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Quality Assurance Project Plan for TMDL Support for EPA New England : Urban Stream NPS TMDLs in Maine / Partnership for Environmental Technology Education (PETE) 2003

Maine Department of Environmental Protection

QUALITY ASSURANCE PROJECT PLAN FOR TMDL SUPPORT FOR EPA NEW ENGLAND:
Urban Stream NPS TMDLs in Maine

Partnership for Environmental Technology Education (PETE)

Prepared For: **U.S. Environmental Protection Agency, Region 1**
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Bureau of Land & Water
Division of Environmental Assessment
State House Station #17
Augusta, ME 04333

Date: 6/13/2003

A1 – Title and Approval Sheet

Urban Stream Non-Point Source Total Maximum Daily Loads in Maine
Quality Assurance Project Plan

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A3 – Distribution List

Name	Organization
Jennie Bridge	U. S. Environmental Protection Agency, Region 1
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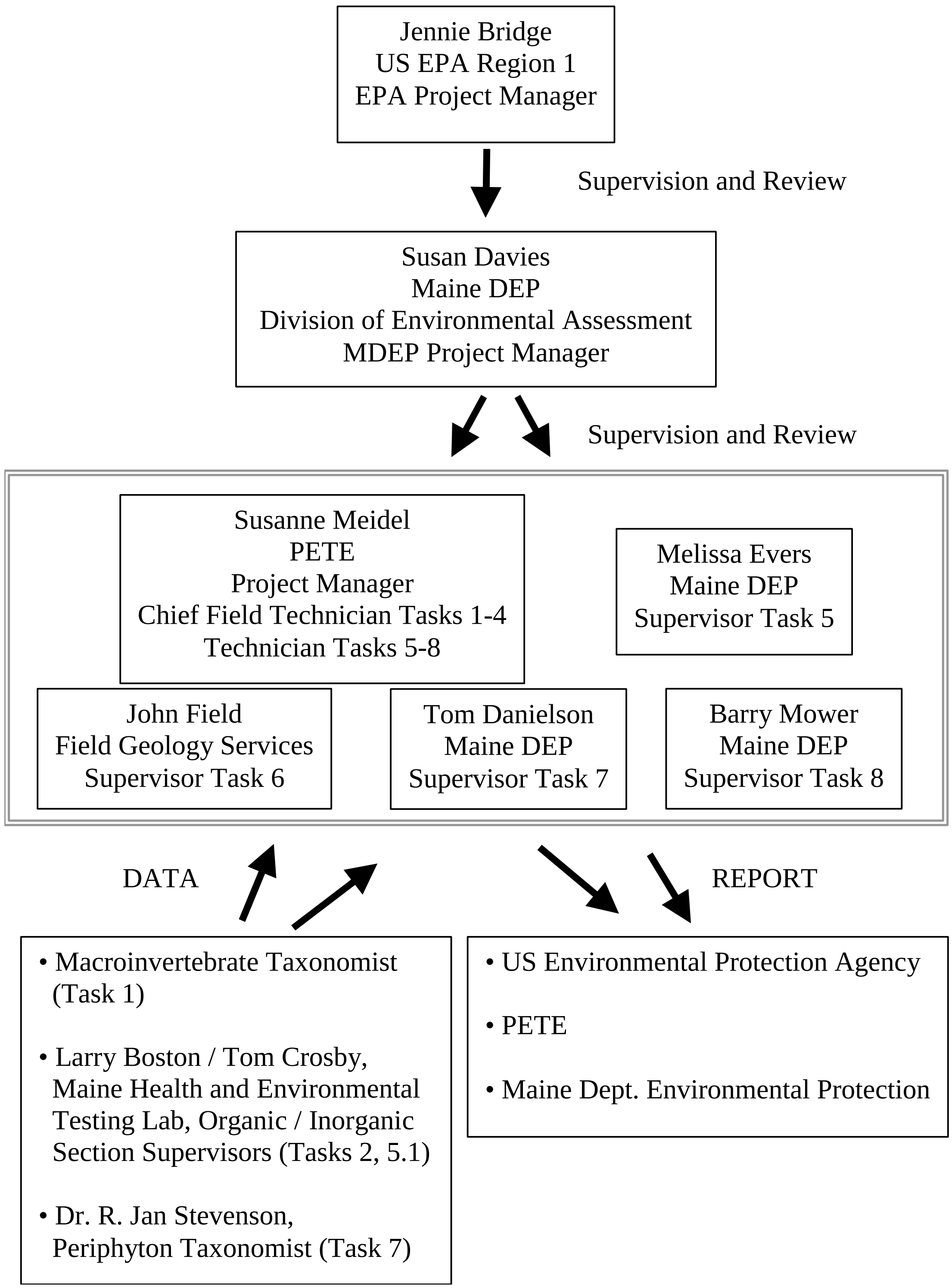
Susanne Meidel	PETE, South Portland
Susan Davies	Maine Department of Environmental Protection
Malcolm Burson	Maine Department of Environmental Protection
John Field	Field Geology Services

Other staff from Maine Department of Environmental Protection as appropriate (e.g., Melissa Evers, Tom Danielson, Barry Mower)

A4 - Project/Task Organization



A5 - Problem Identification/Background

The streams included in the Urban Streams Non-Point Source (NPS) Total Maximum Daily Load (TMDL) Project ('Urban Streams Project') are Birch Stream in Bangor, Trout Brook in Cape Elizabeth and South Portland, Barberry Creek in South Portland, and Capisic Stream in Portland. The major characteristics of the four streams are summarized in Table 1. Briefly, the streams are located in central (Birch Stream) or southern Maine (Trout Brook, Barberry Creek, Capisic Stream), and are of moderate length (<1 to 2.6 miles) and watershed size (1.4 to 2.8 square miles). All have a fairly high percentage of impervious surfaces (15 to 31 %) and are characterized by a variety of urban stressors including high density residential development, commercial development, heavy industry, and extensive transportation infrastructure (roads, railroad, airport).

The four streams were chosen for this study because existing data collected by the Maine Department of Environmental Protection (MDEP) and the University of Maine at Orono (UMO; M. Sc. study by Morse, 2001) indicated that water quality problems exist in those streams. The ecological conditions in the watersheds have likely declined during the last few decades, largely because of increasing urbanization of Bangor and Portland/South Portland. These streams thus illustrate the changes that can occur in rapidly urbanizing areas, such as can be found in several other towns in Maine, particularly in the southern, coastal part. Birch Stream in Bangor was additionally impacted during the winter 2002/2003 because of increased deicing use by the Air National Guard stationed at the Bangor International Airport. Because of limited funding, this project does not include a reference stream, although the upper reaches of Capisic Brook in Portland (station S256) are relatively undisturbed and exhibit fewer problems than the lower reach of Capisic Brook and the other three streams.

A number of specific problems have been identified within the four study streams. Based on data collected by the MDEP, Birch Stream, Trout Brook, and Capisic Stream were included in Maine's 1998 303(d) list because of aquatic life violations of State Water Quality Standards (WQSs). Barberry Creek was listed because of NPS pollution. For Maine's 2002 303(d) list, all four streams are scheduled to be listed because of aquatic life violations. Because of these violations, all streams are scheduled for TMDL development to be based on the data gathered in this study (see Section A6 - Project / Task Development). The UMO study indicated bank erosion problems and minimal riparian width (<10 m) along certain reaches of Birch Stream, Trout Brook, and Barberry Creek (no data available for Capisic Stream; Morse 2001). Existing data also suggest that potential problems exist with a number of water quality parameters (dissolved oxygen, specific conductance, total phosphorus, total nitrogen, copper) at some stations on some occasions (Table 2). These situations likely can be attributed to extensive impervious surfaces with their associated usages, such as retail and industrial complexes, roads, parking lots, airport, etc. Impervious surfaces likely impact the study streams during storm events because of expected increases in peak discharge and pollutant loads. Furthermore, extensive impervious surfaces, because of their associated usages, also likely contribute nutrients and metals to the streams even under baseflow conditions.

The objectives of this study are explained in detail in Section A6 - Project / Task Description (p. 11). Briefly, the primary objective is to provide all of the technical information required to prepare, as an extension of the Urban Streams Project, NPS TMDLs for a set of urban streams in Maine (Birch Stream, Trout Brook, Barberry Creek, Capisic Brook) and to develop stream-specific Best Management Practices (BMPs) which subsequently will be included into the TMDLs. It is also hoped that the novel, macroinvertebrate-based approach to TMDL development (for details of this approach see section A6, p. 11) used in this study will prove to be a more appropriate way than traditional TMDLs for dealing with the mostly NPS-driven impacts of urbanization on stream ecosystems. If so, this approach could improve our ability to determine and alleviate the effects of urbanization on other urban streams in Maine, and indeed nationwide.

Because of the inclusion of existing data in the Urban Stream NPS TMDL Project, some tasks have already been initiated, namely site selection as well as macroinvertebrate sampling and sampling of water chemistry; a variety of mostly physical site descriptors have also been collected. These tasks are described as Tasks 1-4 below.

Task 1. Site selection

The MDEP has established a total of seven sampling stations on the four urban streams. These stations are identified by GIS coordinates and shown in Maps i-iv of App. A. These stations were chosen based on the criteria the MDEP's biomonitoring program employs in site selection for any macroinvertebrate sampling (Davies and Tsomides, 2002; App. D i). For consistency in data collection, most of the same sampling stations will be used in the current study; however, in consultation with MDEP biomonitoring staff it was decided to make two changes to sampling locations:

a) station S454, the upstream station on Trout Brook, will be replaced with a new station ('S new') further upstream. This change was agreed upon because station S454 is considered too close to station S302 to provide significantly more information. Station S454 was originally chosen because it was assumed that the impairment to the water quality in Trout Brook occurred between S302 and S454; this assumption turned out to be incorrect. It is hoped that moving the second station on Trout Brook further upstream will help pinpoint where impairments originate.
b) the upstream station (S384) on Birch Stream in Bangor will be abandoned because a beaver dam has significantly altered the habitat at that station and effectively created an impoundment. Because Birch Stream is very short and the distance between the two existing stations small (~4/10 mile), omitting the upstream station will not cause a loss of critical data.

Morse's (2001) station on Birch Stream is identical with MDEP station S312, while his Barberry Creek station is ~0.1 miles downstream of MDEP station S387, and his Trout Brook station ~0.2 miles downstream of MDEP station S302 (App. A).

Task 2. Macroinvertebrate assessment

Macroinvertebrate data collected by the MDEP between 1995 and 2001 exist for all 7 study sites (App. A, Table 3). Sampling collection and processing methods are detailed in Davies and Tsomides (2002). Macroinvertebrate samples were sorted at the MDEP laboratory and identified by either Lotic, Inc (Unity, ME) or Freshwater Benthic Services (Petosky, MI). The MDEP analyzed taxonomic data using a statistical model which assigned samples to one of three State of Maine water quality classes (A, B, or C) or to a Non-Attainment category.

Morse (2001) also collected macroinvertebrate samples from riffle habitats at three sites using a Surber-type sampler (Table 3). Because these samples were obtained using a different method than that employed by the MDEP or in the present study, macroinvertebrate results from Morse (2001) will be used here for comparative purposes only.

Task 3. Water chemistry (baseflow conditions only)

Standard water chemistry data collected by the MDEP during rockbag deployment include daytime measurements of instantaneous temperature, dissolved oxygen (DO), specific conductance (SPC), and total dissolved solids (TDS) (Table 3). Not all information was recorded during each sampling event but at least one data point per parameter exists for each station. Morse (2201) also collected data for instantaneous temperature and DO (both pre-dawn) as well as for SPC and pH.

At four of the seven sites, the MDEP also collected nutrient (e.g., total phosphorus and nitrogen, ammonia, and dissolved organic carbon) and heavy metal data (e.g., lead, cadmium, zinc; Table 3). In addition, Morse (2001) collected nutrient data (e.g., total phosphorus, soluble reactive phosphorus) at three sites (Table 3). Sampling staff received sampling instructions from the laboratory analyzing the samples, i.e. from the State of Maine Health and Environmental Testing Laboratory (HETL) in Augusta, ME, for samples collected by the MDEP, and from the Maine Soil Testing Laboratory (UMO) for samples collected by Morse.

Task 4. Site descriptors

During each macroinvertebrate sampling event, the MDEP completed field data sheets (App. B i) detailing general (upstream land use and terrain, canopy cover) and instream (substrate, width and depth, and flow velocity) physical information (Table 3). Not all information was recorded during each sampling event but at least one data point per parameter exists for each station.

Morse (2001) carried out physical/morphological surveys at three sites using the Qualitative Habitat Index (QHI; Barbour and Stribling 1994) and the Stream Reach Inventory and Channel Stability Index (SRICSI; Pfankuch 1975) (Table 3). Metrics included evaluations of substrate availability and condition, channel and riparian condition, and extent of erosion/deposition (QHI), and metrics evaluating the channel for instability and erosion/deposition (SRISCI).

Assessment of similar urban streams

The Long Creek and Red Brook Comprehensive Watershed Assessment project ('Long Creek Project') carried out by Jeff Varricchione from the MDEP Portland office (Varricchione 2002) served to inform the Urban Streams NPS TMDLs project. The Long Creek Project collected a wide variety of data on macroinvertebrate, fish, and periphyton communities, instream and riparian conditions, and physical and chemical water parameters for Long Creek and Red Brook, two streams flowing through urbanized areas of Westbrook and South Portland, Maine. All data collected during that study were analyzed according to US EPA's Stressor Identification (SI) Guidance Document (US EPA 2000) and used to interpret the fish and macroinvertebrate data. The SI process indicated which stressors were likely impairing aquatic communities in the two watersheds and needed to be addressed with a TMDL. To date, the SI process for macroinvertebrates has been completed for two stations, and parameters that should be included in an appropriate sampling regime for the Urban Streams Project were identified (Table 4). Briefly, these parameters included various measures of habitat modification (e.g., stream sinuosity, channelization, absence of large woody debris), total suspended solids at base and stormflow, DO, and sedimentation as well as some nutrients and heavy metals.

A6 – Project/Task Description

The primary objective of this study is to provide all of the technical information required to prepare NPS TMDLs for a set of four urban streams in Maine (Birch Stream, Trout Brook, Barberry Creek, Capisic Brook). (It should be noted that the actual TMDL development is not included in the first stage of the Urban Streams Project as detailed in this QAPP.) A thorough analysis of existing and newly collected data on the ecological health of the urban streams will allow the preparation of stream-specific lists of BMPs, which will enable a novel approach to TMDL development, based on biological endpoints to ensure the aquatic community meets Maine's Water Quality Criteria. This novel approach recognizes the fact that the health of biological communities is influenced by many factors, or stressors, originating from a variety of sources that impact the communities over extended periods of time. In urbanized watersheds, stressors often are not easily measurable or quantifiable, and their effect can fluctuate widely with flow conditions. Traditional TMDLs identify individual stressors and quantify pollutant loads, which is not always an effective strategy to restore aquatic life. The TMDLs based on the data gathered during this study will ameliorate the combined effects of many urban stressors on the aquatic macroinvertebrate communities. In this way, the TMDLs will restore impaired communities (i.e., achieve the biological endpoint) and remove the four impaired streams from Maine's 303(d) list. The study team anticipates this novel approach will permit a more appropriate and promising solution to the NPS impacts of urban development on aquatic habitats. Rapid urbanization is a reality in many locations both in Maine and many other parts of the US, and the present study may play a vital role in identifying and reducing the impacts of urbanization on the country's flowing fresh-water resources.

The primary objective of the study will be achieved by collecting data on a wide variety of biological, physical, chemical, and geomorphological parameters in the study streams and their riparian corridors. An investigation of land use patterns and potential point and non-point sources of pollution will allow a comprehensive assessment of local watershed conditions. Because this is a pilot project using a biological endpoint rather than a specific pollutant level, the TMDL approach developed at a later stage of this project will evolve with the study. For further details see section B1, Task 10, below (p. 27).

To facilitate the development of the Urban Streams TMDLs based on the data gathered during this study, a separate file folder containing all information pertinent to TMDL development will be compiled by Susanne Meidel (PETE Urban Streams Project Manager) during the study period. When the study has been completed, copies of this file will be housed both at the PETE office in Portland and at the MDEP office in Augusta, along with copies of the project report, for the future reference of persons in charge of TMDL development.

Outlines of all 10 tasks included in this project are presented below while the details are presented in the Sampling Process Design section (Section B1). Tasks 1-4 and 9-10 will be carried out by Susanne Meidel, with assistance from MDEP staff where appropriate, Task 5 will be carried out by partly by Susanne Meidel and partly by a contractor under the supervision of Melissa Evers (MDEP, River and Stream TMDL section), task 6 by a contractor (Field Geology Services, Farmington, ME), task 7 by Tom Danielson (MDEP, Biomonitoring section), and task 8 by Barry Mower and field personnel (MDEP, Rivers section). A timetable for task completion is shown in the Schedule (pp. 15-16) and in Table 5.

Task 1. Macroinvertebrate sampling.

Because the TMDLs developed on the basis of this project will be predominantly aimed at restoring degraded macroinvertebrate communities, sampling this parameter is of paramount importance. Sampling for this parameter with standard MDEP rockbags (Davies and Tsomides 2002) will occur once during the summer at each station. Because rockbags will be deployed for a 28-day period, they will be exposed to the natural range of flow conditions experienced during that time.

Task 2. Water quality monitoring (baseflow conditions).

A number of standard water quality parameters (e.g., temperature, DO, SPC, TDS, and pH) will be measured on ~6 occasions from mid-spring to early fall. Diurnal DO measurements (measured at 7-8 am and 3-4 pm on the same day) will be obtained 4-5 times during the period July through September. If DO problems (i.e., concentrations <7 mg/L in Birch Stream, <5 mg/L in the other streams, as required by Maine's WQSs) become apparent, a sonde measuring DO continuously will be deployed for ~1 week at the station(s) in question. Water quality monitoring for primary and secondary metals and nutrients, toxic organics (gasoline and diesel range organics), and for bacteria and suspended solids will be performed 1-3 times during the period July through September. A continuous temperature logger will be deployed during the same period on at least one station on each stream.

Task 3. Physical site descriptors (baseflow conditions).

At the same time as the standard water quality parameters are measured, stream wetted width and depth, and instantaneous flow velocity (averaged across the stream) will also be determined. Baseflow discharge will be measured 2-3 times at four of the six stations by a contractor under the supervision of Melissa Evers. An assessment of the stream substrate, canopy cover, and upstream terrain and land use will be made once at the time of rockbag retrieval.

Task 4. Macrophyte assessment.

A qualitative assessment of the macrophyte community at the six stations will be made on 4-5 occasions during baseflow conditions between spring and fall of 2003.

Task 5. Stormflow sampling.

Stormflow measurements will be collected during at least two storms between spring and fall of 2003. Because of logistical and budget constraints this sampling category will be restricted to four of the six stations (see Table 5).

1. <u>Water quality monitoring</u>. A variety of parameters (e.g., metals, nutrients, bacteria, and suspended solids) will be sampled twice, and standard water quality parameters (see Task 2, above) will be collected whenever logistics and safety concerns allow it.
2. <u>Physical site descriptors</u>. Flow velocity (discharge) will be measured during two storms by a contractor under the supervision of Melissa Evers.

Task 6. Geomorphological Watershed Assessment.

This task is contracted out by MDEP to a professional geomorphologist (John Field of Field Geology Services, Farmington, ME) who will perform a variety of tasks on the four study streams and two reference streams (i.e., a total of 6 streams) to be identified by Mr Field. Following an initial historical analysis of conditions in the watersheds, Mr Field will direct MDEP staff to collect a range of geomorphologic data throughout the watersheds. Field Geology Services will then carry out Rapid Habitat Assessments, Rapid Geomorphic Assessments, and rapid field assessment, as well as an assessment of sediment transport dynamics. Channel energy gradients and profile characteristics will be determined, and each stream will be classified according to Rosgen (1996) and Schumm (1984). All of these tasks will aid in evaluating the past, current, and projected future conditions of the urban streams and how they are affected by urbanization. Field Geology Services will also develop restoration/enhancement designs and suggest a list of BMPs to be considered in the TMDL plan. A final report summarizing all data collected and their interpretation will be delivered to MDEP in the fall of 2003. This report also will suggest a long-term monitoring strategy to assess the effectiveness of BMPs and future impacts of continued urbanization on the urban streams.

Task 7. Periphyton Sampling.

Tom Danielson of the MDEP biomonitoring section will collect periphyton samples at one station on each stream once in July. Details of his sampling program can be found in Danielson (2003). Briefly, algal samples will be collected from natural surfaces (rocks) and/or periphytometers (glass slides in a plastic holder), and analyzed for species composition and abundance. In deviation from Danielson (2003), periphyton sampling under the Urban Streams Project will not include analysis of water chemistry or site descriptions, which are covered for this project by Tasks 2 and 3, above.

Task 8. Fish Sampling.

Barry Mower of the MDEP Rivers section will be sampling fish assemblages at one station on each stream under the Surface Water Ambient Toxics (SWAT) program. Briefly, fish will be collected by electrofishing, and samples will be analyzed for species composition, number of individuals per species, fish length and weight, and fish external appearance.

Task 9. Interim Report and Application of SI Protocol.

An interim report summarizing the data collected during this study and displaying them in various formats (text, graphs, tables, maps, photographs) will compile all information gathered during the study in an easily accessible and interpretable form. The report will be organized so as to facilitate application of the EPA SI Protocol, i.e. it will present a preliminary list of candidate causes for the observed impairments, discuss the evidence available, and bring in outside information where appropriate. The report will be distributed to MDEP staff and other appropriate persons (e.g. EPA or University of Maine staff), who will then apply the SI protocol to the Urban Stream database in a workshop organized and run by the Urban Streams Project Manager, Susanne Meidel A summary from the workshop will aid in suggesting best management practices and other remedial actions to be included in the TMDL report.

Task 10. TMDL development. (not included in the first stage of this project)

The stream-specific lists of BMPs and remedial actions developed from the SI summary (see Task 9 above) will be used to develop TMDLs with a biological endpoint. Because this represents a novel approach to TMDL development, the details of this task will evolve with this study.

Schedule:

2003

April - May

- Finalize Quality Assurance Project Plan (PP).
- Award contract for geomorphological survey. Collaborate with geomorphologist on planning watershed and instream surveys.
- Calibrate storm-flow sampling system.
- Go on initial site visit to all stations.
- Set up Urban Streams Project database.
- Collect data on standard water quality parameters and physical site descriptors (May).
- Collect first set of stormflow data.
- Order supplies, and coordinate macroinvertebrate sampling dates with MDEP biomonitoring section.

June

- Conduct watershed surveys.
- Collect data on standard water quality parameters and physical site descriptors.
- Collect electrofishing data.

July

- Deploy continuous temperature loggers at beginning of month.
- Carry out geomorphological surveys on study and reference streams.
- Collect GRO (Gasoline Range Organics) samples at Capisic Stream (S257) and Trout Brook (S302).
- Collect periphyton samples.
- Deploy macroinvertebrate samplers (rockbags) at all sites.
- Collect samples for toxics, nutrients, bacteria, and suspended solids at four stations.
- Collect data on standard water quality parameters and physical site descriptors, including diurnal DO, and macrophytes.
- Collect second set of stormflow data as required and possible.

August

- Retrieve rockbags from all sites; collect one-time physical site descriptors at that time.
- Collect samples for toxics, nutrients, bacteria, and suspended solids at all stations.
- Collect data on standard water quality parameters and physical site descriptors, including diurnal DO, and macrophytes.
- Collect second set of stormflow data as required and possible.

September

- Collect samples for toxics, nutrients, bacteria, and suspended solids at four stations.
- Collect data on standard water quality parameters and physical site descriptors, including diurnal DO, and macrophytes.
- Retrieve temperature logger at end of month.
- Conduct laboratory analyses on water chemistry samples (HETL).
- Initial processing (picking) of macroinvertebrate samples.
- Collect second set of stormflow data as required and possible.

October – December

- Collect data on standard water quality parameters, physical site descriptors, and macrophytes through October.
- Enter data that have not previously been entered into Urban Streams Project database.
- Compile data in tables and graphs, compare to previously existing data.
- Complete processing of macroinvertebrate samples and send samples out for identification (October).
- Have chemical and taxonomic analyses completed by laboratory and taxonomists.

2004

January – April

- Evaluate entire body of data, and compile in a format suitable for application of SI protocol.
- Research additional information required for SI application.

May – June

- Organize and hold SI workshop with MDEP staff.
- Develop list of stressors impairing each urban stream and their sources.
- Prepare summary document from SI workshop and have reviewed by MDEP staff.

July – August

- Develop list of Best Management Practices for each urban stream.
- Generate interim report containing all study results and recommendations for TMDL development.

A7 – Data Quality Objectives for Measurement Data

a, b) Data quality objectives and indicators.

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 a wide range of biological, chemical, physical, and geomorphological parameters largely within but also partly adjacent to the study streams. The specific data quality objectives of this study as discussed below include precision and accuracy, representativeness, comparability, and completeness.

Precision and Accuracy

The precision and accuracy levels desired for all data collected in this study are shown in Table 6. All data collected will be compared with the criteria in Table 6 and will be handled according to procedures outlined in sections D1 (Data Review, Validation, and Verification Requirements; p. 32) and D2 (Validation and Verification Methods; pp. 32-33) of this document. The interim report will include a discussion of the limitations on data interpretation based upon precision and accuracy estimates gathered during the study.

Representativeness

This study does not attempt to collect data that are representative of the conditions in the study streams year-round . Rather, data collection will occur mostly during the summer months (roughly June through September, see section A6, Schedule, pp. 15-16 and Table 5) when macroinvertebrate communities are at their most active and diverse, and when environmental conditions are at their most stressful (August and September), i.e. when low flow and high temperatures combine to stress aquatic life resources. Some standard water quality parameters and physical descriptors also will be collected in spring and fall (see section A6, Tasks 2 and 3, p. 12), and storm data will be collected anytime between April and October. The limited time period investigated in the study will be noted in data interpretation, and care will be taken to not extrapolate beyond these contexts.

The stations used in this study were chosen by the MDEP biomonitoring section in accordance with their standard methods (Davies and Tsomides 2002; App. D i). According to those methods, the stations represent a standardized habitat type (riffle), and either a worst-case-scenario water quality (for impacted waterbodies) or good water quality (for reference sites). Because of the way the study stations were chosen, they are not necessarily representative of typical conditions along the entire stream length. This limitation will be noted in discussing the study results.

Completeness

Budget and logistical constraints will limit the number of samples that can be collected and analyzed, but the large and varied body of biological, chemical, physical, and geomorphological data that will be compiled from both within and adjacent to the study streams will afford much insight into conditions affecting the study streams. This study emphasizes the assessment of various biological communities (predominantly macroinvertebrates, but also macrophytes, periphyton, and fish) because these communities reflect the effects of ecological conditions encountered year-round. In contrast, chemical, physical and geomorphological parameters assessed by means of water grab samples or through observations made on a number of occasions only provide information on conditions at a specific point in time. Therefore, the assessment of biological communities at two stations on two of the four study streams (Birch Stream and Barberry Creek have only one station each) is considered essential to the success of this study. The collection of multiple data points for standard water quality parameters and some physical site descriptors (see Section A6, Tasks 2 and 3, p. 12) is also considered essential as these parameters are expected to exert a large influence on biological communities. Sampling for some parameters (mainly toxics and nutrients) whose analysis is cost-intensive will be carried out at reduced intensities in order to meet budget constraints.

Because ecological conditions often show significant interannual variation even within a given site, it is considered crucial that the entire suite of parameters to be taken into account for TMDL development is measured within the same time period (i.e., spring to fall of 2003). Reliance on data from previous years only for even some parameters would likely diminish the interpretability of the overall dataset. Rather, the availability of a complete dataset from one year combined with the existing body of data spanning multiple years and a wide range of parameters will prove invaluable for interpreting the conditions of the urban streams studied here.

<u>Comparability</u>

To ensure comparability among the data from this study and those from other studies, this study will employ generally-accepted sampling procedures (at the national or State-of-Maine level). References for the methods employed can be found in section B1 (pp. 20-27), and in Tables 6 and 7. Methods employed by contractors or MDEP staff (Evers, Danielson, Mower) are referenced in the respective SOPs (App. D) as noted in Table 7.

c) Measurement performance criteria.

Measurement quality objectives (i.e., measurement ranges, method detection limits, and reporting units) desired for this project are shown in Table 6. The goal of these objectives is to allow a better assessment of the quality of each parameter or sample that is analyzed in either the field or the laboratory.

A8 –Training Requirements/Certification

Project tasks 1-5.1 will be performed by Susanne Meidel, a biologist hired by PETE for this study. Prior to this study, Ms Meidel worked with the MDEP Biomonitoring section for 9 months, and as a research assistant at the University of Maine for two years. She has extensive experience in designing and carrying out field work, analyzing data, and preparing written and oral summaries of her work. During her work with the MDEP, she familiarized herself with the standard sampling procedures of that organization, which will also form the basis of much of the work performed in this study. Ms. Meidel will receive additional training as well as field assistance from MDEP staff from both the Biomonitoring section (for macroinvertebrate sampling and macrophyte assessment, tasks 1 and 4), and the rivers TMDL section (for stormflow sampling, task 5.1). On occasion, MDEP staff might collect data for these tasks without Susanne Meidel being present. These occasions will be very limited and the staff recruited for this purpose will have extensive experience in collecting the required data (e.g., Jeff Varricchione from the MDEP Portland office, project manager of the Long Creek/Red Brook project; Mark Whiting from the MDEP Bangor office, leader of that office's salmon program; staff from the MDEP biomonitoring or rivers TMDL section in Augusta).

Tasks 5.2-8 are not directly under Ms Meidel's supervision and training requirements for these tasks have been met as follows. The contractor for task 5.2 has previously collected the data required for this task under the supervision of Melissa Evers and will receive a technique refresher at the beginning of the field season. Field Geology Services, the contractor carrying out task 6 is a fluvial geomorphology contractor and as such has sufficient expertise to carry out the work included in this task. Part of the work included in this task will be carried out by Susanne Meidel and MDEP staff, and Field Geology Services will provide training to ensure that this part of task 6 will be completed satisfactorily. The MDEP staff carrying out tasks 7 and 8 have multiple years of experience collecting the required data and are thus fully qualified to perform those tasks. Any field personnel used for Tasks 7 and 8 will receive adequate training at the beginning of the field season.

Macroinvertebrate samples collected in this study will be identified professional freshwater taxonomists, i.e., by Lotic Inc. of Unity, ME, or Freshwater Benthic Services of Petosky, MI, depending on availability. The State of Maine HETL will perform the water chemistry analyses not measured with field meters (Table 6). Dr. R. Jan Stevenson's laboratory at Michigan State University will complete the periphyton taxonomic analyses.

A9 – Documentation and Records

The QAPP for this project was written by Susanne Meidel and will be sent to EPA (Alan Petersen) for review. The QAPP also will be reviewed by competent MDEP staff appointed by the MDEP QAPP manager, Malcolm Burson. The most up-to-date version of this QAPP will be available through either Susanne Meidel (PETE), Malcolm Burson (MDEP), or Alan Petersen (EPA).

All data collected for this project will be recorded on the appropriate field or laboratory sheet (App. B) 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 Susanne Meidel's home office. All data will be entered by Susanne Meidel into an Excel database developed specifically for this project as soon as possible after collection, or after receipt from a laboratory or taxonomist. All data variables typically collected by the MDEP biomonitoring unit (App. B i) will also be entered into MDEP's BioMe database or existing Excel spreadsheets by Susanne Meidel. Entering data into that database will occur in the fall of 2003 or whenever data are received from a laboratory or taxonomist.

Quality control procedures for data entry include checking of data entered at the time of entry, and re-checking of data in hardcopy format (table, report, graph) whenever available. The majority of these quality control procedures will be carried out by Ms Meidel but MDEP staff will check a random subset of ~10% of all data entered. All information related to data handling (i.e., collection and entry information, quality control steps) will be recorded in a Microsoft Word® file.

The laboratory analyzing water chemistry samples (HETL) will retain for a minimum of 10 years the raw data for all sample runs and related raw data obtained in the course of QA/QC procedures (e.g., results from lab duplicates, blank or spiked samples, or sterility controls). HETL will send laboratory reports and QA/QC results to Susanne Meidel as soon as they are available. Macroinvertebrate samples will be returned to MDEP after identification, and retained at MDEP for a minimum of 10 years. Periphyton samples usually are destroyed during identification and analysis. Taxonomists will send identification records to MDEP as soon as they are available; they will retain raw taxonomic data for a minimum of 5 years. Field Geology Services will retain for a minimum of 5 years all raw data (from field sheets or electronic equipment) collected in the course of the geomorphological survey, and will send data summaries (e.g., tables, graphs, maps) to Susanne Meidel when they are available. Susanne Meidel will keep originals of all field data sheets, laboratory taxonomic, or geomorphologic reports, quality control records, and miscellaneous correspondence and notes related to this study in the folder dedicated to this project. Electronic copies of these documents, if available, as well as the database developed specifically for this project will be stored on Susanne Meidel's PETE laptop and backed-up on floppy or compact disks, as appropriate, at the end of each day when a document has been altered. All these materials, whether as hardcopies or in electronic format, will be passed on to the MDEP biomonitoring section at the end of this project and will be retained there for a minimum of 10 years.

An interim data report including text, figures, tables, and appendices will be prepared as a bound report, and will also be stored in electronic form on a compact disk. All available quality control (QC) data will be included as an appendix to the report. Difficulties or problems associated with or encountered during field sampling and laboratory analyses also will be documented in the report in an appendix to improve the interpretability of the report. One copy of the interim report for general reference will be kept in the staff area of the MDEP biomonitoring section. Personal copies of the report will be available by contacting:

Susanne Meidel	<u>or</u>:	Susan Davies
Partnership for Environmental		MDEP/ BLWQ
Technology Education		DEA/Biomonitoring Section
584 Main Street		17 State House Station
South Portland, Maine 04106		Augusta, Maine 04333-0017
phone: 207/549-5716		phone: (207) 287-7778

B1 – Sampling Process Design (Experimental Design)

The sampling plan for this project is detailed in Table 5 a (for baseflow conditions) and b (for stormflow conditions), sampling and analysis details can be found in Tables 6 and 7, and station maps are shown in App. A i-iv. As indicated in the introduction (Task 1, p. 9), it was decided to abandon station S454 on Trout Brook and replace it for the purposes of this study with a new station further upstream. This new station will temporarily be called 'S new' because the biomonitoring section assigns new station numbers at the end of each sampling season, i.e. in the fall. Furthermore, the upstream station on Birch Stream in Bangor will be abandoned because a significant alteration in the habitat at that station.

Task 1. Macroinvertebrate sampling

The macroinvertebrate community will be sampled once at each station (see maps in App. A) during a 4-week period in July and August 2003. The protocol employed in collecting and processing the standard rock-bag macroinvertebrate samples is detailed in Davies and Tsomides (2002; App. D i). Briefly, at each site, three replicate rock bags will be deployed in the stream for ~28 days in riffle/runs. At the end of the colonization period, the bags will be retrieved and the contents washed into a sieve bucket. These contents will be transferred into labeled mason jars and preserved with 70% ethyl alcohol. Macroinvertebrate samples will be sorted at the MDEP laboratory and identified by freshwater taxonomists. Taxonomic data (mostly averages of 3 replicate counts, sometimes sums of replicate counts; see App. D i for details) will be analyzed using a statistical model which assigns samples to State of Maine water quality classes or to a Non-Attainment category.

All sampling locations were marked with rebar on initial site visits in April to the Portland area and in early May to Bangor so they can be used as permanent reference points for measuring standard water quality parameters (Task 2, below) and physical site descriptors (Task 3, below). At the end of the study, all remaining rebar stakes will be removed.

As all stations (except for the new station on Trout Brook) have been successfully sampled in the past, no problems are anticipated, with the possible exception of minimal water flow. If this is apparent during sampler deployment, the sampling location will be adjusted to avoid the samplers becoming exposed during the deployment period. The new station on Trout Brook is near some springs and is expected to carry water year-round.

Task 2. Water Quality Monitoring (baseflow conditions).

1. Standard water quality parameters (instantaneous DO, SPC, TDS, temperature, and pH) will be monitored at each station using field meters owned by MDEP. Detailed information on the meters and their use can be found in App. D iii. These parameters will be measured at least 6 times during the period May through October (once at the beginning of each month) but additional data points will likely be added on other occasions such as during deployment or retrieval of macroinvertebrate or periphyton samplers. All data collected will be recorded in the field on the appropriate, stream-specific 'Standard Field Data Sheet' (App. B ii a-c). Logistical constraints jeopardizing data collection may occur as the number of available meters is limited.

Every attempt will be made to coordinate meter use with other projects, or to borrow meters from other MDEP programs if necessary.

2. Diurnal DO measurements (measured at 7-8 am and 3-4 pm on the same day) will be obtained 4-5 times during the period July through September at each station. The same field meter will be used for obtaining these data as in point 1, above. Every effort will be made to collect data on both sunny and cloudy days. All data collected will be recorded in the field on the ‘Diurnal DO Field Data Sheet’ (App. B iii). If DO problems (i.e., concentrations <7 mg/L in Birch Stream or <5 mg/L in the other streams, as stipulated in Maine’s WQSs; or a diurnal range of >2.0 mg/L) become apparent, a sonde measuring DO continuously will be deployed once at the station(s) in question for an approximately one-week period. Detailed information on the sonde and its use can be found in App. D iv.
3. Water chemistry parameters will be sampled as follows: primary toxics (cadmium, copper, iron, lead and zinc) and nutrients (total Kjeldahl nitrogen, nitrate-nitrite, total phosphorus, ortho-phosphorus, chlorophyll *a*) as well as bacteria (*E. coli*) and total suspended solids be sampled three times between July and September at four of the six stations (Table 5); at the remaining two stations, these parameters will be sampled once in August. Secondary toxics (nickel, chromium) and nutrients (dissolved organic carbon) as well as chloride will be sampled once in August at all stations. Detailed information on the sampling and analysis protocols can be found in App. D xii-xxi. In addition, gasoline range organics (GRO) will be sampled once in August at two stations (Table 5), and diesel range organics (DRO) once in August at all stations. Detailed information on the sampling and analysis protocols for these two parameters can be found in Appendices D xxii and xxiii, respectively. All field sampling information regarding the water chemistry parameters will be recorded on the ‘Water Chemistry Field Data Sheet’ (App. C i). The chain-of-custody form required by the analytical laboratory is shown in App. C ii; this form will be completed upon sample delivery to the laboratory.
4. Temperature will be monitored continuously from July through September at 4-5 of the six stations (Table 5) using Optic Stowaway temperature loggers. Detailed information on the loggers and their use can be found in App. D vi.

Task 3. Physical Site Descriptors (baseflow conditions).

1. Stream width and depth will be measured at each station concurrently with standard water quality monitoring (see Task 2, above). Stream width will be measured by running a tape-measure across the stream channel and perpendicular to stream flow. Average stream width will be determined from five measurements (upstream to downstream; middle, no. 3, transect at middle rockbag location) made at 5-m intervals within the study reach. Wetted width will be measured to allow tracking of the stream width as accessible to aquatic life. Stream depth will be measured with a meter stick at three locations of the channel along the middle (no. 3) stream width transect: at 1/4, 1/2, and 3/4 the stream width distance. The average depth will be derived by dividing the total of the three measurements by 4 (to account for the zero depth on the side of the channel) (Platts et al. 1983). All data collected will be recorded in the field on the appropriate, stream-specific ‘Standard Field Data Sheet’ (App. B ii a-d).

2. Flow velocity will be measured at each station concurrently with standard water quality monitoring (see Task 2, above). These data will be obtained using a Global flow meter as detailed in App. D vii. Flow data will be recorded in the field on the appropriate, stream-specific 'Standard Field Data Sheet' (App. B ii a-d).
3. Baseflow discharge will be measured 2-3 times at four of the six stations by a contractor under the supervision of Melissa Evers. Details on the method used to obtain these measurements can be found in App. D viii.
4. Stream substrate, canopy cover, and upstream terrain and land use will be assessed once at the time of macroinvertebrate sampler retrieval. These are visual assessments of subcategories of these parameters (e.g., for canopy cover: dense, partly open, open), as noted on the field sheets used by the MDEP biomonitoring section (App. B i). To ensure consistency with previously collected data, these somewhat subjective assessments will be made by MDEP biomonitoring staff.

Task 4. Macrophyte assessment.

A qualitative assessment of the macrophyte community at the six stations will be made on 4-5 occasions during baseflow conditions between spring and fall of 2003. The assessment is modified from the 'Physical characterization/Water quality field data sheet' as found in EPA's (1999) 'Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers' and will consist of estimates of the percentages of six types of aquatic vegetation (i.e. rooted emergent/submergent, rooted/free floating, floating/attached algae) at three locations at each sampling station. A note will also be made of the dominant species present. The assessments will always be carried out at the same locations to allow an evaluation of temporal trends in macrophyte communities. These locations will be at a point ¼ of the stream-width into the stream from the left bank facing downstream at the most upstream, middle, and most downstream transects used in task 3a, above. If a location proves to be unsuitable as algal habitat during the first assessment event, the location will be shifted and the adjustment noted on the field sheet. All data collected will be recorded in the field on the appropriate, stream-specific 'Standard Field Data Sheet' (App. B ii a-d).

Task 5. Stormflow sampling.

Stormflow measurements will be collected during at least two storms between spring and fall of 2003. Which storms will be chosen is at the discretion of the personnel collecting the data; sampling decisions will be based on safety considerations and logistical feasibility. Storm sampling will target storms that cause a significant increase in discharge and will collect samples from the first flush of runoff or during the rising stage of flow (as per TMDL QAPP by Melissa Evers). Because of limited funding, it will not be possible to specifically target short vs. long-duration storms, or localized vs. widespread storms. Every effort will be made to collect all types of data for a site during the same storm event. Because of logistical and budget constraints, stormflow sampling will be restricted to four of the six stations and a subset of the parameters collected during baseflows (see Table 5).

1. <u>Water quality monitoring</u>. Primary metals and nutrients, bacteria, and total suspended solids will be sampled during two storms using a rising stage sampler as described in App. D ix. All relevant sampling information will be recorded in the field on the 'Stormflow Sampling Field Data Sheet'(App. C iii), and the Chain-of-custody form

(App. C ii) will be completed. This task will be performed by Susanne Meidel or a contractor under the supervision of Melissa Evers, depending on availability. Standard water quality parameters (see Task 2.1, above) will be collected with field meters (Table 6) whenever feasible. All data collected will be recorded in the field on the 'Storm Field Data Sheet' (App. B ii a-d).
Care will be taken to ensure that the data remain legible by either recording on waterproof paper, keeping paper records dry, or immediately transcribing the data onto dry paper in the truck.

2. <u>Physical site descriptors</u>. Flow velocity (discharge) will be measured during two storms by a contractor under the supervision of Melissa Evers. Details on the method used to obtain these measurements can be found in App. D viii. All relevant sampling information will be recorded in the field on the USGS Form 9-275-F (App. B v). No other physical site descriptors will be measured during stormflow conditions.

Task 6. Geomorphological Watershed Assessment.

This task has been contracted out to Field Geology Services in Farmington, ME, a consulting firm specializing in fluvial geomorphology. Field Geology Services under the leadership of John Field will perform a wide range of tasks in the four study watershed and two reference streams as detailed in App. E. What follows is a list with brief descriptions of the major work items included in the geomorphological watershed assessment.

1. <u>Work Item 1</u>. Work cooperatively with MDEP and project personnel to identify stream degradation, and set work priorities.
   An initial meeting will be held to schedule site visits, establish sampling needs, and discuss quality assurance/quality control issues.
2. <u>Work item 2a</u>. Review and incorporate current and historic topographic and aerial photo data into the decision-making process; identify reference streams.
   Historical aerial photographs will be used to document changes in channel morphology and position along the four urban streams, and changes in land use/land cover throughout the watersheds. Information gained from the photographs will be supplemented with information from topographical, soils and geological maps, archives, and oral histories. Two reference streams (one each in the Portland and Bangor areas) will be located and subjected to the same historical analysis of channel and land use changes.
3. <u>Work item 2b</u>. Train and direct MDEP and project staff to collect data throughout the four urban and two reference watersheds.
   Following a 1/2 day training session with John Field, MDEP and project staff will collect data characterizing the morphology of distinct stream reaches by for example assessing substrate properties, measuring cross sectional and longitudinal dimensions, as well as flow velocity, and determining entrenchment ratios. Details on the methods employed by MDEP and project staff in collecting these data are given in App. D xxiv. Data will be entered into the geomorphological morphological data recording form (App. B vi a).
4. <u>Work Item 2c</u>. Complete rapid field assessments utilizing protocols that permit a broad level assessment to determine the relative level of stability throughout the watersheds.
   The information gathered in work item 2b will be used to complete a Rapid Habitat

Assessment and a Rapid Geomorphic Assessment to establish the habitat quality and geomorphic stability of each reach. Assessment forms are shown in App. B vi b-c. Furthermore, a visual field assessment will also be completed by continuously mapping channel features onto vellum sheets overlying orthophoto quadrangles while traversing the length of all streams. All data collected will later be input into ArcView GIS to facilitate an analysis of channel instability.

5. <u>Work Item 2d</u>. Assess sediment transport dynamics to determine mode and extent of transport.
   Detailed surveys of longitudinal profiles and pebble counts at two reaches along each study and reference stream will be used to establish bankfull parameters which are required to assess sediment transport dynamics, an important factor contributing to channel stability. Details on the methods used in collecting these data are given in App. D xxiv. Longitudinal profile data will be collected using a Sokkia Set 530R Electronic Total Station, eliminating the need for data sheets; pebble count data will be recorded on the field sheet shown in App. B vi d.
6. <u>Work Item 2e</u>. Determine energy gradients and profile characteristics.
   Information gathered in work item 2d will be used to determine energy gradients and profile characteristics which are critical in estimating erosive flows and for locating potential areas of instability.
7. <u>Work item 2f</u>. Classify streams or stream reaches based on the Rosgen Classification System and the Schumm Channel Evolution Model.
   A Rosgen Level 2 geomorphic stream assessment will be conducted in conjunction with the survey described in work item 2d. All data collected will be recorded in the field on the geomorphological data recording form shown in App. B vi a. The assessment will provide information on several morphological parameters and habitat features such as width:depth ratios, bankfull width and depth, meander wavelengths, and gradient of bed features. Survey data will permit classification of each stream reach using the Rosgen Classification system (Rosgen 1996; App. B vi e), which indicates the channel's departure from equilibrium conditions and offers guidance on restoration alternatives. All stream reaches will also be classified using the Schumm Channel Evolution Model, which is a schematic/pictorial model that places the existing channel condition in a temporal context whereby future adjustments of the channel can be anticipated and appropriately managed. No data sheets are required for this assessment because it is merely qualitative, relying on best professional judgment.
8. <u>Work Item 2g</u>. Identify and monument reference reaches to be used for long-term monitoring and for the development of enhancement strategies.
   All sites and reaches used for surveys or assessment on the reference streams will be identified with rebar stakes and photographs. Survey locations on the urban streams will be similarly identified. A long-term monitoring strategy on the reference streams will be aimed at analyzing channel migration rates, aggradation and degradation rates, changes in step-pool or pool-riffle spacing, channel evolution, and changes in substrate embeddedness.
9. <u>Work Item 3</u>. Estimate critical erosive flows for each reach to guide future stormwater management decisions and BMPs.
   Information gathered in work items 2b-e will be used to estimate critical erosive flows which will guide future stormwater management decisions and BMPs.

10. Work Item 4. Develop preliminary narrative and graphic conceptual restoration/ enhancement designs that will include alternatives for the restoration/enhancement strategy.
    Information gathered in work items 2a-g will aid in prioritizing sites and developing an enhancement plan for four the urban streams. The actual designs of restoration/ enhancement strategies proposed for individual reaches will vary depending on the disturbance condition and the needs of MDEP.
11. Work Item 5. Develop a monitoring protocol to determine future rates of change within the study systems.
    The monitoring protocol described in work item 2g for the reference streams will also be applied to eight detailed surveying sites on the urban streams. The results of long-term monitoring will provide valuable information on rates of change and the varying channel response to different levels of watershed imperviousness, and on the success of restoration projects.
12. Work Item 6. Prepare a report summarizing the data collected and information for the development of a watershed restoration and enhancement strategy.
    A final report delivered to MDEP will contain the following: all written documentation associated with each work item; all figures, tables, GIS projects, and data forms compiled during the project; additional narrative materials summarizing the results of assessments and surveys and comparing the relative levels of channel instability between the four urban and two reference streams.

Task 7. Periphyton Sampling.

Tom Danielson of the MDEP biomonitoring section and field personnel will collect periphyton samples near four stations (Table 5) once in July as described in Danielson 2003 (App. D ii). Because algal samples are usually collected in sunny areas, whereas macroinvertebrate samples often are collected in (partly) shaded areas, the location of the periphyton samplers will in most cases not be identical with those of the macroinvertebrate samplers. Algal samples will be collected from natural surfaces (rocks) and/or periphytometers (glass microscope slides in a plastic holder), and analyzed by a professional taxonomist (Jan Stevensen, Michigan State University) for species composition and abundance. A qualitative benthic algae survey along three transects also will be performed at each site. All data collected in the field will be recorded in the Periphyton Sampling Field Data Sheets shown in App. B vii a-b. In deviation from Danielson (2003, App. D ii), periphyton sampling under the Urban Streams Project will not include analysis of water chemistry, site descriptions, or habitat assessments which are covered for this project by Tasks 2, 3, and 6, above, or an assessment of epiphytic algae.

Task 8. Fish Sampling.

Barry Mower and field personnel of the MDEP Rivers section will be sampling the fish assemblages at four stations (Table 5) under the Surface Water Ambient Toxics (SWAT) program. Details of this sampling program can be found in App. D x. Briefly, fish samples will be collected by electrofishing and analyzed for species composition, weight and length, and external abnormalities (DELT, i.e., Deformities, Erosions, Lesions, Tumors; App. B viii). After analysis, all fish will be released back into the stream. All data collected in the field will be recorded on the fish sampling data sheet shown in App. B viii.

Task 9. Interim Report and Application of SI Protocol.

All data collected in Tasks 1 through 8 will be subjected to various analyses to determine the influence of watershed conditions on macroinvertebrate communities in the four streams and their habitat. All data will be graphed and tabulated, and, where possible, analyzed using appropriate statistical tests to determine if relationships exist between sampling stations (App. A) and parameter values, or between habitat quality and biotic (predominantly macroinvertebrate) communities. The database also will be compared with State of Maine and US EPA biological community, habitat, and water quality standards to identify specific concerns for the four urban streams. All information will be summarized in an interim report using a variety of presentational formats (e.g., text, graphs, tables, maps, photographs) to make the findings of this study easily accessible and interpretable. The report will be organized so as to facilitate application of the EPA SI Protocol to the data, i.e. it will present potential candidate causes for the observed impairments, discuss the evidence available, and bring in outside information where appropriate. The report and a brief summary of the key issues as they relate to the SI protocol will be distributed to MDEP staff and other appropriated persons (e.g. from EPA or the University of Maine) experienced in assessing stream data. In a workshop organized and run by the Urban Streams project manager, Susanne Meidel, this group of experts will apply the SI protocol to the Urban Stream database and determine the likely causes of impairment of the macroinvertebrate communities in the study streams. A summary document from the workshop will provide a ranked list of the most important stressors in qualitative terms for each of the four streams. This list will aid in developing stream-specific lists of remedial actions and BMPs aimed at facilitating the recovery of the observed biological impairment.

Task 10. TMDL Development. (not included in this first stage of the study)

The stream-specific lists of ranked stressors, BMPs and remedial actions developed from the SI workshop and summary (see Task 9 above) and the recommendations on BMPs and restoration/enhancement strategies included in the interim report submitted by the contracted geomorphologist (Task 6, above) will be used to develop TMDLs with a biological endpoint. In broad terms, the TMDLs will identify the urban stressors that are primarily responsible for causing the observed biological impacts (e.g., increased storm flows, deterioration of riparian corridors, raised heavy metal and/or nutrient concentrations) and their sources (e.g., roads, parking lots, airports, private residences). Major focal areas the TMDLs will address will likely include stormwater non-point source pollution problems, impaired in-stream habitats and degraded riparian areas, and stormwater hydrological impacts. They will furthermore specify an implementation plan for the BMPs as well as a monitoring plan that includes a timeline for biological recovery targets to attain WQSs.

B2 – Sampling Method Requirements

The sampling method requirements for tasks 1-3, 5- 8 of this project are shown in Table 7. (No quantitative data are collected for tasks 4 and 9-10.) This table presents information on the parameters, sampling techniques, sample area or volume, sampling preservation and maximum holding time, analysis location, and reference to the respective SOP detailing sampling and analysis procedures. Samplers and other equipment required for sampling biota (e.g., rockbags, buckets, and glass jars for macroinvertebrates; periphytometers for periphyton; nets for fish) are provided and maintained by the MDEP biomonitoring or rivers section as appropriate. For water quality sampling, labeled cubitainers or brown glass containers will be provided by HETL. Where required, all materials used will be prepared as specified in the respective SOPs. Chemicals required for sample preservation will be provided by MDEP (biomonitoring or rivers section: ethanol, M3) or the analytical laboratory (HETL: $MgCO_3$, H_2SO_4, HCl)).

Cleaning or decontamination procedures for standard sampling equipment or instruments are detailed in the respective SOPs. Information on data quality objectives is presented in section A7, a and b, above (pp. 17-18).

B3 – Sample Handling and Custody Requirements

Susanne Meidel, the field sampling coordinator for project tasks 1-5, will be responsible for ensuring correct sample handling by

- ensuring availability of all required sampling supplies in the field (App. F);
- properly labeling all sample containers for biological samples in the field (for labeling details see SOPs in App. D i and ii);
- recording all relevant sampling information on the respective field sheets and chain-of-custody forms (App. B, App. C i-ii); and
- handling the transfer of all samples from the field to laboratories for analysis.

For project task 6, the geomorphological watershed assessment, Ms Meidel will be responsible for ensuring availability of all required supplies during the field surveys carried out by MDEP and project personnel, while Field Geology Services will be responsible for availability of supplies required for sections of that task carried out by that provider (App. F). For project tasks 7, periphyton sampling, and 8, fish sampling, responsibility for availability of supplies, and for sample labeling and handling will rest with Tom Danielson of the MDEP biomonitoring section and Barry Mower or field personnel of the MDEP Rivers section, respectively (App. D ii and x; App. F). No samples are collected for tasks 9-10.

B4 – Analytical Methods Requirements

Analytical information, and relevant SOPs for tasks 1-3 and 5-8 are listed in Tables 6 and 7. (No quantitative data are collected for tasks 4 and 9-10.)

B5 – Quality Control Requirements

Acceptable relative percent difference values and accuracy levels for quality control procedures for field and laboratory techniques required for tasks 2, 3, 5, and 6 are shown in Table 6. (Tasks 1, 4, and 7-10 do not employ analytical equipment.) The analysis of field duplicates measures precision for the both field sampling and lab analysis, while lab duplicates measure only the precision for the actual analysis. The frequency of lab and field duplicates is shown in Table 7. In the field, baseflow duplicate(s) will be collected randomly. Stormflow duplicates will be collected at the location where the installation of duplicate rising stage samplers is most feasible (to be determined). Field duplicates for parameters measured in the field with meters (i.e., DO, SPC, TDS, pH and temperature) will be collected at the first sampling point of the day, and recorded under 'Notes' on the appropriate field sheet (App. B ii a-d). Results from the analyses of duplicates will be included in the interim report summarizing the study findings.

Corrective actions for quality problems attributable to malfunctioning of lab equipment are specified in the respective HETL SOP. If problems with field duplicates for parameters analyzed in the lab are detected before the end of the field season, every effort will be made to resample that parameter. If quality problems are detected for field duplicates of parameters measured with field meters (see Task 2 in section B1, above, the meter concerned will be recalibrated as specified in the respective SOP. Any quality control problems encountered will be noted in an appendix to the interim report.

B6 – Instrument/Equipment Testing, Inspection, and Maintenance Requirements
B7 – Instrument Calibration and Frequency

Detailed information on testing, inspection, and maintenance requirements, and on calibration procedures and frequency of all meters, instruments and other equipment used in this study can be found in the respective SOPs (App. D iii-xxiii) as referenced in Table 7. An overview of these activities for field instruments is shown in Table 8.

B8 – Inspection/Acceptance Requirements for Supplies and Consumables

Supplies and consumables used in tasks 1-8 of this study will be obtained from the MDEP biomonitoring or rivers sections, State of Maine facilities (HETL), other respected sources (e.g., VWR Scientific Products), or Field Geology Services. For example, 95% ethyl alcohol used for preserving macroinvertebrate samples will be obtained from VWR Scientific Products, while new cubitainers and washed vials and flasks (for collecting water samples for heavy metal and nutrient analyses) will be obtained from the HETL stockroom. Rockbags, periphytometers, nets, and ancillary equipment used for macroinvertebrate, periphyton, and fish sampling is part of the standard equipment used by the biomonitoring and rivers sections, which ensure that everything is in working order at the beginning of the sampling season. Equipment used repeatedly (e.g., nets, buckets) is checked frequently throughout the sampling season to ascertain its functionality. Field Geology Services will be responsible for the maintenance of their equipment to be used by either MDEP or the contractors themselves. Susanne Meidel will obtain all sampling equipment and supplies used for each sampling event, ensure their quality and suitability for this project (with assistance from the MDEP biomonitoring and rivers sections, and Field Geology Services), and ensure that high quality equipment and supplies are indeed used to collect data. On each field day, multiples or spares of materials will be brought to minimize the risk of problems.

B9 – Data Acquisition Requirements

State of Maine and US geologic 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 (especially for Task 6) 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 State of Maine or USGS coverages.

Existing data previously collected by the MDEP biomonitoring section in the four study streams (see Section A5, pp. 8-11) will be used to increase the database for this project. Those data were collected largely using the same protocols, laboratories, and taxonomists as in this study (except for stream width and depth measurements, and quality control duplicates), and should therefore be regarded as being of a high quality. Data collected by Morse (2001) on three study streams (see Section A5, pp. 8-11) were obtained using a different set of protocols, laboratories, and taxonomists, and somewhat different locations than in this study. Because of these discrepancies, results from that study will only be used in a qualitative manner.

B10 – Data Management

Susanne Meidel will be present during all sampling events for Tasks 1-4, 5.1, and 7 to ensure complete data collection and accurate data recording on the appropriate field sheets (Appendices B and C). In the rare instances when Ms Meidel cannot participate in field sampling for these tasks, qualified personnel will take her place (see Section A8, pp. 18-19) although it will be Ms Meidel's responsibility to ascertain as soon as possible after receipt of the field sheets that all data were recorded completely and appear accurate. If any errors or omissions are noted, every effort will be made to remedy those problems and prevent similar occurrences in the future. Ms. Meidel or, in the case of some stormflow samples (Task 5b, pp. 23-24, above), Melissa Evers' contractor will be in charge of the shipment of samples to their appropriate destinations (i.e., HETL for water chemistry samples, professional taxonomists for species identification).

For tasks 5.2 (carried out by a contractor under the supervision of Melissa Evers), 7 (carried out by Tom Danielson), and 8 (carried out by trained staff under the supervision of Barry Mower), it will be the responsibility of the person collecting the data (task 5.2) or the team leader (tasks 7 and 8) to ensure that all data are recorded accurately and completely, and that field sheets are passed on to the supervisor in a timely fashion. Ms Meidel will keep track of the field day schedules for these tasks, and ensure that field sheets are returned to her. For tasks 5.2 and 8, Ms Meidel will accompany the field staff on at least one date to familiarize herself with the sampling procedures while she will accompany Tom Danielson on all sampling events for task 7. For task 6, Ms. Meidel will be present for all survey days staffed by MDEP; she will ensure that all data are recorded accurately and completely and that they are passed on to Field Geology Services in a timely fashion. Ms Meidel will accompany personnel from Field Geology Services on some survey dates staffed by them. It will be the responsibility of Field Geology Services to ensure that all data are recorded accurately and completely on field days staffed by them, and that they submit complete records of all surveys with their final report.

All data collected for tasks 2-5 and 8 will be entered by Susanne Meidel into the Urban Streams Excel database using a DELL Inspiron 3200 laptop with a 128 MB of RAM and a Pentium II processor. Taxonomic data from task 1 as well as field data routinely collected by the MDEP biomonitoring section during macroinvertebrate sampling (see App. B i for a list of parameters) will be entered by Ms Meidel into the biomonitoring section's 'BioMe' database according to the protocol described in App. D xi. Field data routinely collected by the MDEP biomonitoring section during periphyton sampling (Task 7; see App. B vi a-b for a list of parameters), and periphyton identifications received from taxonomists will be entered by Susanne Meidel into the biomonitoring section's Periphyton database. Other software may be used to further analyze the data (e.g., Systat, ArcView, etc.) and Ms Meidel is responsible for the correct transfer or entry of data to those programs. Data will be saved on the laptop's hard rive, and backed up on floppy disks and CDs, as appropriate. Quality control procedures for data entry include checking of data entered at the time of entry, and re-checking of data in hardcopy format (table, report, graph) whenever available. The majority of these quality control procedures will be carried out by Ms Meidel but MDEP staff will be asked to check a random subset of ~10% of all data entered.

All data collected for the geomorphological watershed assessment (task 6), whether collected by MDEP or Field Geology Services, will be entered into databases maintained and controlled by the contractor. Quality control procedures for data entry include checking 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 entirely carried out by staff from Field Geology Services.

C1 – Assessments and Response Actions

Susanne Meidel 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. Ms Meidel's presence will provide consistency among all the different sampling events directly under her control; for tasks 5.2, and 6 – 8, the presence of experienced field staff (MDEP or contractor) will also ensure consistency among sampling events. For any sampling event not attended by Ms Meidel, the responsibility for task completion and adherence to QA/QC procedures will be delegated to the person in charge of collecting the data or the team leader, who also will be required to keep a record of any problems encountered during data collection.

Ms Meidel will report to her Urban Streams MDEP contact, Susan Davies, the status of the sampling program (see C2, below) on a monthly basis, and will report any problems with sampling or with QA/QC procedures as soon as possible. Severe problems will be referred to the appropriate MDEP quality control contact, Malcolm Burson, for his opinion. If deemed necessary, MDEP staff may halt sampling procedures until problems are remedied. Ms Meidel will report back to MDEP staff on the outcome of corrective actions. Staff from the MDEP biomonitoring (i.e., Leon Tsomides, Susan Davies, Tom Danielson) or Rivers TMDL section (Melissa Evers) will be present once for each type of sampling or monitoring outlined in Tasks 1 through 5.1 to assess the techniques of Ms Meidel, and if necessary suggest improvements.

Details on checks of equipment and analytical procedures are given in the SOPs for particular pieces of equipment or instruments as referenced in Table 7. Actions taken to ensure data quality are described in section B10, Data Management, above (p. 30).

C2 – Reports to Management

Susanne Meidel will submit a written 'Status Report' regarding the status of project activities at the end of each month to Susan Davies (Urban Streams MDEP contact) and Malcolm Burson (Urban Streams MDEP Quality Assurance Manager). Problems encountered in the field will be discussed by Ms Meidel with staff from the MDEP biomonitoring section including Ms Davies, and also with Mr Burson when QA/QC issues are involved, and appropriate corrective actions will be determined and implemented. These problems will be documented by Ms Meidel in 'QA/QC Reports' to be included in the interim report summarizing the results of this study to assist readers in the interpretation of results.

D1 – Data Review, Validation, and Verification Requirements

It will be the primary responsibility of the project manager, Susanne Meidel, to review and, as far as possible, validate and verify all data collected in this study upon collection (tasks 1-4 and 5.1) or upon receipt from MDEP personnel (tasks 5.2, 7 and 8), a contractor (task 6) or taxonomist (tasks 1 and 7) to determine if the data meet QAPP objectives (Table 6). The decision whether to accept, reject, or qualify data will rest primarily with Ms Meidel but MDEP staff will be consulted whenever doubts arise as to the quality of the data. For task 6, the geomorphological watershed assessment, data review, validation, and verification as well as the decision whether to accept, reject, or qualify any data will rest with John Field of Field Geology Services.

To allow correct interpretation of the data, all problems encountered in the field or the laboratory will be listed in an appendix of the interim report and discussed in the general text of the report. In addition, statistically relevant information on the sampling events such as sample size, sample mean, and sample variance will be reported, where applicable, to further assist in the interpretation of the study data. Quality problems relating to method detection limits, duplicate precision criteria and results, and accuracy criteria (Table 6) and results will also be presented in the report.

D2 –Validation, and Verification Methods

The project manager, Susanne Meidel, will be responsible for data validation and verification for tasks 1 – 5, 7 and 8. Data recorded in the field will initially be validated by the person in charge as detailed in section B10, above (pp. 30-31). Data will be further validated during entry into the Urban Streams database as noted in section B10. This task requires a reconciliation of data recorded on field sheets with those entered into the database, a critical review of spreadsheet print-outs, graphs and tables produced from the database, and the identification of any potential data gaps. A subset (~10 %) of the data entered will be reviewed by MDEP staff (to be determined by who) to further ensure data quality. Ms Meidel also will perform an analysis of the quality control data collected which will include a review of the chain-of-custody information and all information available from equipment log books as well as a comparison of the results from quality control samples with those from regular samples,. Any errors detected will be rectified by either editing incorrect entries, resampling (where possible), or excluding questionable data (after consultation with MDEP staff, see Section D1, above).

Once all data have been compiled for inclusion in the interim report, Malcolm Burson (Urban Streams Project Quality Assurance Manager), in cooperation with Susanne Meidel, will review the data to determine if all data have been included in the report. He will also review the data and analyses presented in the report to determine if all items proposed in this Quality Assurance Project Plan have been included. In the report, Susanne Meidel will qualify any data that do not meet the measurement performance criteria detailed in section A7 and Table 6 to enable the reader to make an informed judgment of the results.

D3 – Reconciliation with Data Quality Objectives

Susanne Meidel will be responsible for the reconciliation of all data collected in this study with original data quality objectives as detailed in section A7, above (pp. 17-18). 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 resampling may occur as specified in sections B5 (p.28) and C1 (p. 31). The interim report will note any limitations on data due to quality issues; it will also include information such as sample size and sample variance to help readers to better understand the limitations of the study. Furthermore, any problems encountered in the field or in the analysis phase will be listed in an appendix and, if necessary, noted in the discussion of the interim report.

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Supply lists for tasks included in Urban Streams Project

<u>Macroinvertebrate sampling (Task 1):</u>

Hip boots
Field sheet (Maine DEP Biological Monitoring Unit Stream Macroinvertebrate Field Data Sheet)
Rock bags
Catch net
Sieve bucket
Glass jars with new lids
Ethanol
Cooler with ice packs
GPS unit
DO meter
SPC/TDS/temperature/(pH) meter
Global® stream velocity meter
Meter stick
Digital camera and diskettes
Permanent marker, pencils
Tackle box with miscellaneous supplies

<u>Standard field sampling (Tasks 2-4):</u>

Hip boots
Field sheets (Standard field sheets a-d)
GPS unit
DO meter
SPC/TDS/temperature/(pH) meter
Global® stream velocity meter
Meter stick
Tape measure
Digital camera and diskettes
Pencils
Tackle box with miscellaneous supplies

<u>Water chemistry sampling (Tasks 2, 5.1):</u>

Hip boots
Field sheets (Water chemistry field data sheet)
Cooler with ice packs
Water quality kits from HETL (labeled containers, preservation agents)
HETL chain of custody sheets
Disposable gloves

<u>Stormflow sampling (Task 5.2)</u>

Hip boots
Field sheets (Storm Field Data Sheet, USGS Form 9-275-F)
Water chemistry sampling supplies (as above)
Rising stage sampler
Pygmy current meter
Wading rod
Tape measure
Stakes
Mallet
Current meter digitizer

<u>Geomorphological watershed data collection (Task 6):</u>

Rapid Assessment (MDEP personnel)
Hand level
Stadia rod
30 m measuring tape
Clip board
Global flow meter
Field sheets (Rapid Habitat and Rapid Geomorphic Assessment forms; Geomorphological Data Recording Form)

Visual Assessment Data
Clip board
Vellum sheets
Copies of Orthophotoquadrangles
Colored pencils

Detailed Surveying for Rosgen Level 2
Electronic total station
Tripod
Prism and pole
Carpenter's level
3 m measuring tape
2 2-way radios
Field notebook
Surveyor's pin flags
Hip waders

Pebble Counts
Calipers
3-m tape
Pebble count recording form
Clip board
Hip waders
LaMotte soil texture unit
Pebble Count Data Recording Form

Periphyton sampling (Task 7):
Hip boots
Field sheets (Maine DEP Stream Algae Data Sheet, Maine DEP Qualitative Benthic Algae Survey Field Sheet)
Periphytometer (microscope slides, lightweight rope, rebar, mallet)
Cooler with ice packs
Natural substrate sample (toothbrushes, metal chemistry tool for scraping rocks, large white sample trays, bottle of M3 preservative, pipette and bulb for measuring M3, 250 ml beaker, brown nalgene bottles 125 ml or 250ml)
Rapid periphyton survey (viewing bucket, 6 inch ruler marked with millimeters)
GPS unit
DO meter
SPC/TDS/temperature/(pH) meter
Global® stream velocity meter
Meter stick
Digital camera and diskettes
Permanent marker, pencils
Tackle box with miscellaneous supplies

Fish sampling (Task 8):
Electrofishing unit
Anode pole
Cathode
Batteries (charged)
Manual
Tool box
Nets
Gloves (rubber)
Boots (rubber)
Buckets/tubs
Measuring board
Weighing scales
Anesthesia
Scale envelopes
Field forms and notebook
Fishes of Maine
Topo map or Delorme atlas
Formalin
Sample containers (plastic)
Cooler with ice packs
Thermometer
Conductivity meter
DO meter
pH meter
Sunglasses
Towels