving the sampling area(s).
- ***Site Safety and Health Plan*** - This section should describe the procedures that need to be followed if emergency medical assistance is required, including substance-specific first aid procedures. In addition, the locations of first aid and safety equipment should be identified in this section of the document. The actions that need to be taken in the event of a personal protective equipment failure should be described, along with any environmental monitoring that needs to be conducted to assure worker safety.
- ***Site-Specific Orientation*** - This section should describe the frequency, timing, and content of health and safety orientation/briefings that will be provided to the members of the sampling team. A sign-off page should be included in this section to enable field personnel to certify that they have reviewed the HSP, that they agree to conform to its requirements, and that they have received the site-specific health and safety orientation.

The HSP is a document prepared to identify and control hazards associated with field sampling. As such, the responsible regulatory board is unlikely to require its submission for review and approval. Nevertheless, it is critically important to develop such a plan and use it to guide field sampling operations.

4.0 Field Validation of the Sampling Design

Before the Sampling and Analysis Plan is implemented, it is important to verify that samples specified in the FSP can be collected at the site. During field verification of

the sampling design, the testable hypotheses, exposure pathway models, and measurement endpoints are evaluated for their appropriateness and implementability (OMEE 1996; USEPA 1997). More specifically, information obtained previously and the feasibility of sampling should be verified through one or more visits to the site. For abiotic media, such as water and sediment, it is important to determine if the selected sampling methods are appropriate and applicable to the conditions at the site. For biological sampling, it is important to confirm that target species occur at the site, to determine if adequate numbers of individuals of the required species can be collected, and to evaluate the efficacy of various sampling methods. In this way, the level of effort required to collect the required number of samples can be determined. At this state of the process, it is prudent to develop a number of contingency plans that can be used to direct field sampling efforts if unexpected conditions are encountered (e.g., fish sampling contingency plan). Importantly, TK and western scientific data provide essential information for determining if the sampling design can be fully implemented within the study area. Therefore, the project proponent is strongly encouraged to fully engage Aboriginal governments/organizations and other interested parties during this stage of the process.

When changes are made to the AEMP design to address sampling feasibility issues, it is important to demonstrate that the overall integrity of the monitoring program has been maintained. For example, the revised AEMP design must ensure that all of the assessment endpoints and testable hypotheses developed during problem formulation are still being addressed. In addition, any new measurement endpoints must be evaluated according to their utility for assessing the status of the assessment endpoints and their compatibility with the Conceptual site model (USEPA 1997). Furthermore, the results of power analyses should demonstrate that the revised AEMP design will still have the agreed-to ability (i.e., power) to identify project-related effects. Final agreement on the AEMP design will be considered to have been achieved when the AEMP Design document, the FSP, and the QAPP have been approved by the responsible regulatory board. This general approach to planning should be applied during baseline data collection, data collection during project construction and operation, and project closure and reclamation. In this way, baseline data, AEMP data, and post-closure monitoring data will be as comparable as possible.

5.0 Review of the Aquatic Effects Monitoring Program Documentation

If appropriately developed, the AEMP design will address the requirements identified by the responsible regulatory board and the expectations of participants in the process. To confirm that AEMP documentation has accurately reflected the input provided during development of the AEMP design, the AEMP Design document, the FSP, and the QAPP should be reviewed by the Aboriginal governments/organizations and other interested parties prior to implementing the AEMP. Any changes to the design of the monitoring program in response to field verification efforts must be made with the agreement of the AEMP Working Group, fully documented, and communicated to the responsible regulatory board. A detailed responsiveness summary provides a useful vehicle for documenting how the comments offered by reviewers were addressed. The rationale for making such changes must be provided in the appropriate documents.

6.0 Implementation of the Aquatic Effects Monitoring Program

While the design of an AEMP determines its potential application for supporting management decisions, the manner in which it is implemented can affect the completeness and usability of the resultant data. Therefore, even a well-designed AEMP can have limited utility, if it is not implemented in an appropriate manner. For this reason, it is essential to strictly adhere to the AEMP Design that is developed, to carefully evaluate the resultant data relative to the project DQOs, and to compile useable data in a manner that affords ready access by data users. This section of the AEMP Guidelines briefly describes the steps that should be undertaken to implement the AEMP as designed.

While the DQOs process represents a key element of the overall AEMP design process (See Technical Guidance Document Volume 3 for more information), there

are several other steps that need to be completed before implementing the program. First, the final design needs to be documented in the AEMP Design Document, the FSP, and the QAPP that are prepared to guide the collection and analysis of the project data. In addition, a project HSP should be developed to ensure that the field program is implemented safely by the people involved in the collection, preservation, handling, and transport of environmental samples.

The FSP provides guidance for all field work by defining, in detail, the sampling and data-gathering methods that are to be used in the monitoring program. The FSP should be written so that a field sampling team unfamiliar with the water body or the AEMP design would be able to gather the required samples and field information. Upon completion, the FSP should be distributed to everyone on the field sampling team for review and comment. Any issues identified should be addressed through revisions to the FSP, delivery of specific training, and/or site reconnaissance.

The QAPP is a tool for planners and managers to document the type and quality of data needed to support water management decisions and to describe the methods for collecting and assessing those data. A QAPP generally consists of four major elements, including project management, data generation and acquisition, assessment and oversight, and data validation and usability. To be effective, the QAPP needs to be distributed to everyone involved in the collection and analysis of environmental samples for the project. Key individuals involved in the management of the project should be asked to approve the QAPP and, is so doing, confirm that the approved methods and procedures will be followed during the study. The use of laboratories that have been accredited by the Canadian Association for Laboratory Accreditation for generating analytical data under AEMPs is recommended.

The HSP is intended to assure the safety of field personnel by evaluating the risks to health and safety in the study area and by establishing procedures to be followed to mitigate those risks. As was the case with the FSP, the HSP must be distributed to all members of the field sampling team prior to the onset of sampling. All of the sampling team members must sign-off on the HSP and agree to abide by its provisions.

Field sampling can commence once the AEMP Design Document, FSP, and QAPP have been approved by the responsible regulatory board. It is essential that field sampling activities conform to the requirements identified in the FSP and QAPP. In addition, all analytical activities must conform to the requirements identified in the QAPP to ensure that the performance criteria for measurement data and other elements of the DQOs are met. Achieving these requirements typically requires a substantial level of coordination and oversight by the project team leader. Attention to the detailed requirements of the FSP and QAPP throughout the sampling and analysis process will increase the likelihood that accurate, precise, sensitive, representative, and complete data are collected under the AEMP. Such data are likely to support the management decisions needed to protect the environment and assure the long-term sustainability of aquatic resources and their uses.

7.0 References Cited

CCME (Canadian Council of Ministers of the Environment). 1993. Guidance manual on sampling, analysis, and data management for contaminated sites. The National Contaminated Sites Remediation Program. Winnipeg, Manitoba.

CNSC (Canadian Nuclear Safety Commission). 2004. Draft regulatory guide: Environmental monitoring program at Class 1 nuclear facilities and uranium mines and mills. G-224. Ottawa, Canada.

OMEE (Ontario Ministry of Environment and Energy). 1996. Guidance on sampling and analytical methods for use at contaminated sites in Ontario. ISBN-0-7778-4056-1. Standards Development Branch. Toronto, Ontario.

USEPA (United States Environmental Protection Agency). 1997. Ecological risk assessment guidance for Superfund: Process for designing and conducting ecological risk assessments. Environmental Response Team. Edison, New Jersey.

USEPA (United States Environmental Protection Agency). 1998. EPA guidance for quality assurance project plans. EPA QA/G-5. Office of Research and Development. Washington, District of Columbia.

USEPA (United States Environmental Protection Agency). 2001. EPA requirements for quality assurance project plans. EPA QA/R-5. EPA/240/B-01/003. Office of Environmental Information. Washington, District of Columbia.