QUALITY ASSURANCE PROJECT PLAN FOR:

MARE BROOK FLUVIAL GEOMORPHIC ASSESSMENT IN BRUNSWICK, MAINE

May 2, 2020

Prepared for:
Maine Department of Environmental Protection

Prepared by:
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On behalf of:
Town of Brunswick
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Group A: Project Management Elements

A1 – Title and Approval Sheet

Mare Brook Fluvial Geomorphic Assessment in Brunswick, Maine
Quality Assurance Project Plan

5/21/20

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Susanne Meidel 5/21/20

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John Field DATE
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PROJECT GEOMORPHOLOGIST

A2 – Table of Contents

Appendix

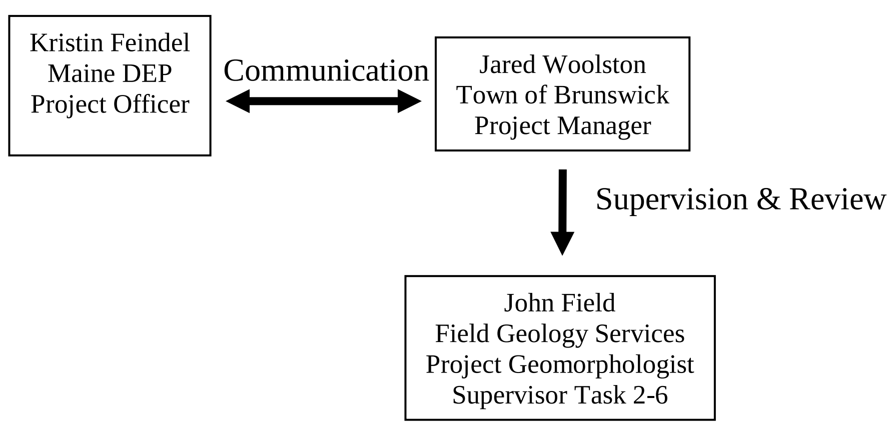
A3 – Distribution List

Dr. John Field will distribute this Quality Assurance Project Plan (QAPP) to the following persons:

Name	Organization
Kristin Feindel	Maine Department of Environmental Protection
Jared Woolston	Town of Brunswick
Bill Longfellow	Maine Department of Environmental Protection
Jeff Dennis	Maine Department of Environmental Protection
Susanne Meidel	Maine Department of Environmental Protection

A4 – Project/Task Organization

The chart below illustrates the organizational structure for the project. Kristin Feindel from Maine DEP will serve as the Project Officer and will communicate periodically on project progress and address policy questions with Jared Woolston from the Town of Brunswick who will serve as Project Manager. Mr. Woolston will supervise and review the technical work completed by John Field of Field Geology Services who will serve as Project Geomorphologist.

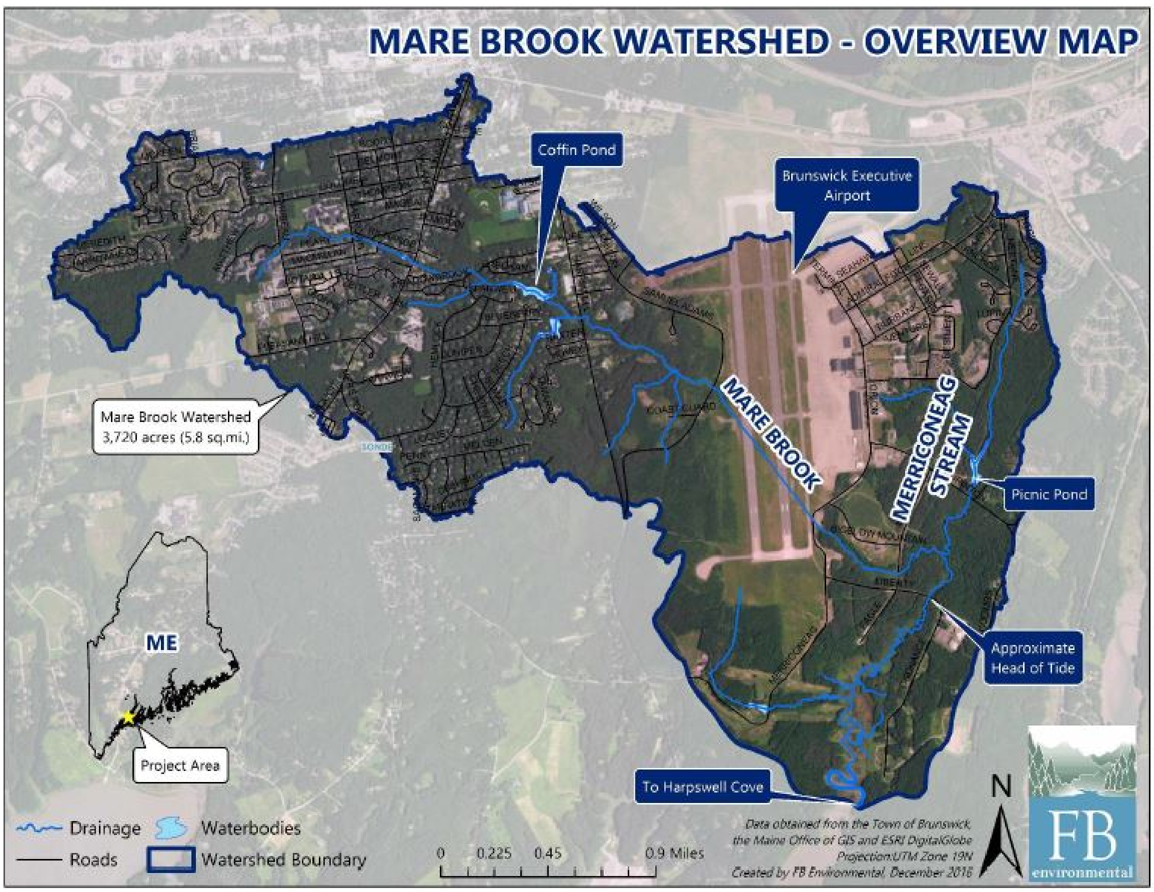


A5 - Problem Identification/Background

The Mare Brook Watershed is located in Brunswick, Maine, and has a drainage area of approximately 3,720 acres; the stream is approximately 3.9 mi long from upstream of Baribeau Drive downstream to Liberty Crossing where the brook becomes tidally influenced. Mare Brook has a statutory state water quality classification designation of Class B (MDEP, 2012). According to the Integrated Water Quality Monitoring and

Assessment Report Mare Brook does not meet Class B designated uses and criteria. Specifically, Mare Brook is listed on the 303(d) list of impaired waters for not providing for aquatic life use due to benthic macroinvertebrate non-attainment (MDEP, 2016, p. 93). According to the Maine DEP, the largest likely source contributing to the impairment is stormwater runoff from impervious cover. The watershed of Mare Brook is estimated to have an impervious cover area of 21 percent (MDEP, 2012).

The the main stem of Mare Brook begins west of Baribeau Drive and generally flows in a southeasterly direction, passing through Brunswick Landing (former Naval Air Station), before turning in a southwesterly direction at the confluence with Merriconeag Stream, Mare Stream's largest tributary, and ultimately emptying into Harpswell Cove (see map below). Unlike typical urban-impaired streams, Mare Brook has large areas of highly buffered shoreline and the watershed contains 38.7 percent forest and wetland complexes (FBE, 2016). However, the remaining 61 percent of land is urban and has led to alteration of the stream and degradation to habitat and water quality. Most of the impervious cover is concentrated along the Brunswick Executive Airport runway and associated redevelopment east of the runway. In addition, significant residential development borders the stream in the upper (western) watershed.



The primary purpose of the geomorphic assessment is to assist in determining if the stream is stable for the biological community. The assessment will identify locations that are experiencing adverse hydrologic impacts from surrounding land uses or stream alterations, keeping in mind both stream dynamics and habitat considerations.

A6 – Project/Task Description

The goal of the project is to employ fluvial geomorphological methodologies to identify and quantify changes in the stream channel and provide insight into the effects of current and future stormwater management practices on the stream's habitat.

The geomorphic assessment objectives will be achieved by collecting data on geomorphological parameters along Mare Brook and adjacent riparian corridor. A listing of all 5 technical tasks included in this project is presented below while further details are presented below in the Sampling Process Design section (Section B1) and Analytical Methods Requirements (B4). All tasks will be completed by Dr. John Field of Field Geology Services in Portland, Maine. Task 1 (QAPP preparation) is not discussed further in the Quality Assurance Project Plan. An assessment report will also be completed.

Task 2. Background review and historic assessment
Task 3. Reach delineation
Task 4. Rapid geomorphic assessment
Task 5. Topographic surveying and substrate particle size analysis
Task 6. Establish long-term monitoring program

Schedule:

May 2020

- Prepare QAPP

May 2020

- Reach delineation
- Rapid geomorphic assessment

June 2020

- Topographic surveying

July 2020

- Final report preparation with recommendations for long-term monitoring

A7 – Data Quality Objectives for Measurement Data

As with any study, collecting high quality data is of prime importance for this project. However, because of budget and logistical constraints, this primary concern must be balanced with the requirement to conduct a comprehensive study of geomorphological parameters largely within but also partly adjacent to the study stream. The specific data quality objectives of this study as discussed below include precision and accuracy, representativeness, comparability, and completeness.

<u>Precision and Accuracy</u>

The precision and accuracy levels achieved will be determined by the instrumentation used. For the reach delineation (Task 3), this will be based on the accuracy of the Trimble Yuma tablet computer loaded with ArcPad software to be used following procedures outlined in the owner's manual. For the topographic surveying (Task 5), this will be based on the accuracy of the Sokkia Set 5 electronic total station to be used following procedures outlined in the user manual (Web citation 1). The accuracy of measurements taken from historical topographic maps and aerial photographs (Task 2) will be dependent on the resolution of the maps and photographs available. The final report will include a discussion of the limitations on data interpretation based upon precision and accuracy estimates gathered during the study.

<u>Representativeness</u>

This study will collect data that are representative of the conditions on the brook. Reaches chosen for topographic surveying will be representative of other like reaches along the brook. The range of study sites chosen for survey will, therefore, be representative of the range of conditions present along the brook. However, storms can alter channel morphology in a single day, so the conditions assessed and surveyed will not necessarily be permanent.

<u>Completeness</u>

Budget and logistical constraints will limit the number and types of detailed studies to be completed. A rapid geomorphic assessment will be completed on all identified reaches to provide baseline data on the morphological character of each reach. Similar reaches will be identified such that detailed information from topographic surveying noted in one reach may be used to more completely understand the morphological condition of other like reaches.

<u>Comparability</u>

To ensure comparability among the data from this study and those from other studies, this study will employ the Vermont Geomorphic Assessment Protocols (Web citation 2) and a rapid geomorphic assessment tool developed by the Maine Department of Inland Fisheries and Wildlife (Web citation 3 and Appendix A); both of these methods have been used in previous projects completed by Field Geology Services within Maine, and widely throughout the state.

A8 –Training Requirements/Certification

Dr. John Field, President of Field Geology Services, is overseeing all tasks related to this project. Dr. Field earned a PhD from the University of Arizona in Geosciences with a specialty in fluvial geomorphology and hydrology. As such, he has sufficient expertise to carry out the work tasks included in this project. Dr. Field has completed similar assessments in other watersheds in Maine over the past several years, ensuring familiarity with natural conditions in the northeastern United States.

A9 – Documentation and Records

The QAPP for this project was written by John Field, with revisions by the Town of Brunswick, and will be sent to Maine DEP for review. The most up-to-date version of this QAPP will be available through either the project manager, Jared Woolston (Town of Brunswick), or the project officer, Kristin Feindel (Maine DEP) and will be retained by John Field for a period of at least five (5) years.

All rapid geomorphic assessment data collected for this project will be recorded on the appropriate field sheet (Appendix A) at the time of data collection. These sheets will be stored in a file folder dedicated to this project; this folder will be kept at John Field's home office. Survey data collected as part of this project will be stored internally within the electronic total station in the field and immediately downloaded to a computer upon return to the office. A backup of the electronic files will be stored on an external hard drive and retained by John Field. Field Geology Services will retain for a minimum of five (5) years all raw data (from field sheets or electronic equipment) collected in the course of the work.

Group B: Measurement/Data Acquisition Elements

B1 – Sampling Process Design

The process by which data will be collected, and the reasoning for collecting such data, for each technical work task associated with this project is described below. The Standard Operating Procedure to be employed in completing the assessment tasks is provided as Appendix A.

<u>Work Task 2</u>. Field Geology Services will review and incorporate current and historic topographic and aerial photo data into the decision-making process. Aerial photographs will include both historical and the newest available versions available online. Approximate dates for online historical photographs should be from the 1990s and possibly earlier, however this will depend on availability of material. Photographs should have acceptable resolution, scale, and temporal relationships with known large floods or significant land use/land cover changes. The channel position for the length of the brook will be visually compared between years and direct human interferences on stream channel position and sinuosity noted.

Work Task 3. Since different portions of a stream can respond differently to the same natural and human influences, one of the first assessment tasks will be to subdivide the brook into distinct reaches of varying length. Within a given reach, the stream is likely to respond similarly to changing watershed conditions, while adjacent reaches may respond differently. Reaches that share similar traits are referred to as "like-reaches" and an understanding of channel response or effective restoration techniques gained in one reach may apply to other "like-reaches". The break points between different reaches for the assessment will be delineated at: a) large tributary confluences (or sites of major stormwater inputs, b) grade controls (e.g., ledge across the channel, culverts), c) abrupt changes in channel slope or valley confinement, and d) significant human impacts (e.g., channel straightening, floodplain constriction). The procedures used to delineate reaches for the assessment largely follow those detailed in Vermont Geomorphic Assessment Protocols; more information is provided in Appendix A.

Work Task 4. Rapid Geomorphic Assessment data sheets developed by the Maine Department of Inland Fisheries and Wildlife (Appendix A) will be completed for each delineated reach of the brook to characterize changes along the brook and identify the types of instability along the brook (e.g., channel incision, aggradation, lateral migration). The Rapid Geomorphic Assessment form has been widely used throughout Maine and is included as part of the Standard Operating Procedure[1](Appendix A).

Work Task 5. A detailed assessment of three reaches will be completed using topographic surveying to determine channel dimensions. Within each reach the survey will include at least three topographic cross sections, a longitudinal profile, and a planview detailing the position of the bank line and other features such as sand/gravel bars. The detailed assessment will include a substrate particle size analysis using standard pebble count procedures. Details on the procedures and forms to be used in the topographic surveying and substrate particle size analyses are included as part of the Standard Operating Procedure (Appendix A).

Work Task 6. The rapid geomorphic assessment data, historical aerial photographs and maps, and the topographic surveying and substrate particle size analysis data will be analyzed to determine impacts of human activities on channel conditions. Maps and tables will be developed to illustrate these changes and recommendations provided on long-term monitoring of future changes. All cross sections completed during the topographic surveying will be monumented and the GPS coordinates of all cross section end points recorded so the cross sections can be resurveyed as part of future monitoring. An initial round of oriented ground photographs will also be taken at the survey sites to serve as baseline data for the long-term monitoring program. The analysis will also develop an assessment report detailing: 1) what and how long the natural process of channel evolution will be in the absence of restoration; 2) how proposed restoration design will bring the stream system back into equilibrium with expected future watershed conditions; and 3) the potential impacts of the proposed restoration design ideas on upstream and downstream reaches. The final report will also provide instructions and procedures for continuing the long-term monitoring program.

[1] The Standard Operating Procedure allows for persons other than Dr. John Field to collect data. Under the Mare Brook QAPP, all work will be done by Dr. John Field.

B2 – Sampling Methods Requirements
B3 – Sampling Handling and Custody Requirements

No samples will be collected under this QAPP.

B4 – Analytical Methods Requirements

The Standard Operating Procedure to be employed in completing the assessment tasks is provided as Appendix A.

B5 – Quality Control Requirements

Geomorphological studies do not employ quality control measures like, for example, water quality studies which involve sample collection.

B6 – Instrument Testing, Inspection and Maintenance Requirements

B7 – Instrument Calibration and Frequency

The Trimble Yuma tablet computer and embedded GPS and associated ArcPad GIS software to be used in delineating reaches are updated with the latest online updates as they become available. The GPS unit is calibrated before each use by comparing recorded coordinates with known coordinates of a given point near the area of fieldwork. This calibration ensures GPS measurements are accurate and comparable from year to year.

The Sokkia Set5 electronic total station to be used in completing the topographic surveying is calibrated each year by Maine Technical Source in Yarmouth, Maine. In the field, an initial measurement is taken and corroborated with a tape measure and compass to be certain the equipment is functioning properly.

B8 – Inspection/Acceptance Requirements for Equipment

Field Geology Services will be responsible for the maintenance of equipment to be used in the completion of the work tasks.

B9 – Data Acquisition Requirements

State of Maine (Office of GIS, MEGIS) and United States Geological Survey (USGS) databases will be accessed to obtain Geographic Information System (GIS) data required to generate maps for this study. Combining multiple layers of land features (hydrography, topography, roads, etc.) with station identification will allow the production of accurate and informational maps of the study streams and their watersheds. These maps will not only be used to gather additional information but will also facilitate interpretation of study results and help readers put the data into a broader context. The quality of the map data will be assessed based on the metadata accompanying the MEGIS or USGS coverages.

B10 – Data Management

Dr. John Field will complete all work tasks to ensure comprehensive data collection and accurate data recording on the appropriate field sheets in Appendix A. If any errors or omissions are noted, every effort will be made to remedy those problems and prevent similar occurrences in the future.

All data will be entered by John Field into Excel spreadsheets or GIS database (depending on the nature of the data) developed specifically for this project as soon as possible after collection. Entering data into Excel or a GIS database will occur May-July 2020. Data will be saved on Field Geology Service's computer hard drive and backed up on an external hard drive at the end of each day. Quality control procedures for data entry include a 100% check of data entered at the time of entry and re-checking of data in hardcopy format (table, report, graph) whenever available. These quality control procedures will be carried out by Dr. Field.

Group C: Assessment/Oversight Elements

C1 – Assessments and Response Actions

Dr. John Field will ensure that each of the project tasks is completed and that their associated quality assurance and quality control (QA/QC) procedures as described above are adhered to. Dr. Field's oversight will provide consistency with data collection for each study reach. Dr. Field will report to Kristin Feindel, Maine DEP's Technical Project Officer, any problems with data collection or with QA/QC procedures as soon as possible.

C2 – Reports to Management

Dr. John Field will submit a written 'Status Report' with each invoice submitted and a final technical geomorphic assessment report at the end of the project. Problems encountered in the field will be discussed in the status reports and appropriate corrective actions will be determined and implemented. Any problems encountered will also be discussed in the final report to assist readers in the interpretation of results and its limitations based on the precision and accuracy estimates made during the study.

Group D: Data Validation and Usability

D1 – Data Review, Validation, and Verification Requirements

The project geomorphologist, Dr. John Field, will have the primary responsibility to review and, as far as possible, validate and verify all data collected in this study to determine if the data meet QAPP objectives. The decision whether to accept, reject, or qualify data will rest with Dr. Field. To allow correct interpretation of the data, all problems encountered in the field or the office will be discussed in the general text of the final geomorphic assessment report.

D2 –Validation and Verification Methods

The project geomorphologist, Dr. John Field, will be responsible for data validation and verification for all work tasks. This task requires a reconciliation of data recorded on field sheets with those entered into spreadsheets or the GIS database, a critical review of spreadsheet print-outs, graphs and tables and of maps produced from the GIS database, and the identification of any potential data gaps. Any errors detected will be rectified by either editing incorrect entries, revisiting and resurveying field sites, or excluding questionable data if not deemed critical to the final project outcome. In the final report, Dr. John Field will qualify any data that do not meet the measurement performance criteria detailed in Section A7 above, so that the reader can make an informed judgment of the results.

D3 – Reconciliation with Data Quality Objectives

Dr. John Field will be responsible for the reconciliation of all data collected in this study with original data quality objectives as detailed in Section A7 above. All data collected in this study will be reviewed on an ongoing basis for precision, accuracy, and completeness, and corrective action will be implemented if needed. If data quality indicators do not meet the specifications, data may be discarded and data collection redone. The final report will note any limitations on data due to quality issues. Furthermore, any problems encountered in the field or in the analysis phase will be discussed in the final report.

References

FB Environmental Associates (FBE). 2016. *Mare Brook Baseline & Best Management Practices Report.* https://www.brunswickme.org/DocumentCenter/View/697/Mare-Brook-Baseline-and-Best-Management-Practices-Report-PDF

Maine Department of Environmental Protection (MDEP). 2012. *Impervious Cover TMDL Report.* http://www.maine.gov/dep/water/monitoring/tmdl/2012/Appendix_17_Mere_Brook.pdf

Maine Department of Environmental Protection (MDEP). 2016. *Integrated water quality monitoring and assessment report appendices: acronyms, HUC maps, definitions, integrated lists of surface waters, and Maine's implementation of EPA's 303(d) vision.* https://www.maine.gov/dep/water/monitoring/305b/2016/28-Feb-2018_2016-ME-IntegratedRptLIST.pdf

Web citations:

Web citation 1: https://nl.sokkia.com/sites/default/files/sc_files/downloads/set5f-set5w_operators_manual.pdf (Accessed May 20, 2020)

Web citation 2: https://dec.vermont.gov/sites/dec/files/wsm/rivers/docs/rv_SGA_Phase2_Protocol.pdf (Accessed May 20, 2020)

Web citation 3: https://dep.wv.gov/WWE/getinvolved/sos/Documents/More/RGA_PictureKey(Maine).pdf (Accessed May 20, 2020)