# Section 1 – Project Management

## 1.1 Title & Approvals

**Assessment of Tile Drainage System Impacts to Lake Champlain and Phosphorus Loads in Tile Drainage in the Jewett Brook Watershed of St. Albans Bay**

**Task 1: Literature Review of Published Research Examining Tile Drainage Systems**

2016 Tile Drainage Quality Assurance Project Plan: 15-309QAPP Version 1.0

Prepared by:

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**Approved:**

This project is funded through the Great Lakes Fishery Commission FFY16 allocation to LCBP.

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Kim Watson, RQAP-GLP, Project QA/QC Manager, Stone Environmental Date

Chris Stone, President, Stone Environmental Date

Eric Howe, Project Officer, LCBP Date

Stephanie Castle, NEIWPCC QA Manager or designee, LCBP Date

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## 1.3 Distribution List

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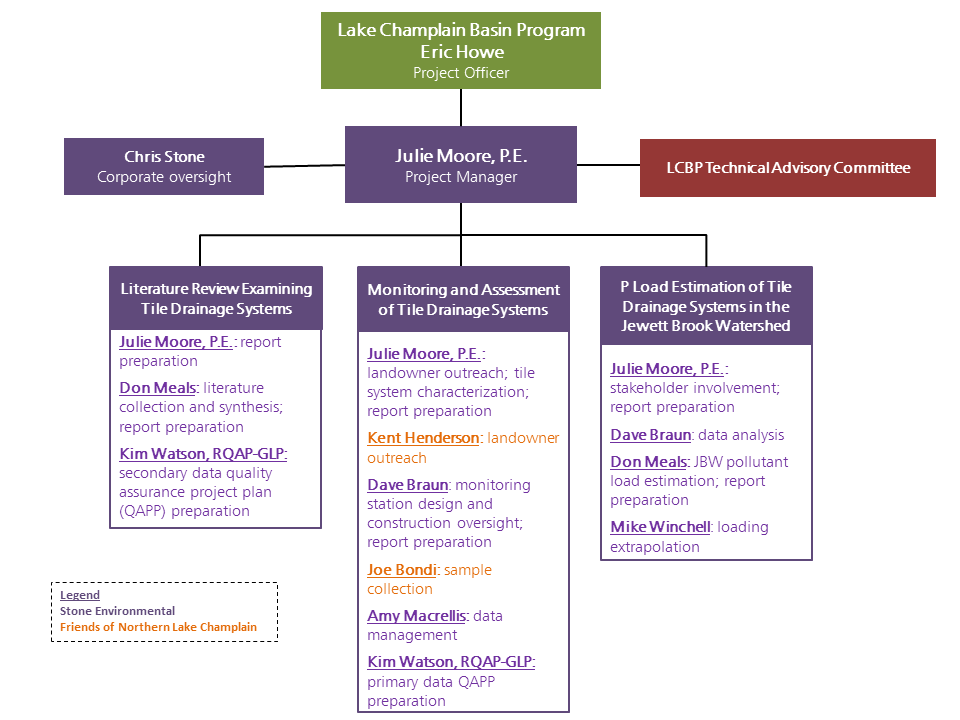
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## 1.4 Project/Task Organization

The diagram in Figure 1 below outlines the primary project participants and their roles in the project, by task. The scope of this QAPP document is limited to Task 1 (*Literature Review Examining Tile Drainage Systems*); an amendment to this QAPP for primary data collection will be prepared in support of monitoring and assessment activities defined in Task II.



**Figure 1:** Project Organizational Chart

Stone Environmental, Inc.:

Staff members from Stone Environmental, Inc. (and their authorized subcontractor) will report to the project manager for technical and administrative direction. Each staff member has responsibility for performance of assigned quality control duties in the course of accomplishing identified sub-tasks. The quality control duties include: completing the assigned task on or before schedule and in a quality manner in accordance with established procedures,documenting andascertaining that the work performed is technically correct and meets all aspects of the QAPP. An amendment to this QAPP for primary data collection will be prepared in support of monitoring and assessment activities.

**Table 1**: Roles and Responsibilities

| **Individual(s) assigned** | **Responsible for:** | **Authorized to:** |
| --- | --- | --- |
| **Stone Environmental** |  |  |
| Julie Moore, PE | Project manager, overall study design, landowner outreach, primary contact with the Lake Champlain Basin Program. | Coordinate all aspects of project operations  Document and approve all major project changes  Manage personnel schedules and assign duties  Approve overall study design  Conduct site evaluation and characterization activities  Interim/Final Report preparation |
| David Braun | Monitoring station design, construction oversight, non-routine maintenance, data management | Develop and approve final station designs  Supervise station construction  Repair damage/breakdown in field stations  Calibrate and maintain monitoring equipment  Collect, handle, and ship water samples  Conduct routine operation and maintenance of field stations  Perform data QA and reduction  Interim/Final Report preparation |
| Don Meals | Literature review, statistical analysis of monitoring data, and interpretation of results. | Collect and synthesize relevant literature  Receive and verify collected data  Conduct statistical data analysis  Interpret project findings  Interim/Final Report preparation |
| Amy Macrellis | Database development and data management | Develop and maintain data management system  Provide data reports and outputs |
| Mike Winchell | Load extrapolation | Evaluate and apply most-suitable approach for developing load estimates |
| Kim Watson, RQAP-GLP | Quality review, maintaining the approved QAPP | Evaluate all aspects of project operations for compliance with approved QAPP  Resolve QA/QC issues |

|  |  |  |
| --- | --- | --- |
| **Subcontractors** |  |  |
| Kent Henderson, Friends of Northern Lake Champlain | Landowner outreach, sample collection | Collect project-related data from participating landowners  Collect, handle, and ship water samples  Conduct routine operation and maintenance of field stations |
| Joe Bondi, Friends of Northern Lake Champlain | Sample collection | Collect, handle, and ship water samples  Conduct routine operation and maintenance of field stations |

# Section 2. Project Definition, Objectives, Organization, Approach

## 2.1 Problem Definition/Background

Subsurface drainage is an essential agronomic practice on many agricultural fields in the Lake Champlain Basin (LCB), allowing timely equipment access, reduced soil compaction and increased crop yields in fields otherwise too wet to efficiently farm. The combined effects of drawing down the water table and providing rapid conveyance of subsurface water to an outlet can significantly change the hydrologic behavior of a field, generally reducing surface runoff by enhancing infiltration and ground water transmission. Until recently, it was widely believed that, despite hydrologic changes caused by implementation of subsurface drainage, phosphorus (P) losses from agricultural lands occurred primarily via surface runoff and that very little P was lost through subsurface drainage such that tiling a field could reasonably be expected to reduce P losses.

Recent research has revealed that subsurface drainage systems in agricultural fields can discharge significant quantities of P under a wide range of soil characteristics and management practices and should be considered in management strategies seeking to minimize nonpoint source pollution of surface waters.

In Vermont and across the LCB, little is known about the extent of tile drainage systems, and the potential impacts of tile drainage systems on water quality have not been assessed. To address this knowledge gap, the Project Team will review and synthesize published research documenting P loading impacts of tile drainage systems that can be related to conditions commonly found in the LCB, monitor representative tile drainage systems in the Jewett Brook watershed (JBW), estimate P loading to Jewett Brook from these tile systems, and to assess the significance of this loading to the overall P export from the JBW and similar areas of the LCB.

This secondary data QAPP applies to the literature review component of the project (Task 1); monitoring and other data-gathering activities will be covered by an amendment to this QAPP for the primary data collection activities.

## 2.2 Project/Task Description

The objective of this task (Task 1: *Literature Review of Published Research Examining Tile Drainage Systems*, as described in the approved project Work Plan) is to synthesize the current state of knowledge of P loading from tile drainage systems from published scientific literature and expert knowledge within the Lake Champlain Region.

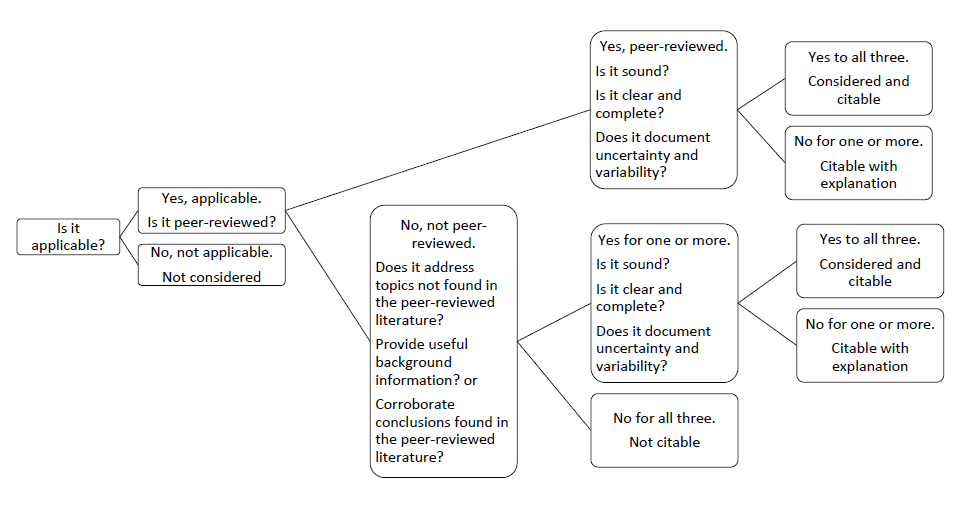
The Project Team will identify existing literature and data using a variety of methods, including:

* Search of online scientific databases including but not limited to Web of Science, the National Agricultural Library (AGRICOLA), Elton B. Stephens Co. (EBSCO), and the web search engine Google Scholar;
* Search of federal, state, and stakeholder websites for recent materials (articles, technical papers, reports, and abstracts) and materials addressing topics not covered by sources listed above; and
* Sources proposed by members of the LCBP Technical Advisory Committee (TAC) and other stakeholders/experts within the LCB.

Emphasis will be on peer-reviewed articles, but data from gray literature of suitable quality (see Section 4) will be included to the extent available.

References cited within each reviewed source will be searched for additional resources. If a review article summarizes data from another study or report, the Project Team will obtain the original document so that information is collected from original sources. The search will be repeated with multiple iterations of keywords and in multiple databases until no additional references are identified.

Once the Project Team identifies a potential reference for inclusion in the literature review, they will use the decision process diagramed in Figure 2 and assess the quality of that reference according to five assessment factors recommended by the EPA’s Science Policy Council (US EPA 2003): soundness; applicability and utility; clarity and completeness; uncertainty and variability; and evaluation and review. These factors are described in more detail in Section 4. Once an article is qualified, key data from the source will be logged into a set of spreadsheets. The spreadsheets will include fields for all important aspects of the work reported, including full citation, publication date, geographic location, scale, tile drainage system characteristics (e.g., depth, spacing, age), land use, crop and crop management, precipitation and flow, manure and fertilizer applications, soil type, slope, tillage, erosion control, nutrient management, and annual P concentrations and/or loads. Where papers generate multiple cases (e.g., unique combination of study year, study site, treatment condition, and measured constituent) as individual records, each case will be reported as a separate record.



**Figure 2**. Process for literature screening and inclusion.

# Section 3. Sources of Secondary Data

## 3.1 Data Sources

The data needed for this project fall under the category of non-direct measurements and may include data from the following types of sources:

***Peer-Reviewed Literature***

* Journal publications
* Reports, white papers, fact sheets, and similar publications developed by federal and state agencies
* Reports on industry-sponsored research, including white papers, fact sheets, and similar publications
* Symposium/conference proceedings

***Non Peer-Reviewed Literature***

* Non peer-reviewed government documents
* Other types
  + Workshop or conference presentations/proceedings
  + Master’s/PhD theses (approved)
  + Reports and white papers from private companies, associations, or non-governmental organizations
  + Textbooks
  + Maps
  + Publications with unknown peer-review status

***Datasets***

* Online databases
* Unpublished government data

All data and existing literature will be evaluated using the guidelines given in Section 4 of this QAPP. It is expected that information included in the synthesis report will be drawn primarily from peer-reviewed publications. These publications will be viewed generally as containing the most reliable information, particularly if all of the criteria in Section 2 are met. High reliability will be ascribed to publications with high levels of review and evaluation and where extensive tabulation of supporting information is often available. Similarly, some agencies (e.g., EPA, USGS, etc.) are known to follow extensive quality assurance and review procedures for documents they produce.

Non peer-reviewed publications may provide useful information as long as they enhance understanding from peer-reviewed sources, or if peer-reviewed sources prove too scarce or insufficient to answer certain research questions by themselves. Because workshop and conference papers may be abbreviated, and may present works-in-progress, these are not expected to form the sole basis of conclusions presented in the report. Generally, these publications may be of most use to support results presented from peer-reviewed work, to identify promising ideas of investigation and to discuss further in-depth work needed.

Once information for this report has been collected and reviewed for adequate quality (see Section 4.1 Data Quality Requirements below), the Project Team will develop a draft narrative report and other deliverables (see Section 5). Any further data sources that become available during the course of the project will be vetted for utility for the final deliverable as well as for quality.

# Section 4. Quality of Secondary Data

## 4.1 Data Quality Requirements

Literature and data identified in the course of the search strategy above will be evaluated using the five assessment factors outlined by the Science Policy Council in *A Summary of General Assessment Factors for Evaluating the Quality of Scientific and Technical Information* (US EPA, 2003): Applicability and Utility; Evaluation and Review; Soundness; Clarity and Completeness; and Uncertainty and Variability. Those factors are defined by the following criteria:

**Table 2.** Criteria for each quality factor used for assessing data and literature.

|  |  |
| --- | --- |
| **Factor** | **Criteria** |
| Applicability | Document provides information useful for assessing the magnitude of P loading from tile drainage, agronomic or site factors influencing P loss through tile drainage, or documents the effectiveness of measures to reduce or avoid potential P losses in tile drainage.  Work and results reported are relevant to the environmental conditions found in the Champlain region (e.g., soil types, climate, and representative agronomic practices). |
| Review | Document has been peer-reviewed. |
| Soundness | Document relies on sound scientific principles and approaches, and conclusions are consistent with data presented. |
| Clarity/completeness | Document provides underlying data, assumptions, procedures, and measured parameters, as applicable, as well as information about sponsorship and author affiliations. |
| Uncertainty/variability | Document identifies uncertainties, variability, sources of error and/or bias and properly reflects them in any conclusions drawn. |

Our objective will be to include literature that conforms in full to all five criteria. However, from previous search efforts, we have learned that the preponderance of literature on some topics does not fully conform to some aspect of the outlined criteria. For instance, there are many white papers and reports in technical areas in which independent peer-review is not standard practice or is not well documented. Should non-peer reviewed references address topics not found in the peer reviewed literature, provide useful background information, or corroborate conclusions in the peer reviewed literature, we may cite them with clear explanation. The same kind of explanation will also be offered should references be cited that do not fully conform to one of the other criteria.

The process for considering literature sources for inclusion is described in the decision tree shown in Figure 2 above. Any limitations and gaps in data included in the final deliverables for this project will be fully disclosed within the report, and it will be noted that these data should be used with caution. For example, certain datasets or published research may only cover a limited window in time but still be crucial to complement or provide a perspective for other available work. Data developed from laboratory or `plot studies may be difficult to extrapolate to field or watershed scale. Even if data do not fully satisfy all the quality criteria, they may represent the best available knowledge for that particular topic and may not only provide a glimpse into current conditions, but also point to the need for improved data collection efforts to help refine recommendations of future projects.

## 4.2 Data Review and Evaluation

The quality of the secondary data will be determined according to the decision tree shown in Figure 2 and based on data quality requirements defined in Section 4.1 of this document. Unless the Project Team identifies specific issues or shortcomings in the reported work, data from peer-reviewed journal articles will be assumed to have been generated, analyzed, and reported according to acceptable quality standards. Data from non peer-reviewed sources will be evaluated according to procedures outlined above and reported with appropriate caveats.

All tables and figures created from existing literature and data sources will undergo an appropriate review process to ensure that the data were correctly transcribed. This process will include checking the created tables and figures against the original sources. The report text associated with the selected citations will be checked against the original sources to ensure that the report text accurately reflects the information in the original source. Electronic copies of all sources used in the literature will be included in project deliverables (see Section 5.3).

## 4.3 Disclaimers

References and data sources that do not strictly meet the criteria listed in Section 4.1 may still be included in the synthesis report at the discretion of the Project Team, particularly with respect to data that have not undergone external peer review (e.g., data collected by states or industry). The literature review leader is responsible for deciding to include these data, documenting the rationale for inclusion and providing all available background information on these data in order to place these results in the appropriate context.

As stated previously, any limitations in data quality will be fully disclosed with the final report deliverables. If a decision is made to use data of unknown quality, this will be indicated in a disclaimer that will be added to any project deliverable. The disclaimer will read: “These data are of unknown quality and presented here for illustrative purposes only. No inferences regarding the impacts of tile drainage on water quality in the Lake Champlain Basin should be made based on these data until their quality can be determined.”

# Section 5. Data Reporting, Data Reduction, Data Validation, and Records Management

## 5.1 Documentation of Data Sources and Records

All published research accessed for this project to inform the final deliverables developed for this project will be considered for data quality as described in Section 4.1 and documented in the final report if used. More detailed information about the data source and interpretation methods will be documented by the Project Team and available upon request, as noted in Section 5.4.

## 5.2 Data Validation

The reporting of accurate project data will generally be ensured by carefully conducting and clearly expressing data reduction (if and when needed) and visual inspection of data before synthesizing for the final report. Specifically:

* A copy of every original source will be saved in a separate folder where it will not be edited in the event the integrity of the working datasets is compromised.
* Working data will be stored in spreadsheet format and will include all relevant raw data.
* Data manipulation will be minimized to decrease the chances of inadvertently introducing errors; such manipulations will be limited to unit conversion, summation of intermediate values (e.g., seasonal) to annual values, and the like. In rare cases, it may be necessary to visually interpret numerical values from graphs if the data are not reported in tabular form. Any such manipulations will be documented and checked by a member of the Project Team who did not perform the original manipulation. All formulas, along with units and conversion factors, will be shown in the spreadsheet; in addition, the formulas will be visible in each cell containing the reduced values.
* Transcribed data, calculations, tables and figures will be checked in accordance with Stone’s standard operating procedure; SEI-4.14.2 Quality Control Check On Transcribed Data, Data Calculations, Figures, And Tables.

In-house documentation of assembled datasets will be reviewed to verify references to the use and limitations of the data.

## 5.3 Deliverables

Stone will develop and submit a narrative report for LCBP review summarizing all information obtained through the literature review, including an executive summary suitable for wide distribution beyond the scientific community. The deliverables for this project will include:

* The narrative report and executive summary with complete list of references;
* Spreadsheets summarizing detailed information from each literature source; and
* Electronic copies of all sources cited.

## 5.4 Records Management

Secondary data and publications collected by Project Team used in the final deliverables for this project will be stored on the Stone server in Montpelier, VT. Techniques used to interpret and display data in the report will also be documented by the Project Team and stored on the server and available to the public upon inquiry. All data published in the final project deliverables will be cited to its original source in the final publication. The data will be provided to the LCBP.

Quarterly reports will be submitted to LCBP, per the standard LCBP reporting process for review and approval. Relevant LCBP advisory committees, notably the Technical Advisory Committee, will be presented with the final report deliverables and a summary of any QA/QC actions taken before providing final approval to the report.

# Section 6. References

U.S. Environmental Protection Agency. 2003. A Summary of General Assessment Factors for Evaluating the Quality of Scientific and Technical Information. Washington, DC: Office of Research and Development, Science Policy Council; Report No. EPA/100/B-03/001.