

EPA New England Quality Assurance Plan (QAPP) Checklist for Model Applications

QAPP element numbers	Element	Element Name and Review Aspect	A Acceptable	U Unacceptable	NI Not Included	NA Not Applicable	Page # (Section #)	Comments (and notes)
A		PROJECT MANAGEMENT						
A1		Title and Approval Sheet (s)						
A1.1		Contains Quality Assurance Project Plan (QAPP) title						
		Indicates revision number, if applicable						
		Indicates organization's name						
		Dated signature of organization's project manager present						
		Signature block for organization's Project Manager						
		Signature block for organization's QA Officer						
		Other signatures						
A1.2		Table of Contents						
		Lists QAPP information sections.						
		Document control information indicated.						
		Provides lists of tables and figures.						
		Provides contents of each Appendix.						
		Lists all attached SOPs (with names, not just numbers).						
A1.3		Distribution List						
		Includes all individuals who are to receive a copy of the QAPP and identifies their organization.						
A1.4		Project/Task Organization						
		Identifies key individuals involved in all major aspects of the QAPP, including contractors. Discusses their responsibilities.						
		Identifies that the QA Manager has independence from unit(s) generating data and model outputs.						
		Identifies individual responsible for maintaining the official, approved QAPP.						
		Organizational chart shows lines of authority and reporting responsibilities						

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		Clearly identifies who is part of the Project Team and who is related to the Project in an advisory role (but is not responsible for delivery of any product).						
A1.5		Problem Definition/Background						
		States decision(s) to be made, actions to be taken, or outcomes expected from the information to be obtained from modeling activities.						
		Clearly explains the reason (site background or historical context) for initiating this QAPP.						
		Identifies regulatory information, applicable criteria, action limits, etc. that model outcomes will reference.						
		Identifies assumptions for the modeling process.						
		Provides for notification when new models will be created and justifies inability to use existing models.						
		Provides for notification of modifications to model code.						
		Describes how suitability of models to resolve application niche will be evaluated, including:						
		Mapping model attributes to problem statements						
		Degree of certainty needed in model outputs						
		Amount of reliable data, available resources and technical expertise						
A1.6		Project/Task Description						
		Summarizes work to be performed, for example, measurements to be made, data files to be obtained, etc., that support the modeling.						
		Provides schedules indicating critical project points, e.g., start and completion dates for such activities.						
		Details geographical locations to be studied, including maps where possible.						
		Discusses resource and time constraints, if applicable.						

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A1.7		Quality Objectives and Criteria for Measurement Data						
		Describes how the objectives of projects and the associated data quality acceptance criteria/model performance criteria will be established for all information to be collected including information obtained from previous studies. Explains how performance criteria will relate to the quality of model outputs.						
		Identifies acceptance criteria for all previously collected information.						
		Includes statement(s) of the general objectives and demonstrate knowledge of the overarching purpose for the QAPP. Phrase decisions in terms of "...if...then..." type of statements.						
		Describes the data quality needed to support project decisions. Discusses the data quality indicators (DQIs) and the acceptance criteria/measurement performance criteria for each DQI, and identifies the quality control (QC) or other mechanism to be used to assess if the criteria were met.						
		Identifies how acceptance/performance criteria will be established for existing data, model calibration, validation, sensitivity and uncertainty.						
A1.8		Special Training/Certifications						
		Identifies any project personnel specialized training or certifications						
		States that the QA Officer is responsible for overseeing training.						
		Discusses how this training will be provided.						
		Indicates personnel responsible for assuring these are satisfied.						
		Identifies where this information will documented.						
A1.9		Documentation and Records						
		Identifies report format and summaries of all data report package information including model parameterization, model inputs, and model outputs.						
		Lists all other project documents, record, and electronic files that will be produced, including:						

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		Results of technical reviews, model tests, data quality assessments of output data and audits.						

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		Documentation of candidate model assessments used for model selection, including references.						
		Actual input used and databases used						
		Response actions taken during projects to correct model development of implementation problems.						
		Pre and post software development						
		Spreadsheet data files containing monitoring data						
		Copy of the modeling reports						
		Identifies where project information should be kept and for how long.						
		Discusses back up plans for records stored electronically.						
		States how individuals identified in A1.4 will receive the most current copy of the approved QA Project Plan, identifying the responsible individuals.						
B2.0		Data Generation and Acquisition						
B2.1		Data Acquisition Requirements (Non-Direct Measurements)						
		Identifies the range of data sources, for example, computer databases or literature files, or models that may be accessed and used.						
		Describes the intended use of this information and the rationale for their selection, i.e., its relevance to the QAPP objectives.						
		Indicates how the acceptance criteria for data sources and/or models will be established. Criteria are related to model performance.						
		Identifies key resources/support facilities needed.						
		Identifies any types of data needed (for project implementation or decision making) that are obtained from non-direct measurement sources such as existing data from another project, photographs and maps, literature files, and historical databases.						
		Identifies procedures to ensure data are not outdated, consistency in excluding data and documentation of data exclusions.						
B2.2		Data Management						
		Describes how data will be managed, tracing the path of data generation in the field or laboratory to final use or storage.						

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		Describes or references the standard record-keeping procedures, and discusses the approach to be used for data storage and retrieval of electronic media.						
		Discusses the plan for detecting and correcting errors from conversion of data, as well as for preventing loss of data during reduction, reporting, and entry to forms, reports, and databases.						
		Identifies and describes all data handling equipment and procedures to process, compile, analyze and interpret the model data, including any required computer hardware and software. Addresses any specific performance requirements and describes the procedures that will be followed to demonstrate acceptability of the hardware/software configuration required.						
		Identifies who in the organization is responsible for each data management task.						
C3.0	Assessment/Oversight and Response Actions							
		Describes the assessments to be performed during projects to ensure activities are being conducted as planned. States the frequency and purpose of assessments, along with the success/acceptance criteria for assessments. Lists the approximate schedule of activities, and identifies potential organizations and participants.						
		Defines the scope of authority of the assessors, including stop work orders. Discusses how response actions to non-conforming conditions shall be addressed and by whom. Defines the conditions under which the assessors are authorized to act.						
		Indicates that a summary of any assessments will be included in the modeling report and in a modeling journal.						
		Describes how and to whom the results of the assessments shall be reported.						
		Provides examples of any forms or checklists to be used to document assessment and response/corrective action activities in an appendix/attachment.						

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C4.0 Model Development or Modification								
C4.1		Applicability: 1). Many existing model frameworks in the public domain can be used in environmental assessments. When this is the case, the requirements in this section do not apply to QA plans. 2). Sometimes no model frameworks are appropriate to the task, and it is necessary to develop a new model framework or to modify an existing framework to include the additional capabilities needed to address the project needs. When this is the case, the requirements of this section apply to QA plans.						
C4.2		Requirements For Model Development or Modification						
		Specify the environmental problem (or set of issues) the model is intended to address and develop the conceptual model.						
		Develop the model framework (develop the mathematical model)						
		Evaluate the model to develop the application tool						
		Development and intended application of the software product;						
		Specification of the scientific theories that form the basis for model(s)						
		Software to be used in its development;						
		Most important functions that the software product must address;						
		Computer hardware and software operating system requirements;						
		Quantitative or qualitative quality objectives for the software product;						
		Evaluation of each component model and all integrated models;						
		Documentation stating why and how the model can and will be used;						
		Objectives for uncertainty analysis either qualitatively/quantitatively						
C4.2.1		Evaluation of the Model Framework						
		Soundness of the underlying science (peer-reviewed theory/equations)						

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		Appropriateness of model complexity for the problem at hand;						
		Data quality and quantity objectives to support the choice of model;						
		Consistency of model structure with all inputs of the conceptual model						
		Identification of the model code and code verification, if completed;						
		Implementation process for the software and development standards;						
		Internal quality checks applied during the development process;						
		Procedures for controlling, documenting, and archiving, all significant changes to the software and hardware;						
		Testing strategies including individual module tests, integration tests, systems testing, acceptance testing, and beta testing, as applicable. The procedure for each test shall be provided and the process of confirming the test results included. That is, evaluation criteria are to be identified during the initial stages of model development;						
		Requirements for project documentation (e.g., design document, source code, and user guide);						
		Expected maintenance and user support needed by the software product.						
		Application of scientific hypothesis testing (Platt 1964) using an iterative approach (Hilborn and Mangel 1997). When evaluating multiple model frameworks, statistical comparison of the performance of these competing models with observational, field, or laboratory data.						
C5.0		Requirements For Lifecycle Model Evaluation						
		Identification of the mathematical algorithms and approaches to be used in executing the model computations;						
		Appropriateness of input data (specify the availability and quality of monitoring and laboratory data to be used for both developing model input parameters and assessing model results);						

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		Appropriateness of boundary condition specifications;						
		Assumptions and limitations and affect on model applicability, if any;						
		Applicability and appropriateness of selected parameter values;						
		Documentation and justification for adjusting model inputs to improve model performance (calibration, where applicable);						
		Model application with respect to the range of its validity;						
		Quality assurance and quality control (QA/QC) activities involving planning, implementation, documentation, assessment, reporting, and improvement to ensure that a model and its components are of the type needed for its task and that they will meet all required performance standards; and						
		Requirements for documenting the model evaluation that allows individuals and groups outside modeling activities to comprehend either the processes followed in evaluation or the essential workings of the model and its outputs.						
C6.0		Model Application						
C6.1		Model Parameterization (Calibration)						
		Describes the range of calibration performance measures that will be applied.						
		Identifies critical activities and methods for model calibration.						
		Describes how criteria will be established to stop calibration.						
		Describes activities for parameter estimation and criteria for defaulting to non site-specific data.						
		Describes how parameters for calibration will be selected and how parameters kept constant will be determined.						
		Identifies how statistically important parameters will be determined.						
		Describes how calibration uncertainty and soundness will be determined and how they will relate to calibration performance goals.						

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		Identifies activities and methods for sensitivity analyses.						
		Identifies how records of calibration/validation will be maintained.						
		Identifies how deficiencies should be resolved and documented.						
C6.2		Model Corroboration (Validation and Simulation)						
		Describes the activities and (qualitative and quantitative (statistical) methods to be used for model corroboration (validation).						
		Describes how model corroboration performance measures will be established.						
		Describes how the validation uncertainty and soundness will be determined.						
		Describes how the simulation uncertainty and soundness will be determined.						
		Describes the use of independent data sets for model parameterization and corroboration.						
		Discusses how issues shall be resolved and identifies the authorities for resolving such issues.						
		Provides examples of any forms or checklists to be used in an appendix/attachment. All associated criteria identified in the documentation should be consistent with and/or supportive of the model quality objectives and model performance criteria.						
C6.3		Reconciliation with User Requirements						
		Describes how sample results (which have already been reviewed, verified, and validated/evaluated) will be reconciled with the project objectives and measurement performance criteria/acceptance criteria.						
		Outlines the proposed methods to analyze modeling results and determine possible anomalies or limitations on the use for the intended purposes and how departures from assumptions established in the planning phase of the modeling process will be assessed.						
		Describes how anomalies will be resolved, and discusses how limitations on the use of the data from anomalies and departures from assumptions will be reported to decision makers.						

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C7.0		Reports to Management						
		Identifies the frequency and distribution of reports issued to inform management of the status of the project, results of performance evaluations and systems assessments, results of data quality and modeling evaluations, and any significant quality assurance problems and recommended solutions.						
		Identifies the preparer and the recipients of the reports, and any specific actions management is expected to take as a result of the reports.						
C7.1		Reports						
		Describe the content of the report(s) as including each of the following from sections 7.1.1 through 7.1.4 below.						
C7.1.1		Model Development or Modification						
		Specification of environmental problem;						
		Description of mathematical model;						
		Software performance against any quantitative or qualitative objectives;						
		Assessment of each model component and integrated models, where applicable;						
		Assessment of why and how the model can be used; and						
		Performance against objectives for uncertainty analysis.						
C7.1.2		Evaluation of Newly Developed or Modified Existing Model						
		Describe the evaluation of the model framework including;						
		Soundness of the underlying science (including peer-reviewed theory and equations)						
		Appropriateness of model complexity for the problem at hand;						
		Data quality and quantity objectives to support the choice of model;						

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		Consistency of model structure with all the relevant inputs described in the conceptual model;						
		Identification of the model code and code verification, if completed;						
		Implementation process for the software product and any applicable development standards;						
		Internal quality checks applied during the development process (e.g., design and code verification, configuration control procedures, and						
		Procedures for controlling, documenting, and archiving, all significant changes to the software and hardware;						
		Testing strategies including individual module tests, integration tests, systems testing, acceptance testing, and beta testing, as applicable.						
		Design document, source code, and user guide); and						
		Expected maintenance and user support needed by the software product.						
D7.1.3		Model Application						
		Introduction and Background						
		Purpose of Modeling/Modeling Objectives						
		Scope and Approach for Each Model Used (including):						
		Physical Setting (and Hydrology, if applicable)						
		Observational Data Used to Support Modeling						
		Quantity of Acquired Data (and references to data quantity reports)						
		Achievement in Meeting Acceptance Criteria						
		References to Monitoring Data						
		Discussion on Excluded Data and Basis for Exclusion						
		Description of Model(s) (including):						
		Documentation of Candidate Model Assessments Used for Model Selection (includes references to successful applications).						
		Model Configuration (discusses how model was applied, including):						
		Spatial and Temporal Resolution						
		Nature of Grid, Network Design or Sub-watershed Delineation						

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		Application of Sub-models						
		Model Inflows, Loads and Forcing Functions						
		Key Assumptions (and associated limitations, if any)						
		Changes and Verification of Changes Made in Code						
		Model Parameterization (Calibration) and Corroboration (Validation) including:						
		Objectives, Activities and Methods						
		Parameter Values and Sources						
		Rational for Parameter Values in the Absence of Data						
		Model Validation Results						
		Calibration Targets						
		Measures of Calibration Performance						
		Calibration Input, Output and Results Analysis						
		Model Use Scenario Analysis and Results (should relate to purpose)						
		Output of Model Runs and Interpretation						
		Summary of Assessments and Response Actions						
		Soundness of Calibration, Validation and Simulations						
		Review of Initial Assumptions and Model Suitability Evaluation						
		Performance Against Acceptance Criteria for Calibration, Validation, Sensitivity and Uncertainty						
		Pre- and Post-Processing Software Development						
		Maps, Photographs and Drawings (if appropriate)						
		Deviations from the QAPP Including a List of Non-Applicable Reporting Elements with Explanations.						
		Conclusions and Recommendations						
		References and Appendices - NOTE: For references for this checklist, see the companion QAPP template.						
		Reviewer Name/Date:						