

**NC Ecosystem Enhancement Program
Local Watershed Planning Manual**

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NC Ecosystem Enhancement Program

INTRODUCTION

A. Background

The Wetlands Restoration Program (WRP) was established by General Statute within the Department of Environment and Natural Resources in 1996 and was charged with developing basinwide restoration plans for each of the 17 major river basins in North Carolina. When it was established by Memorandum of Agreement (MOA) in 2003, the Ecosystem Enhancement Program (EEP) incorporated the WRP and its planning responsibilities. The mission of EEP is to provide a comprehensive, natural resource enhancement program that identifies ecosystem needs at the local watershed level and preserves, enhances, and restores ecological functions within target watersheds while addressing impacts from anticipated NCDOT transportation projects and permitted impacts from other development projects.

EEP achieves this mission by utilizing a watershed planning approach to provide high-quality and cost-effective compensatory mitigation for impacts to streams, wetlands, and riparian buffers throughout the State of North Carolina. Through this process, EEP is able to identify and implement watershed improvement projects in the watersheds of greatest need.

A team of state and federal resource agency professionals, the Watershed Needs Assessment Team (WNAT), convened in 2002-2003 to develop specific methodologies for application of these watershed planning processes. Members of WNAT include: NC Division of Coastal Management, NC Division of Water Quality, NC Natural Heritage Program, NC Department of Transportation, NC Wildlife Resources Commission, US Army Corps of Engineers, US Natural Resources Conservation Service, US Environmental Protection Agency, US Federal Highway Administration, US Fish and Wildlife Service, and US Forest Service. One of two assessment methods developed by WNAT is a detailed watershed needs assessment methodology. The team determined that due to the uniqueness and complexity inherent in individual watersheds, and the variety and number of assessment tools available for watershed analysis, providing a general assessment framework was more appropriate than providing a highly prescriptive method. Effective watershed assessment must allow watershed planners and managers to apply the most appropriate tools available for a specific scenario (WNAT, 2003). EEP integrated WNAT recommendations into its planning processes to target priority watersheds for restoration and conduct comprehensive analysis of current watershed conditions to identify actions necessary to achieve desired watershed goals.

In June 2008, new federal rules governing compensatory mitigation became effective that required all in-lieu fee (ILF) programs in the United States to develop instruments (legal documents) that must be approved by the U.S. Army Corps of Engineers. A fundamental

part of the instrument requirements for ILFs was the development and approval of a [Compensation Planning Framework](#) (CPF) by which ILFs develop watershed plans and identify watershed restoration projects for implementation. In an effort to ensure that EEP's watershed-planning processes comply with state and federal requirements for a watershed approach, EEP recently re-evaluated its watershed planning guidelines and procedures. Based upon this review, EEP updated its processes and developed standardized methodologies that address federal requirements for a watershed approach and incorporate lessons learned since the development of the 2003 WNAT guidance. It is expected that the watershed planning process will continue to evolve based upon advances in the science, regulatory developments and experiences in the application of new processes. EEP will continue to update this document as changes occur.

B. Local Watershed Plan Overview

EEP's current Local Watershed Planning (LWP) process is based upon recommendations of the detailed needs assessment methodology and is divided into four phases:

Phase I: Characterization of Current Watershed Conditions

Phase II: Detailed Watershed Assessment

Phase III: Development of Watershed Management Plan and Project Atlas

Phase IV: Implementation of Watershed Management Plan and Project Atlas

The following sections provide guidance regarding the objectives and major tasks associated with each of the phases, including information on the content and format of the major reports produced at the end of each phase. The sections are intended to provide guidance for a variety of users including but not limited to new EEP planning staff, EEP project managers, EEP monitoring staff, EEP LWP stakeholders, and EEP consultant staff. A glossary of key terms and acronyms associated with watershed planning is included as **Appendix A**.

Major Phase I-IV tasks are performed by the planning team, which always includes an EEP lead planner and project manager, and may include a technical consultant and DWQ, as well as an EEP co-planner or other EEP staff. The lead planner's primary role is to coordinate the planning team on all Phase I-III tasks.

Phase I is characterized as the evaluation of available data sources and a preliminary determination of current watershed conditions. This phase identifies data gaps and includes the development of the scope or tasks for a watershed assessment plan, which is a more detailed evaluation of the watershed, including the assessment of *water quality*, *habitat* and *hydrologic* functions and is developed in Phase II. Phase I data is summarized in a **Preliminary Findings Report**.

Phase II includes more detailed data collection through the implementation of the watershed assessment plan identified in Phase I. Watershed assessments include physical, chemical and biological monitoring to determine the general functional integrity of streams and other aquatic systems in the watershed. This includes the identification of the key stressors and their sources impacting water quality, habitat, and hydrology. This

in turn enables EEP and watershed stakeholders to better focus on-the-ground projects and management strategies. Phase II data is summarized in a **Watershed Assessment Report**.

Phase III, focuses on the development of a **Watershed Management Plan** and **Project Atlas** which are the two final products of the EEP LWP efforts. These documents identify projects and management strategies that address identified stressors and have the best opportunity for bringing about functional improvement to the watershed. The Watershed Management Plan not only identifies appropriate watershed management strategies but also includes recommendations for the most appropriate entities to implement the strategies and possible funding sources.

Phase IV describes implementation of the Watershed Management Plan and Project Atlas. Objectives include identifying priority projects (included in the Project Atlas) that will address watershed stressors, implementing landowner outreach and stakeholder participation strategies, and documenting watershed improvement and protections activities and project feasibility over time. It also provides recommendations for stakeholder coordination and communication to help foster and support implementation of watershed management strategies that go beyond mitigation projects.

Throughout all phases of this planning process EEP believes it is critical to involve **stakeholders** in the decision making in order to accurately identify watershed needs and to develop appropriate management strategies. Stakeholders can assist in understanding the trends and pressures in a given watershed as well as serve as partners for the implementation of management strategies identified during the process.

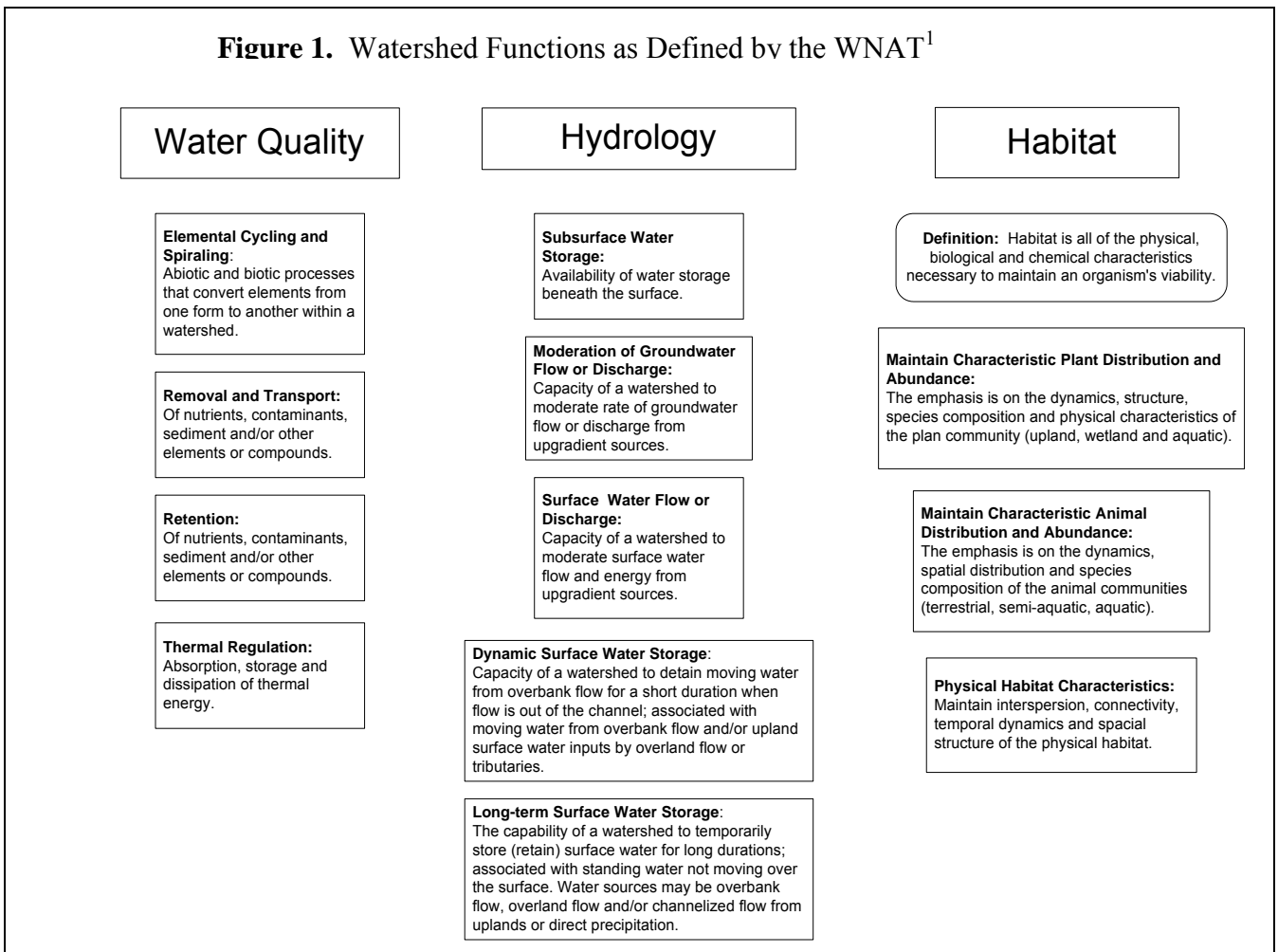
Though these four phases each have a distinct contribution to the planning process, it is possible that activities from separate phases will occur simultaneously as appropriate for each individual LWP. For example, EEP may initiate development of a project prioritization methodology (typically a Phase III activity) while preliminarily assessing potential project sites in Phase I or II or begin to develop the Project Atlas prior to Phase III if particularly urgent mitigation needs exist. If a planning area has an extensive amount of existing water quality data available then implementation of the watershed assessments may begin in Phase I rather than Phase II.

C. Functional Assessment

Although the focus of this guidance is on the characterization and reporting of *aquatic* resource conditions in our Local Watershed Planning areas, planners need to develop comprehensive recommendations that protect *entire watersheds*. Conditions and activities in riparian and upland areas that affect aquatic resources must be documented as part of the planning process. Furthermore, all phases of the LWP effort should be geared towards a reasonably comprehensive assessment of the most important local watershed functions, as presented in the WNAT Report (2003). Functions are the results of the interaction of the physical, biological, and chemical components, including external factors, of the ecosystem. The WNAT Report describes functions in terms of *water quality, hydrology, and habitat* (see **Figure 1**). According to the Report, the

WNAT generally did not attempt to identify specific measures, but focused on indicators of watershed functions...indicators may be of several types:

- **functional indicators** that directly assess a particular watershed function or process (ex. measuring sediment transport through direct measurements of erosion and deposition rates)
- **structural indicators** that do not assess function directly, but measure ecological structural characteristics of the system that are known to be or assumed to be closely tied to a specific function (ex. evaluating sediment transport through structural indicators such as stream substrate composition)
- **surrogate indicators** that measure watershed characteristics that do not assess a specific function, but that are associated with a number of functions or with watershed functioning in general (ex. associating percent imperviousness with a watershed's sediment transport function)



¹WNAT, 2003

As part of this functional assessment, watershed assets and problems should be determined. An **asset** is anything that *demonstrates* or *contributes* to a high level of function of natural systems. For example, highly functioning aquatic systems can be

demonstrated by the presence of benthic or fish communities that are impact-sensitive and taxonomically rich (rated Good or Excellent). Other characteristics can *contribute* to or protect high levels of function such as intact forested buffers, presence of protected land, and low levels of imperviousness. A **problem** *demonstrates* or *contributes* to a low level of function. For example, low function can be *demonstrated* by a 303(d) listing, benthic or fish communities rated Fair or Poor or closed shellfish harvest areas. Characteristics that *contribute* to low levels of function include high levels of imperviousness, lack of adequate riparian buffer or lack of stormwater management. As problems and assets are identified, key stressors to aquatic system integrity should also be identified and evaluated. A **stressor** is any physical, chemical, or biological agent or process that induces an adverse response in watershed function. Examples range from broad watershed processes such as stormwater runoff from areas with high impervious cover to specific water quality pollutants (nutrients, sediment, fecal coliform) affecting a particular stream reach or catchment. Generally, benthic and fish communities can be used to gauge stream integrity or general functional level. If there are no biological data available, preliminary stressors can be identified based solely on the analysis of watershed problems. GIS is a very useful tool that is widely used by EEP planners in the preliminary identification of problems and assets, typically during Phase I.

In general, watersheds provide *aquatic* and *terrestrial habitat* for living organisms when functioning properly. They also help maintain good *water quality* by filtering runoff and retaining sediment on land during rainfall events. Lastly, watersheds maintain a good *hydrologic balance* when functioning well; rainfall and flooding don't cause catastrophic changes to the general character of streams because streams are well-connected to their floodplains. When parts of a watershed cease proper function, balances are disturbed and indicators of problems that are occurring need to be measured. Problems and assets identified should be classified according to the functions they affect. An effort should be made to determine the level at which the system was functioning before impacts occurred. The loss or decrease in any function is *relative* to the starting point for any measured parameter. A comparison using all available information on the system and a reference system to assess the degree of loss of water quality, hydrologic and habitat function is often the most valuable approach.

PHASE I: Characterization of Current Watershed Conditions

Phase I is characterized as the evaluation of available data sources and a preliminary determination of current watershed conditions. This phase identifies data gaps and includes the development the scope or tasks for a watershed assessment plan, which is a more detailed evaluation of the watershed, including the assessment of water quality, habitat and hydrologic functions and is developed in Phase II. The final product of Phase I is the **Preliminary Findings Report**.

A. Goals and Objectives:

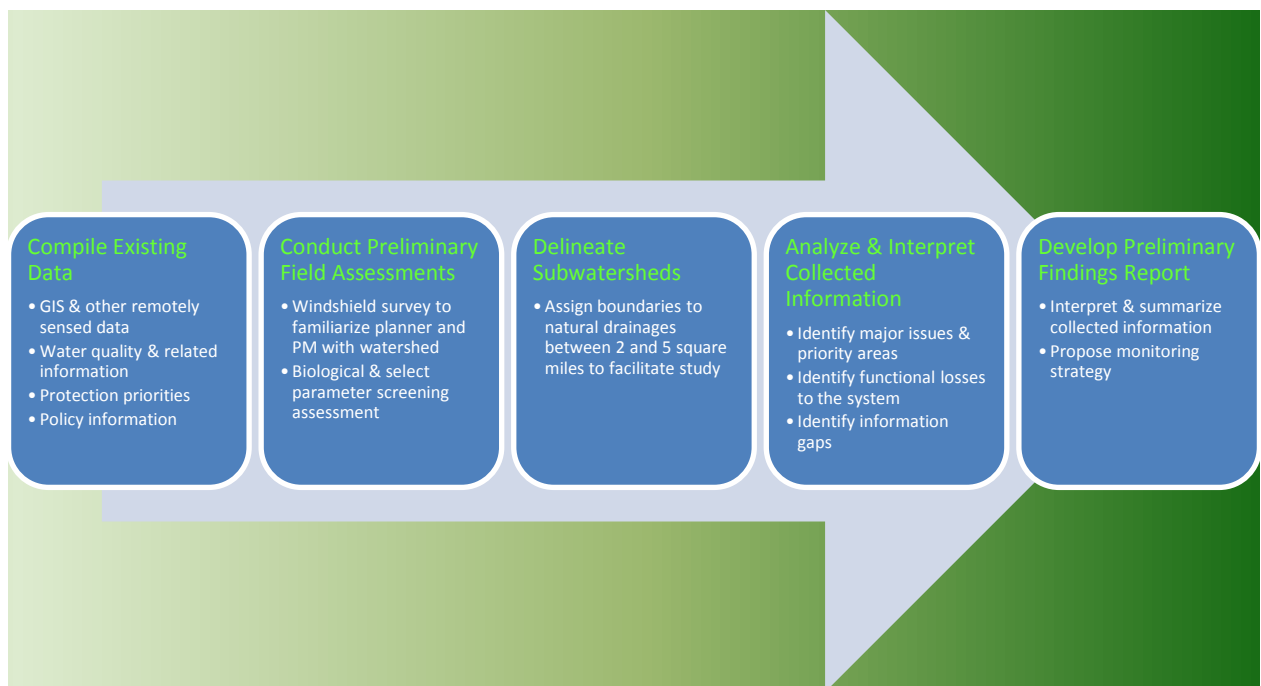
The primary goals of Phase I are (**Figure 2**):

- 1) Develop a preliminary characterization of current watershed conditions and land use trends based on data compiled from a variety of sources
- 2) Preliminarily identify **priority subwatersheds** for additional assessment and possible project sites
- 3) Develop the Preliminary Findings Report
- 4) Scope out the recommended approach for conducting detailed assessment tasks during Phase II

In order to meet the above goals, several specific objectives must be met, including:

- identify critical data gaps within the watershed;
- engage key stakeholders in the planning process to obtain input in various Phase I activities and lay the foundation for future collaboration;
- identify major functional stressors and sources within the local watersheds; and
- delineate subwatersheds within the local watersheds

Figure 2. Phase I Local Watershed Planning Process



B. Compile Existing Data

1) Remotely sensed data and other geo-referenced information

Remotely sensed data and other geo-referenced data should be compiled in Geographic Information System (GIS) format for the watershed. **Table 1** provides a list of datasets to be gathered and/or located. This is not an exhaustive list, as other datasets may be available or applicable for specific watersheds. Many of the datasets in Table 1 are readily available through the Center for Geographic Information and Analysis (CGIA), through EEP, or on DENR's GIS website (at <http://gis.enr.state.nc.us/denrdata.asp>). Municipalities, counties, and regional councils often have GIS departments that develop and maintain local datasets, and any applicable datasets should be acquired.

Two of the most important datasets to successful local watershed planning are aerial photography and land use/cover. The most recent digital aerial photography should be used. Many counties and municipalities maintain relatively recent aerial photography. Other aerial datasets are often available which may have coarser resolution but are more recent, such as National Agricultural Imagery Program (NAIP) or Google Earth. The planner must determine if the aerial imagery is sufficient in scale and time-frame given the activity (e.g., urbanization, logging) in the watershed. If not, new imagery, via satellite or flyover, should be acquired. In cases where images and spatial datasets are too old, the planner should first attempt to procure up-to-date products from sources such as TerraServer (<http://www.terraserver.com/>) or Image Trader (<http://www.landsat.com/>). In the absence of any other adequate sources, the planner may contract with consulting firms or organizations to collect new aerial imagery and develop land cover data for the study LWP area.

For localized assessments of land use, additional historical imagery may be available. Planners should check with local Soil and Water Conservation District/Natural Resource Conservation Service, city, and county offices for archived aerial imagery or maps. USDA Farm Service Agency (FSA) also maintains a library of historic aerial photographs.

The default minimum land use/cover datasets are the 2001 National Land Cover Dataset (based on 2001 satellite imagery and available on the web via <http://www.mrlc.gov/>) and the North Carolina 2006 Land Cover Data for coastal areas (available at <http://www.csc.noaa.gov/crs/lca/southeast.html>). More recent and detailed datasets may be available in certain areas. Again, a determination must be made of the utility of this dataset given the activity in the watershed. Considerations to include in this determination are recent land use/cover changes, the importance of impervious cover estimations (as in an urban area), and inaccuracies in the land use/cover dataset.

Impervious cover is especially important for an urban or suburban watershed. This may be available in more developed areas. At the least, it can be roughly estimated using the impervious cover dataset developed with the 2001 National Land Cover Dataset or the percent impervious estimates for land use/cover type from the 1996 CGIA land use/cover dataset. The planner should also review the list of impervious cover data available for download at NC OneMap (<http://www.cgia.state.nc.us/Default.aspx?tabid=55>).

Table 1. Georeferenced datasets for watershed evaluations

<i>Source¹</i>	<i>Dataset</i>
	Basics
DOT	1:24,000 scale topographic maps (http://www.ncdot.org/it/gis/DataDistribution/USGSTopoMaps/default.html)
CGIA, local	Aerial photography—most recent digital: NAIP, Bing, County aeriels, recent. historic aeriels-- National Archive, SWCDs, NRCS, FSA
EEP	Land use/cover—from 2001 NLCD and APES (1988) for coastal areas OR more recent dataset
Local, MRLC, EEP	Land use/cover; impervious cover—MRLC has national lu/lc from 2001 satellite imagery; see http://www.mrlc.gov/mrlc2k_nlcd.asp
FMP	DEMs via LIDAR through Division of Floodplain Management
Local	Parcel data
CGIA	County boundaries
DOT, local	Municipal boundaries (http://www.ncdot.org/it/gis/DataDistribution/DOTData/default.html)
	Hydrography
CGIA	1:24,000 scale, complete with use support designation, DWQ classification.
CGIA	1:100,000 scale
DCM	Division of Costal Management wetland dataset for coastal areas
CGIA; DWQ	Detailed hydrography dataset if available
EEP	National Hydrography Dataset (NHD or NHD+)
CGIA	National Wetland Inventory
FMP, local	Flood zones: floodway, 100 yr floodplain, etc. (http://floodmaps.nc.gov/fmis/Download.aspx)
EEP	8, 14, 12 digit hydrological units
	Natural Resources
local	Soils—including hydric classification
EEP	Ecoregion—level IV (via NRCS)
EEP	NC GAP
CGIA	NHP data—significant natural heritage areas, NHP element occurrences
CGIA	Lands managed for conservation and open space—state/federal/county parks, forest, conservancy
EEP	Fish nursery areas, anadromous fish spawning areas, WRC trout waters, shellfish harvest areas
NHP	NC One Map Conservation Planning Tool (http://www.onencnaturally.org/pages/ConservationPlanningTool.html)
	Monitoring Data
CGIA	Ambient monitoring locales
CGIA; DWQ	Benthic and fish monitoring locales
local	Non-DWQ data—e.g., volunteer monitoring networks, other agency, etc.
CGIA	Stream gauges
	Pollution Sources
CGIA	NPDES facilities
DWM	Underground Storage Tanks (USTs), brownfields, landfill data http://portal.ncdenr.org/web/wm/gis/data
CGIA	Sanitary sewer systems-land application sites
CGIA	Swine lagoons
CGIA	Hazardous waste disposal sites (Superfund)
	Infrastructure
local; DOT	Roads
local; CGIA	Ordinance areas—e.g., DWQ WS, zoning, Phase II jurisdiction, etc.
CGIA	Railroads
EEP	Dams
private	Powerlines—power companies maintain GIS data, but acquisition is difficult
CGIA; local	Sewer, storm sewer

Source ¹	Dataset
	Other
EEP	TIP locales—via DOT
EEP	Federal Lands
EEP, CGIA	Stream restoration/enhancement projects: EEP, USFWS, 319, CWMTF

¹CGIA= Available through NC Center for Geographic Information and Analysis (<http://www.nconemap.com/default.aspx?tabid=286>); MRLC=Multi Resolution Land Characteristics Consortium; EEP=available through EEP; DOT = Available through NC Department of Transportation GIS website; DCM=NC Division of Coastal Management; FMP=NC Floodplain Mapping Program; NP=NC Natural Heritage Program; DWM=NC Division of Waste Management

If additional significant gaps in GIS datasets are identified through this process, the planning team may develop new GIS datasets in Phase I or Phase II. Examples of GIS datasets that have been updated are land use/cover, hydrography, and riparian buffer quality datasets. Analysis of GIS and other remotely sensed data sets supports the identification of major threats to aquatic resources within the planning area as required in EEP’s CPF Section (ii). Any GIS data developed should also have accompanying metadata, meeting federal government standards set by the Federal Geographic Data Committee (<http://www.fgdc.gov/metadata>). The EEP GIS coordinator should be consulted to ensure the GIS data conforms to EEP standard geodatabase format.

2) Water quality and related information

There are three major goals for compiling water quality data during Phase I: (1) to identify gaps in information that may be filled during Phase II of the LWP process, (2) to assist in the preliminary identification of major watershed stressors, and (3) to establish a basis for making decisions guiding the next steps of the LWP process.

A field team should be assembled for the LWP and may consist of members from the Division of Water Quality (DWQ) Watershed Assessment Team (WAT), EEP, and/or a consulting firm. The team collects and summarizes water quality data as comprehensively as possible. The Existing Data Summary Report includes all existing stream data for the LWP study area and reference streams and helps identify the historic resources lost within the planning area as required in **EEP’s CPF Section (iii)**. Data sources include but are not limited to DWQ ambient monitoring data, data collected by local coalitions, TMDL studies, special studies like DWQ Watershed Assessment and Restoration Project (WARP) or Collaborative Assessment for Watersheds and Streams, National Pollutant Discharge Elimination System (NPDES) discharger data, etc. The report should provide an interpretation of the data and a characterization of reference streams to help guide the development of the monitoring plan for Phase II. Ensure the DWQ WAT team member is aware of special data reports and information that may not be immediately at hand (e.g., special studies performed by local organizations, USGS data, etc.). In instances where data are minimal or lacking in significant portions of the watershed, the team may collect screening level data (e.g. physical or chemical data collected with field meters) during watershed reconnaissance. These data should also be included in the summary. In some cases, other organizations may compile water quality data.

From the summary report, compile a list of information gaps that should be addressed to make the stressor identification and decision-making process more successful. Consider whether there is a need to investigate “possible problems” further in Phase II. Issues that could be related to temporary conditions that may no longer exist should also be considered for further study.

In situations where data are particularly sparse or if logistics require it (e.g., season-specific benthic data collection in swamps), the field team may begin sampling during Phase I instead of Phase II. The planning team may decide to collect screening level data such as (1) biological data that will help determine where to focus stressor identification work in Phase II, and (2) physical and chemical data, such as nutrients and fecal coliform bacteria throughout the watershed to identify areas for more detailed assessment. This information isn’t reported in the Existing Data Summary Report, but in separate memos to be incorporated in the Phase I Preliminary Findings Report.

The planning team should use the information in the Existing Data Summary Report and from the GIS data compiled in Phase I to preliminarily identify *stressors* and *sources* of water quality problems in the watershed. Consider whether or not there are influences on watershed function coming from outside the watershed. If GIS and aerial photography study suggest there are external influences (e.g., discharges situated upstream of the LWP area), incorporate further investigation into the Phase II monitoring plan.

3) Preservation priorities

The planning team should identify important, high quality resources in the LWP watershed that may warrant additional protection or require more study during the watershed assessment. The team should review datasets such as rare species distributions and prevalence, existing conservation lands, and aggregate conservation priorities developed by other agencies (e.g., [NC Conservation Planning Tool](#) priorities). It is important to consult experts in particular agencies (e.g., NC Natural Heritage Program, US Fish and Wildlife Service, NC Wildlife Resources Commission, local land conservancy) and other relevant stakeholders from the watershed to make the best recommendations for establishing preliminary priorities and developing the monitoring plan.

4) Policy information

The planning team should review policies and regulations that control activities in the watershed that affect water quality, habitat, and hydrologic function. It is important to understand how these rules affect watershed resources now and in the future. Research as comprehensively as possible how water and land resources are managed in the watershed. Consult with local (municipal and/or county) planning staff. Is there information available on land use, zoning or planning that may contribute to your study? Document what DWQ classifications have been assigned to the waters in the watershed. Are there water supply waters in the watershed? Have any streams been designated as impaired? Determine which rules are in effect throughout the watershed and which only affect portions of the watershed. For example, in Stoney Creek, the nutrient reduction policies for the Neuse River apply to the entire watershed, while Phase II Stormwater

Regulations apply only to the part of the watershed within boundaries of the City of Goldsboro. The following list can be used to help determine what to research in the watershed of interest:

- NPDES Phase II (or other) stormwater regulations
- Zoning information (protective zoning, unified development ordinances, etc.)
- Buffer or nutrient management regulations
- DWQ standards for water quality and other policies
- Drainage district management policies (especially relevant to eastern NC)
- Sediment and erosion control policies
- Floodplain management programs
- Local information from resource agencies
- Farmland protection policies (e.g., voluntary agricultural districts)
- Nutrient management plans

Write a description of how these policies are applied in the watershed and to the extent possible, determine if they are serving their intended purposes. From this compilation of information, determine if there are gaps in water resource protection that recommendations developed by EEP and local stakeholders may help to fill. Also consider state and local resources related to the enforcement of existing rules and policies. Sometimes there are watershed protection-related policies and rules on the books (both state and local), but inadequate staff for monitoring and enforcement of such provisions.

5) Other information

Pertinent studies from universities, land trusts and other non-profit groups, mitigation banks, local governments, Department of Transportation (DOT) (Cumulative Impact Assessments, Environmental Impact Statements, Environmental Assessments), NC Wildlife Resources Commission (e.g. NC Wildlife Action Plan) etc. should be identified within the applicable LWP area. Existing projects within the LWP area should also be identified, including but not limited to projects implemented by EEP, mitigation bank, Clean Water Management Trust Fund, 319 grant funds, Conservation Reserve Enhancement Program, and local land trusts.

C. Stakeholder Involvement

EEP initiates stakeholder involvement at the beginning of the watershed planning effort. The composition of the stakeholder group varies dependent on the region and level of interest expressed by different organizations/agencies and may include both public and private entities, but as required in **EEP's CPF Section (viii)**, includes at a minimum the following public and private entities to inform them of the watershed planning process:

- Division of Water Quality Regional Office
- Division of Water Quality Basinwide planner
- Local Natural Resource Conservation Service (NRCS)
- Soil & Water Conservation District (SWCD)
- Resource Conservation and Development Program (RC&D) representative

- County Cooperative Extension Office
- NC Department of Transportation (DOT) Project Development & Environmental Analysis-Assistant Manager
- NC DOT Division Office
- NC Wildlife Resource Commission Regional Office
- NC Division of Forest Resources
- CWMTF field representative
- Local Governments (including Planning Director and Utilities Director)
- Regional Councils of Government
- Metropolitan Planning Organizations (MPOs)/Rural Planning Organizations (RPOs)
- Universities and/or colleges in study area
- US Fish and Wildlife Service Regional Office
- United States Army Corps of Engineers Regional Office
- Local land trusts
- The Nature Conservancy
- Environmental Defense Fund
- Private landowners/community representatives

At a minimum, EEP will update the stakeholder group at meetings conducted at plan initiation and following completion of the Watershed Assessment Report and Watershed Management Plan and Project Atlas. In addition, a Technical Advisory Committee composed of a subset of the larger stakeholder group may also be developed in some watersheds to assist EEP in plan development and implementation. Applicable EEP implementation and monitoring staff, and DWQ planning and modeling staff should also be consulted and involved in this process.

Stakeholder meetings are typically held quarterly, beginning in Phase I. Facilitation of stakeholder meetings requires a significant amount of meeting preparation time, including the development and distribution of meeting agendas and reminders a week or two in advance of each meeting; as well as follow-up meeting summaries within a couple weeks after each meeting. Members of the planning team should have clear and specific objectives developed ahead of time for each stakeholder meeting. Because there is typically a three- or four-month gap between each full stakeholder meeting, the beginning of each new stakeholder meeting should include a review of major discussion topics and action items from the previous meeting.

The WNAT Report (2003) recommends the following approach to stakeholder involvement:

- *Each individual watershed planning project should be considered singularly to determine the best approach for stakeholder involvement using a publication entitled Local Watershed Planning: Citizen Participation Guidebook (Smutko et al, 2003);*
- *Preference should be given to using a stakeholder involvement model that relies on local resource professionals in the early phases with targeted outreach to the public at later stages to generate support for specific solutions. Under this model, resource*

professionals participate in understanding and evaluating available and generated data to make management recommendations. Depending on the recommendations that result, outreach to specific stakeholder communities can be conducted in a targeted fashion; and

- *Boundaries and expectations must be made clear to stakeholders invited to participate. It should be apparent to participants that not all of their recommendations will be implemented through the EEP.*

D. Preliminary Field Reconnaissance

Reconnaissance of the watershed takes two different forms—a windshield survey and more intensive assessment of streams, channels, and riparian habitat. A windshield survey is a cursory field exercise, typically performed by the planner and project manager during Phase I, intended to provide a general impression of watershed conditions. Observations are documented in a worksheet for future reference (**Table 2**). More intensive assessments are usually performed in Phase II and include biological community, habitat, and physical/chemical water quality assessments. A comparison of the goals, participants, and outcomes of these reconnaissance efforts is presented in **Figure 3**.

At this point in the process, it is typically too early to collect detailed information on specific reaches and precise localities unless it is incidental to the survey. Instead, this should be considered a familiarization process through which the *general* attributes of the various subwatersheds within the watershed are documented.

In advance of the field work, the planner and project manager should meet to review data gathered so far on the LWP area. Spatial data should be closely examined to plan the route. The land use and land cover information may be the most important information for orientation at this point. Because those data are produced remotely or may be somewhat outdated, consider the route you drive a field verification of actual land use. Historic and current aerial photography can also be a great help guiding your survey. Make a list of points of interest on the maps or photos and be sure to include those as places to stop on the route. To the extent possible, develop questions to answer about each subwatershed before setting out.

After planning the route, drive each subwatershed and record information on copies of maps and aerial photos. Take detailed notes and photographs at the key sites you've outlined for your route. In smaller LWP areas, compiling information at all or most road crossings may be possible. In larger LWP areas, a representative subset of crossings should be utilized. Do the same for unanticipated points of interest you find as you progress through the subwatersheds. If working in the coastal plain, field-verify that LIDAR information to be used to make delineations of subwatersheds is accurate; recall that all water in a subwatershed should exit it from a single point.

Table 2. Windshield survey site description worksheet

SITE ID NUMBER: _____

SITE INFORMATION:

Latitude: _____

Longitude: _____

Watershed: _____

Stream Name: _____

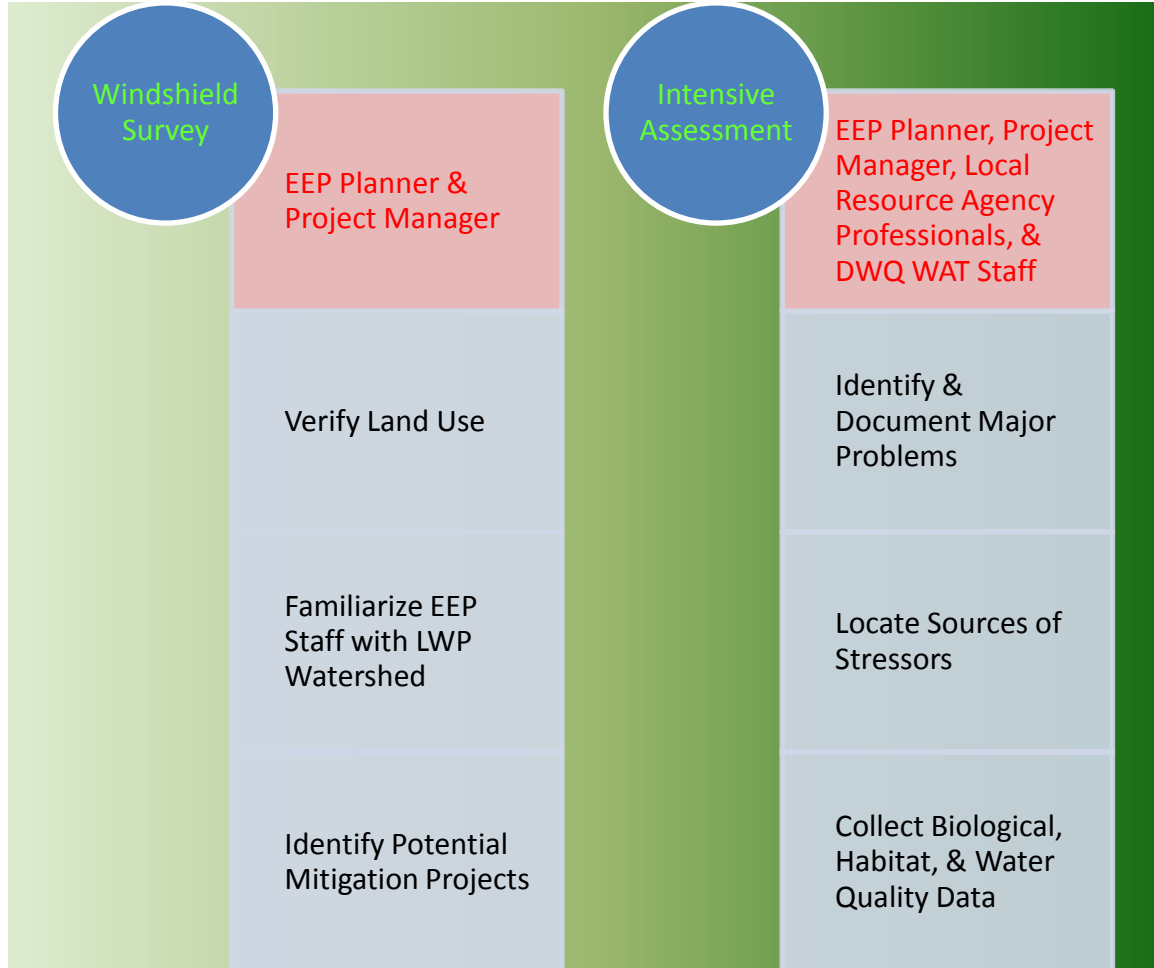
Date: _____

Investigator: _____

Site Description (eg-- "stream name" at "road name", etc.): _____

UPSTREAM	DOWNSTREAM
Dominant Land Uses:	
<input type="checkbox"/> Forest <input type="checkbox"/> Pasture <input type="checkbox"/> Row Crops <input type="checkbox"/> Low Density Residential <input type="checkbox"/> High Density Residential <input type="checkbox"/> Commercial/Industrial <input type="checkbox"/> Other: _____	<input type="checkbox"/> Forest <input type="checkbox"/> Pasture <input type="checkbox"/> Row Crops <input type="checkbox"/> Low Density Residential <input type="checkbox"/> High Density Residential <input type="checkbox"/> Commercial/Industrial <input type="checkbox"/> Other: _____
Buffer Condition:	
<input type="checkbox"/> Good <input type="checkbox"/> both sides <input type="checkbox"/> Fair <input type="checkbox"/> one side only <input type="checkbox"/> Poor <input type="checkbox"/> Absent	<input type="checkbox"/> Good <input type="checkbox"/> both sides <input type="checkbox"/> Fair <input type="checkbox"/> one side only <input type="checkbox"/> Poor <input type="checkbox"/> Absent
Bank Condition:	
<input type="checkbox"/> Good <input type="checkbox"/> both sides <input type="checkbox"/> Fair <input type="checkbox"/> one side only <input type="checkbox"/> Poor	<input type="checkbox"/> Good <input type="checkbox"/> both sides <input type="checkbox"/> Fair <input type="checkbox"/> one side only <input type="checkbox"/> Poor
Stream Condition:	
<input type="checkbox"/> Good <input type="checkbox"/> Fair <input type="checkbox"/> Poor	<input type="checkbox"/> Good <input type="checkbox"/> Fair <input type="checkbox"/> Poor
Potentially Detrimental Features:	
<input type="checkbox"/> Clearcutting <input type="checkbox"/> Construction <input type="checkbox"/> Livestock in Stream <input type="checkbox"/> Straightened/Altered Channel <input type="checkbox"/> Invasive/Exotic Species: <input type="checkbox"/> Other:	<input type="checkbox"/> Clearcutting <input type="checkbox"/> Construction <input type="checkbox"/> Livestock in Stream <input type="checkbox"/> Straightened/Altered Channel <input type="checkbox"/> Invasive/Exotic Species: <input type="checkbox"/> Other:
Positive Features:	
<input type="checkbox"/> Large Tracts of Mature Forest <input type="checkbox"/> Conservation Tillage <input type="checkbox"/> Stormwater BMPs <input type="checkbox"/> Other BMPs: <input type="checkbox"/> Important Species Identified: <input type="checkbox"/> Other:	<input type="checkbox"/> Large Tracts of Mature Forest <input type="checkbox"/> Conservation Tillage <input type="checkbox"/> Stormwater BMPs <input type="checkbox"/> Other BMPs: <input type="checkbox"/> Important Species Identified: <input type="checkbox"/> Other:

Figure 3. A comparison of windshield surveys and intensive assessments



Try to determine the following for each subwatershed:

- Dominant land use and cover (if developed, be specific as to mix of types—e.g., residential vs. commercial—and location)
- Intensity of use (density)
- Land management (if urban, document observed stormwater BMPs; if agricultural, note conservation tillage, or field borders; for either, document stream buffers and their extent)
- Active land disturbance—type and extent
- General stream condition
- Other obvious problems
- Positive features (e.g.—large tracts of mature forest)

If it is helpful, use data sheets in the field to systematically document your subwatershed findings (see **Table 2**). Information can be recorded manually on paper copies or directly into a field computer or GPS. When the field survey is completed, organize the

information in a database file to promote easy sorting and simplified subwatershed comparisons.

More intensive assessment activities are typically performed in Phase II, but in some LWPs, some of this assessment work can be performed in Phase I. For additional information on intensive assessment, see the Phase II section.

E. Subwatershed delineation

After existing data have been compiled and windshield surveys have been performed, a preliminary delineation of subwatersheds should be performed. Subwatershed size can vary but a target of 2-5 square miles should be used so that land use activities can be more easily connected to water and aquatic habitat conditions in a localized area. Subwatershed boundaries must follow topographic features and land use within each subwatershed should be as homogenous as possible. Small municipalities and towns often do not occupy entire subwatersheds so those subwatersheds tend to be mixed use (vs. primarily agricultural, etc.).

The planning team should identify the total number of subwatersheds based on the total size of the LWP watershed. Once the approximate number of subwatersheds is determined, conduct a GIS exercise whereby logical points of division are identified (e.g.—tributary confluences with larger streams or rivers, road crossings, etc.). Because road crossings provide convenient access for biological and chemical sampling, as well as channel assessment, they can be used as downstream subwatershed boundaries. After the points defining downstream subwatershed boundaries are identified, use GIS software (e.g.—ArcGIS ArcHydro) to draw boundaries along ridges surrounding the subwatershed drainage. These subwatershed boundaries may be adjusted in Phase II, based on additional data or planning objectives. Of note is the difficulty of correctly delineating drainage boundaries in the coastal plain, where elevation differences are low and actual drainage features may not be correctly mapped on USGS topographic maps. A digital elevation model (DEM) based on high resolution LIDAR data will assist in delineating problematic, low-slope coastal plain watersheds.

F. Preliminary Findings Report

The steps described below illustrate the basic process the planning team follows to produce the Phase I Preliminary Findings Report.

1) Interpretation of collected information

The planning team uses the assembled and collected data to preliminarily characterize the watershed. From this analysis, watershed assets and problems should be determined. High level of function in aquatic systems can be *demonstrated* by benthic or fish communities that are impact-sensitive and taxonomically rich (or rated Excellent or Good) or the presence of sensitive species or communities, such as brook trout in the mountain streams or open shellfish harvest areas in estuaries. Other characteristics can *contribute* to or protect high levels of function, such as intact forested buffers, presence of protected land, and low levels of imperviousness.

Likewise low function can be demonstrated by 303(d) listing, benthic or fish communities rated Fair or Poor, or closed shellfish harvest areas. Characteristics that may indicate low levels of function include high levels of imperviousness, intensive channelization, lack of adequate riparian buffers, high percentage of developed land, or lack of stormwater management. Obvious pollution sources can also contribute to low function, such as pasture or logging adjacent to streams without adequate BMPs, faulty septic systems and straight pipes, groundwater contamination sites, and poorly managed wastewater treatment plants.

Key stressors to aquatic system integrity should be proposed. This step is dependent on the level of data available. In general, biological communities (fish and benthos) can be used to gauge stream integrity or general functional level. Where biota indicate a limited degree of function (e.g., Good-Fair, Fair, or Poor ratings), stressors should be hypothesized, based on biological community analysis, aquatic habitat scores, water quality data, and various watershed problems identified above. However, it is important to note that Good or even Excellent biological community ratings do not automatically indicate a lack of stressors; these communities can still be limited by low level stressors, such as moderate sediment deposition.

Where there are no biological data, preliminary stressors can be identified based solely on the analysis of watershed problems. Data collected in Phase II will enable better stressor identification.

2) Identification of functional losses to the system

The loss or decrease in any function is *relative* to the starting point for any measured parameter. Use all available information on your stream and a reference stream to assess the degree of loss of water quality, hydrologic and habitat functions. A scoring system analogous to the CU-screening in EEP's [River Basin Restoration Priorities methodology](#) can be employed. The problems and assets identified in the previous section should be classified according to what functions they affect. Values can be assigned to each subwatershed for problems and assets representing each functional category. Make a relative assessment of how the identified problems translate into functional losses to each subwatershed. An effort should be made to determine at what level the subwatershed was functioning before impacts occurred. Possibly the best option is to assess conditions in a nearby stream that hasn't been impacted by the major problems of the study area. This *reference stream or condition* will likely not be a pristine watershed but the goal is to locate one as similar as possible to what the study stream resembled before alteration. The planner should also consult with EEP monitoring staff to determine if relevant reference information is available internally. It should be in the same ecoregion and have similar geologic character.

Finding a reference stream can be important in situations where what appears to be a problem may actually be a naturally occurring condition for streams in that particular ecoregion. For example, poor benthic communities suggest environmental or habitat degradation in general. However, in streams located in the Triassic basin and the North Carolina slate belt, benthic macroinvertebrate diversity tends to be somewhat lower due

to naturally occurring conditions—chronic drying of the headwaters in summer and less diverse substrate for habitat. Documenting the representative benthic community of a reference stream will help you avoid identifying losses greater than actually have occurred in the study stream.

3) Preliminary identification of major problems and potential priority areas

Broadly describe problems in the watershed. Consider if there are obvious delineations in the watershed that characterize what is different in each section. A simple example exists in the Stoney Creek watershed (Neuse 03020202). The southwestern part of the watershed is primarily occupied by the City of Goldsboro while the northern part is occupied by agricultural fields and low-density residential areas. In general, the urban section has a mix of problems associated with urban areas like hydrologic modification, imperviousness, and a mix of water chemistry and toxicity issues. In the north, many of the problems are related to agriculture like fertilizer runoff causing high nutrient levels in the water. These generalized land uses help to classify each of the subwatersheds (i.e., urban subwatersheds vs. agricultural subwatersheds).

Using the available data along with maps and aerial photography, look for stressors and sources like unbuffered streams, undocumented impoundments, concentrations of cleared areas, concentrations of animal operations, etc. Identify which problems may warrant subsequent investigation to determine their actual extent. Keep in mind that this information is intended to guide where attention will be focused in the next phases of the process. This may be the basis by which detailed field assessments are conducted in Phase II.

The planning team should develop a map (or series of maps) of the local watershed area showing the delineated subwatersheds as color-coded to match one of three or four basic “disturbance” or “impact” classes or categories. For example, there may be some relatively undisturbed subwatersheds with generally intact buffers, low percent impervious cover (IC) and little or no evidence of stream modification/channelization in the headwater regions of a rural landscape. These could be classified as subwatersheds with relatively “High Preservation Potential”. Conversely, some subwatersheds may be in urban settings with high impervious cover, many channelized/modified streams, and degraded or absent buffers; these could be classified at the other end of a simple three- or four-tiered classification spectrum as “Likely to be Highly Degraded” or “Highest Probable Need for Restoration/Retrofit”.

Characterizing the major problems and where they are concentrated physically in the watershed is particularly important because it can provide insight on how clusters of restoration or enhancement and best management projects might have a greater impact on improving the system (i.e., provide greater functional uplift). Use the GIS and other remotely sensed information collected earlier in this process to identify sections of each subwatershed where groups of problem areas appear to exist. It is unlikely that you can know precisely if these problems are ongoing in all the areas of a cluster you may have identified since remotely sensed data may be outdated. Regardless, this will give you a reasonable point to assess in the field during subsequent phases of the LWP process.

4) Identification of information gaps and proposed monitoring approach for Phase II

Phase I is a preliminary characterization of the watershed, identifying major watershed assets and problems, functional deficits, and stressors that limit function. Phase II completes this characterization, filling in the gaps to provide a better picture of watershed assets and problems and prioritizing stressors and sources. In order to set the stage for Phase II, obvious information gaps should be identified.

Data that are essential to determine the importance and sources of stressors, to prioritize subwatersheds and drainage areas for attention, and to identify specific project areas should be identified. These data gaps will vary from watershed to watershed, but the most essential datasets to consider are recent aerial imagery, buffer characterization, hydric soils, degree of channelization, impervious cover, and land use/cover. Modeling may be required where there is a dearth of water quality monitoring data (e.g., nutrient loading model) or to address particular issues of interest (e.g., build-out scenarios in urbanizing areas).

The planning team should develop a plan to assess stream and wetland integrity. The objective of a monitoring or assessment plan should be to obtain adequate coverage of data in order to characterize overall integrity of resources and identify stressors to biological communities. As referenced in **CPF Section (iv)**, data to be collected typically includes, at a minimum, biological community data (e.g., fish or benthic macroinvertebrate), water column physical/chemical data, habitat data, and other stream assessment information (e.g., channel stability, pollution sources). A general scope of work for DWQ water quality assessments is included as **Appendix B**. Additional data collection, such as toxicity monitoring may be recommended based on watershed conditions.

5) Summary of functional impacts & proposed scope of work for Phases II and III

Addressing the major functional losses (or impacts) and protecting the major functional assets identified during Phase I can be translated into specific goals for the watershed as referenced in **CPF Section (v)**. These goals, in turn, can be linked to specific objectives and associated tasks recommended for the detailed assessment and plan development phases of the effort (LWP Phases II and III).

The last major section of the Preliminary Findings Report (PFR) should include one or more tables that:

- 1) summarizes the major watershed-wide and, if possible, subwatershed-specific functional issues -- both problems and assets -- and any related data gaps;
- 2) identifies the presumed or documented major stressors linked to specific watershed functional problems/deficits; and
- 3) then translates these stressors into specific indicators/metrics and assessment tools for the subsequent phase of work (i.e., Phase II – Detailed Assessment).

This can be a difficult section of the PFR to develop, but it is critical to be able to concisely summarize the major results of the Phase I work in terms of functional problems and assets, and to then convert these functional issues into logical watershed goals/objectives (within the context of EEP’s overall mission to “restore, enhance, protect”). Hand in hand with this identification of specific watershed functional goals is the preliminary identification of major functional stressors linked to specific problems. In many cases the stressors identified during the Phase I tasks are more appropriately seen as working hypotheses about the most important causes or sources of functional impacts/losses. The hypothesized (presumed or apparent) major stressors can then be converted into appropriate indicators/metrics to be pursued using various assessment tools during the detailed assessment tasks (Phase II).

In determining where to conduct the Phase II assessment work, depending on the amount and quality of data that has been collected and evaluated during the Phase I tasks, it is usually possible to identify preliminary **priority subwatersheds** or catchments for detailed assessment. These priority subwatersheds can be chosen to represent areas of the LWP in which certain functional stressors and associated deficits are occurring (or are most likely to occur). These priority areas may also be subwatersheds or catchments with specific issues that are prioritized for detailed assessment.

Recommended Phase II assessment tasks may include some (or all) of the following, depending on the nature and scale of functional stressors in question and basic site access issues: high-priority, representative subwatersheds (one to five square miles), catchments (< 1 sq. mile), and/or specific stream or buffer and wetland sites. For instance, an urban catchment with documented (or high potential for) aquatic habitat issues related to stormwater hydraulic stresses may be a logical area in which to recommend collection of detailed information related to stormwater infrastructure and/or detailed channel condition and stream biological data, assuming that this catchment is representative of other catchments or subwatersheds and/or has been identified as an important “hot spot” for local functional impacts.

This last section of the PFR should be a detailed summary or outline of the recommended major tasks and sub-tasks for the next two Phases of work, developed logically from the goals, objectives, functional stressors and recommended indicators/metrics identified in the summary table(s). **Table 3** provides an example of summary of objectives developed for the Peachtree Martins Creek LWP. The Phase II recommendations in this section of the PFR should be detailed enough to serve as the basis for defensible cost/budget estimates and scope of work development for any outside consultants/contractors that EEP may use. The PFR should be reviewed internally as designated in the most recent version of the EEP Watershed Planning Document Review Assignment table.

Table 3. Proposed objectives for Phases II & III of the Peachtree-Martins Creek LWP, from the Preliminary Findings and Recommendations Report (EEP, 2006c)

Objective	Related Stressors
<i>A. General Ecological Objectives</i>	
A1. More fully assess the status of fish and macroinvertebrate communities	multiple
A2. More fully assess aquatic habitat conditions	multiple
A3. Identify aquatic and terrestrial habitats that are of natural heritage value and prioritize for conservation	multiple
A4. Develop protection strategies for high priority areas of natural heritage value	multiple
<i>B. Stressor-Specific Objectives Pertaining to All or Most of the Project Area</i>	
B1. Quantify the extent of channel modification and evaluate its impacts in terms of channel erosion and stream stability	channel modification
B2. Identify stream segments impacted by channel modification where restoration is feasible, and prioritize stream segments for restoration	channel modification
B3. Quantify riparian area disturbance due to agricultural activities, development or other causes	riparian area disturbance
B4. Identify stream segments impacted by the removal of riparian vegetation, or ongoing activity within the riparian zone, where restoration is feasible	riparian area disturbance
B5. Prioritize sites for riparian vegetation enhancement, and evaluate BMPs to address other identified riparian area problems	riparian area disturbance
B6. Quantify the extent of in-stream impacts due to excessive sediment loading	sediment
B7. Identify upland sediment sources and evaluate strategies for reducing sediment inputs	sediment
B8. Quantify the extent of fecal coliform and nutrient contamination	bacteria & nutrients
B9. Identify potential pollution sources and management measures to reduce fecal coliform and nutrient inputs	bacteria & nutrients
<i>C. Objectives for Localized Stressor Impacts</i>	
C1. Quantify potential stormwater impacts, focusing primarily on the Peachtree area (including densely developed portions of the following sub-watersheds: McComb Branch, Peachtree Bottomlands, Middle Peachtree, Slow Creek Bottomlands)	stormwater
C2. Develop strategies to mitigate identified stormwater impacts	stormwater
C3. Quantify potential impacts of groundwater contamination from organic chemicals at known sites in the following sub-watersheds: McComb Branch, Peachtree Bottomlands, Slow Creek Bottomlands	organic chemicals
C4. Develop groundwater remediation strategies as needed	
C5. Further evaluate conductivity levels in the Hiwassee River tributary draining the Mission Quarry area. Assess the sources of high conductivity and develop management strategies if warranted.	unknown pollutants
<i>D. Objectives Regarding Future Threats to Ecological Function</i>	
D1. Evaluate the extent to which increased residential construction, and other development, is likely within the project area over the next 20 years. Quantify impacts	multiple
D2. Evaluate strategies to mitigate the potential ecological impacts of future development	multiple

G. Preliminary Findings Report Outline

The minimum elements and content of the Preliminary Findings Report are outlined below:

- I. Introduction
(scope/purpose; EEP watershed planning approach, phases)
- II. LWP Study Area –
(background & overview: summary of previous studies, existing/historical land use data, applicable state & local programs, rules, & policies)
- III. Subwatershed Delineation
- IV. Preliminary Watershed Characterization
 - A. Introduction & Methodology
 - B. Physical Characteristics
(topography, land cover/land use, etc.)
 - C. Ecological Characteristics
(streams, wetlands, riparian areas, uplands)
 - i. Terrestrial Habitat & Species of Concern
 - ii. Water Quality & Aquatic Habitat
 - D. Historical Land Use & Development
 - E. Preliminary Identification of *Problems* (Stressors/Sources) and *Assets*
 - F. Preliminary Functional Assessment
- V. Recommendations for Phase II Assessment
 - A. Key Data Gaps
 - B. Objectives and Priority Subwatersheds for Phase II Assessment
 - C. Assessment Strategy/Approach – indicators and methods
- VI. Preliminary Project Implementation Opportunities

References

Appendices

- GIS Data Summary/Sources
- Supporting Documents (e.g., DWQ-WAT Existing Data Summary Report)

PHASE II: Detailed Watershed Assessment

Phase II is the detailed watershed assessment phase of the LWP effort that addresses assessment goals and objectives determined at the end of Phase I. More intensive field and GIS data collection and analysis efforts are performed in order to better characterize aquatic integrity and identify stressors and their sources. The final product of Phase II is the **Watershed Assessment Report**.

A. Goals and Objectives

During Phase I, specific goals and objectives for Phases II and III of the LWP are identified (see **Table 3** in Phase I section for an example). During Phase II, these goals and objectives should be reviewed and further refined by the planning team as necessary.

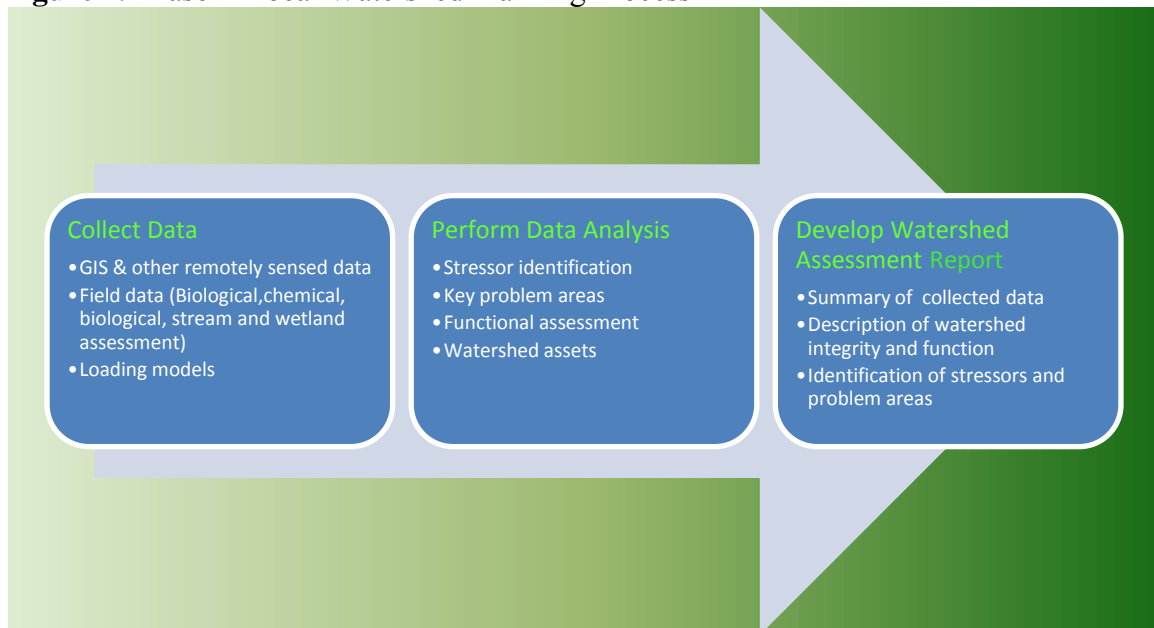
Phase II activities should not only address specific needs and questions named in Phase I, they should also allow for a comprehensive assessment of overall watershed function. The method to be used to determine function and integrity with the data collected should be determined by the planning team before data collection begins. In most LWPs, detailed assessment tasks are often concentrated in priority subwatersheds that have been identified during Phase I.

The basic goals of the watershed assessment are:

1. Determine the functional integrity of streams and other aquatic systems in the watershed.
2. Further refine identification of the key stressors and their sources impacting water quality, habitat, and hydrology and determine where they are focused.
3. Identify key assets in the watershed.

Figure 4 summarizes the major steps taken to achieve these goals.

Figure 4. Phase II Local Watershed Planning Process



B. Data Collection and Modeling

Typically, most new data collected for the LWP effort are collected in Phase II. However, depending on the amount of data already available during Phase I and access to monitoring resources, some of the detailed assessment activities may have begun during Phase I.

1) GIS data

The Phase I report identified additional GIS datasets to address critical data gaps. During Phase II, GIS datasets that are essential to address Phase II and III objectives should be acquired or developed. Examples of some important datasets and their applications in the LWP process are provided in the next several paragraphs.

One of the most important base datasets that may be needed is recent aerial imagery. County GIS staff should be able to provide the most recent GIS datasets available for parcel information and finer resolution aerial photography. However, the more recent aerial imagery at a coarser resolution may be available through statewide sources, such as that from the National Agriculture Imagery Program (NAIP). Current aerial imagery can also be acquired via contractors that provide orthophotography for specified areas, such as the Tennessee Valley Authority (TVA). In some situations, flying over the LWP area can be a cost-effective way to gather updated information; this can involve a formal set of orthophotographs (using an established company such as TVA) or simple photos and notes taken by the planner (using a local pilot).

Datasets that change frequently, such as parcel information, should be updated from those obtained in Phase I. Parcel information is used to identify on-the-ground projects and landowners that may need to be contacted during assessment activities.

If the LWP area contains an urbanizing area, a recent impervious cover dataset may be needed. This can be derived through analysis of aerial imagery or parcel information through numerous automated methods. High levels of impervious cover alter the hydrology of a watershed by increasing the speed and volume of storm runoff entering streams, resulting in downcutting, bank erosion, and general stream instability. In-stream habitat for benthos and fish is severely altered by the effects of imperviousness. Typically in urban areas, the community structure of benthos and fish reflects this poor habitat. Measures of habitat and hydrologic alteration are integral to developing an effective plan. Accurate assessments of the extent and configuration of imperviousness in catchments and measures of habitat alteration throughout the study area can allow determination of the best areas in which to concentrate projects to address these impacts.

A riparian buffer dataset is also a useful GIS dataset, which can be used in both assessment and project identification. An intact riparian buffer influences in-stream habitat, bank stability, water quality, and water temperature. The width of existing forested buffer can be determined a number of ways. Using existing land use/cover data can be an inexpensive way to determine if a stream has a forested buffer, but the land use/cover pixel size may be too large if buffer widths of certain increments are to be

determined. The most precise way to determine buffer width is to determine it manually with recent aerial photography. In mountain watersheds, for example, planners have used 0 ft, 0-30 ft, 30-100 ft, and >100 ft as classifications for woody buffer width (e.g., the Franklin to Fontana LWP, see EEP, 2009).

Important datasets to consider for wetland assessment include: hydric soils, USDA soil survey wet areas, LIDAR, NWI wetlands, NC Floodplain mapping, USGS topographic mapping and stream layers. In the coastal counties, NC Coastal Region Evaluation of Wetland Significance (NC-CREWS) data are available. These data, in association with landuse data and aerial photography (both historic and current) can provide insights to wetland areas within the watershed. Those areas that are currently in agricultural land use but are dominated by hydric soils often serve as good indicators for wetland restoration opportunities.

Any GIS data developed should also have accompanying metadata, meeting federal government standards set by the Federal Geographic Data Committee (<http://www.fgdc.gov/metadata>). The EEP GIS coordinator should be consulted to ensure the GIS data conforms to EEP standard geodatabase format.

2) Field data

Field data can be collected by DWQ, EEP, and/or consultant staff. Field data should be stored in electronic files (Access or Excel) that have undergone proper quality assurance. All sampling plans and data reports should be reviewed internally as designated in the most recent version of the EEP Watershed Planning Document Review Assignment table.

a) Biological communities

Community structure of benthic macroinvertebrates and fish can provide synoptic information indicating the overall habitability of a stream. Because biological community data can be used to gauge overall stream integrity and specific stressors, they comprise an important base dataset. The information provided by the biological community dataset can guide a plan for subsequent stressor and source identification activities, including physical/chemical/toxicity sampling and habitat/channel assessments.

In most EEP LWPs, benthic macroinvertebrates have been the key biological community assessed. The DWQ benthic macroinvertebrate assessment program is well-established and covers many more sites across the state than the fish assessment program. Benthic macroinvertebrate sampling and data analysis techniques are geared to assessment of *water quality*. Fish community sampling and data analysis techniques gauge both *water quality and habitat*. As the two different biological communities respond differently to various stressors (e.g., benthos can demonstrate severe impacts from slugs of pesticides, fish communities have distinct responses to excess nutrients), they can provide different information on stream integrity and stressors. The planning team should discuss with DWQ biologists whether benthos or fish or a combination of the two should be assessed.

The detailed sampling plan developed in Phase I by the planning team should be carried out. Benthos sampling is conducted by Biological Assessment Unit of DWQ and/or EEP biologists. Benthic data results are provided to EEP for interpretation unless specifically requested of DWQ. Fish community sampling along with results and data interpretation are conducted by NCDOT Biological Survey Unit or BAU staff. Submitted data should note any stressors suggested or identified through community analysis. Additional interpretation should be requested if data might help explain localized conditions uncovered subsequent to the original biological sampling.

Biological community data can provide some of the most powerful information collected during the watershed assessment, as they can be used to gauge overall functional integrity of a stream and to suggest specific limiting stressors. Therefore, they are often used to broadly characterize subwatershed and stream function; optimally, it would be best to have at least one sampling site in each subwatershed or catchment. Typically this isn't feasible. Instead it often makes better sense to strategically place sampling points so that all parts of the watershed have the same level of coverage. Consideration should be given to locating a sampling location at the lower end of a subwatershed in an effort to capture information on exiting water quality. Further sampling may be incorporated later to try and track the source of water quality concerns.

Alternatively, in study areas with only a few land uses covering most subwatersheds, it may be better to choose one or two catchments as representatives for examining how that land use impacts biota. This is a particularly good approach in very large study areas. This sort of characterization work can be performed during Phase I or Phase II. Biological communities can also be assessed to determine site-specific issues, such as point source problems, pesticide and nutrient impacts, and causes of stream impairment.

b) Physical/chemical/toxicological data

Data gaps identified during Phase I should be filled to the extent practicable with new data collected. A detailed plan should be followed that provides information potentially serving several purposes, which can include general watershed water quality *characterization*, specific *hypothesis testing*, and *model calibration*. If DWQ-WAT is performing the monitoring, this monitoring plan is referred to as the "DWQ Assessment Plan". A general scope of work outlining tasks associated with the DWQ Assessment Plan is included as **Appendix B**.

Watershed characterization data can consist of a wide array of parameters. As referenced in **Section (iv) of the CPF**, field parameters that are typically and easily collected are dissolved oxygen, pH, temperature, and specific conductance. Most other parameters must be analyzed in the laboratory; the most common lab analyzed parameters include nutrients, fecal coliform bacteria, total suspended residue, metals, and turbidity. Typically, large-scale organics and metals sampling is cost-prohibitive, but in instances where a particular organic chemical (e.g., a pesticide compound) or suite of metals is suspected, it may be targeted for sampling.

Hypothesis testing can consist of field data collection and laboratory analyses focused on answering a specific question about a localized area of the watershed. Questions to be answered in the context of a local watershed plan should be framed to help determine the success of recommended projects and management strategies. For example, it may be possible to determine why biological communities in one tributary are significantly poorer than most in the study watershed. Field or laboratory data may suggest what pollutants make the particular community less diverse. The utility of answering such a question is that it allows the development of better recommendations. If laboratory data show that one tributary suffers from a chronic toxicity problem that stream and wetland restoration projects cannot address adequately, then it wouldn't make sense to recommend the same traditional restoration projects that may be recommended for most tributaries in the study watershed. Instead, a set of recommendations that will address the problem can be developed in the plan with the input of stakeholders. These recommendations often require the efforts of other agencies and organizations (e.g., DWQ or the local health department).

Data collection for model calibration should be carefully planned out in advance by the planning team. The particular model for which this type of data is being collected will dictate the array of parameters and intensity of collected data. Refer to the next section titled "Loading Models".

Toxicological analyses available through DWQ consist of Whole Effluent Toxicity (WET) analyses, including acute and chronic toxicity screening methods with standard test organisms (see <http://cfpub.epa.gov/npdes/wqbasedpermitting/wet.cfm>). These WET analyses can be helpful if toxicity is suspected from a specific source (e.g., landfill leachate). If sediment toxicity is suspected or different water column toxicity assays are needed, EEP will contract with outside laboratories to perform analyses.

In addition to characterization of baseflow conditions, storm sampling may be important to identify concentrated slugs of pollutants that run off into streams during rain events. The movement of pollutants within a watershed is critical information to document during plan development. Without a clear understanding of watershed hydrology and water quality during storms, predicting the success of projects or management strategies can be an unreliable exercise. **Table 4** presents an array of pollutant and toxicant groups and indicates conditions when they should be sampled. For a complete list of parameters available to be sampled, consult the DWQ Chemical Laboratory website at <http://portal.ncdenr.org/web/wq/lab>.

Some stressors are more likely found in particular physiographic regions with particular land uses. Typically catchments or subwatersheds are classified as either rural or urban (occasionally urbanizing, but rarely on a catchment scale). Rural subwatersheds dominated by agricultural are impacted by an array of pollutants that are usually more easily defined than in urban subwatersheds. Within a catchment, it is likely that only a small number of crops are grown. The fertilizers and pesticides applied to these crops can be determined by contacting local agricultural extension agents. If the biological community shows signs of toxic impacts, testing for these chemicals in the water column

or sediment during baseflow (for chronic conditions) or in the water column only during storms (for estimating acute concentrations) may help identify specific stressors.

Table 4. Potential physical/chemical/toxicological parameters that may be evaluated in LWP assessments

PARAMETER	WATERSHED TYPE	FLOW	JUSTIFICATION
Field Measures¹	All	Both	Measured at all sites each visit for baseline
Turbidity	All	Stormflow	Measured primarily at sites where sediment and erosion are issues
Total Residual Chlorine	Urban	Baseflow	Measured above and below known sources such as waste water treatment plants
Salinity	All	Both	Taken with other field measurements only at coastal and estuarine sites as baseline data
Nutrients	All	Both	Measured in agricultural and residential areas to detect fertilizer runoff from chemical application to crops and lawns and from livestock waste
Metals	Urban	Both	Measured where treatment plant or industrial inputs suspected; or high amount of impervious cover
Suspended Residue	All	Stormflow	Measured in conjunction with turbidity to quantify water column sediment
Fecal Coliform Bacteria	All	Both	Measured as a surrogate when bacterial issues are expected in streams
Organic Compounds²	All	Both	Measured to quantify specific pesticides and herbicides in agricultural areas; in urban areas used to document particular industrial inputs
Toxicity Screening	Urban, mixed	Both	Used where toxicity is suspected; indicates where traditional projects may not be effective
Benthic Macroinvertebrates	All	Baseflow	To diagnose overall watershed integrity at a point or reach (or of a tributary)
Fish Community Assessment	All	Baseflow	To diagnose overall watershed integrity at a point or reach (or of a tributary)

¹ Field Measures include dissolved oxygen, water temperature, pH, and specific conductance.

² Organics measured at a site are usually limited to known chemicals applied to crops or used in industrial processing

The pollutants impacting urban watersheds are many and it would be difficult and extremely expensive to test for them all. It may be more feasible to test for chemical groups associated with known practices within the watershed. For example, testing for metals and residual chlorine would be a good place to start when determining the impact of a wastewater treatment plant in the study area. Similarly, in urban areas where there is a history of sewer leaks or leaching septic systems, testing for fecal coliform bacteria is a reasonable way to determine this impact.

c) Channel and riparian zone assessment

As with biological community assessment and pollutant testing, the monitoring plan developed during Phase I should outline a channel assessment strategy that will fill key gaps in our knowledge of the watershed conditions, providing a more complete picture of functional integrity, stressors, and their sources. In some LWPs, especially those with less staff and financial resources and/or those on a tight time-frame to provide mitigation project opportunities, channel assessment is used to gather information where it appears stream restoration will be needed. Both the assessment and reach selection methods should be tailored to the objective of the channel assessment. Methods employed can range from rapid visual assessments, similar to the windshield surveys performed in Phase I, to detailed protocols with specific measurements such as the ECU coastal riparian assessment methodology (Rheinhardt et al., 2005; Brinson et al., 2006). In particularly small study areas, it may be possible to assess channel condition in all major streams in the watershed. More likely, the watershed will be substantially large, making assessment of all stream reaches infeasible. In these cases, it may be more sensible to focus assessment on representative stream reaches based on land use or priority reaches based on identified stressors.

As much as possible, channels covering a full range of conditions and settings should be characterized: headwater and downstream, urban and rural, pristine and degraded. During the course of the stream assessments, field staff should also keep in mind the potential for particular reaches to serve as project sites and document potential feasibility. The benefits and disadvantages of employing widely accepted methods, versus ones developed for specific regions such as coastal plain versus piedmont streams or channel types, should be considered. **Table 5** outlines examples of assessment methodologies that may be employed to characterize channel and riparian zone conditions in the watershed.

Field data including photographic documentation should be provided in standard electronic file formats. If possible, field staff should determine GPS coordinates for all photo locations, for subsequent creation of georeferenced (photo-linked) map figures to be included in Phase II reports (the final Watershed Assessment Report and/or interim Technical Memos).

d) Wetland assessment

Remote sensing information can be used to approximate the extent of wetlands in the LWP area. Wetlands identified using GIS should be field verified. The level of field work needed depends on the purpose of wetland assessment. If wetlands are being used

to gauge subwatershed function, wetland location and boundaries can be GPSed and verified using the 1987 US Army Corps of Engineers Routine Wetland Determination Form (<http://www.wetlands.com/pdf/wldetfm1.pdf>). For wetlands within counties regulated by the Coastal Area Management Act (CAMA) or located within North Carolina's inner coastal plain, the NC-CREWS (<http://dcm2.enr.state.nc.us/wetlands/nccrews.htm>) dataset provides a rating of a wetland's overall significance and its water quality, wildlife habitat, and hydrologic subfunctions. NCWAM may be used at the same time to assess existing function. Potential wetland restoration or enhancement sites should be field verified, and information gathered on hydric soil extent, hydrologic modifications, and existing vegetation. The general wetland group--coastal, riparian (riverine or non-riverine), non-riparian—should also be determined. **Table 6** provides a cross reference for NCWAM and general wetland type.

Once wetland location, area, and features (soils, hydrology, vegetation) are identified in the field, additional analysis desired related to wetlands can be performed. Analysis can address extent of wetland loss, extent of habitat, hydrologic or water quality function lost, and potential for wetland restoration and preservation.

3) Loading models

The planning team should determine if any models already exist for the watershed, including those developed for Total Maximum Daily Loads (TMDLs). Pollutant modeling is performed by numerous state and federal agencies (e.g., NC DWQ, NC Department of Transportation, US Geological Survey, universities), which should be consulted so that any previous modeling can be reviewed and used if applicable to the LWP effort.

Watershed modeling is one tool that may be used to better understand the dynamic functions of a watershed, especially its *hydrologic and water quality functions*. In instances where data are sparse, modeling can estimate relative impacts of a particular stressor, allowing justifiable comparison and prioritization of subwatersheds. Loading models demonstrate how land use in upstream subwatersheds affects functions in downstream subwatersheds. Many models quantify inputs of pollutants such as nutrients and sediment, usually based on types of land use. In watersheds where the primary stressors include these sorts of parameters, it should be determined whether collecting actual water quality data from the watershed will improve the model's predictions. If additional data are to be collected, a well-crafted data collection strategy should be laid out in advance of any field sampling; sampling goals and model assumptions should be explicitly described.

Models are not limited to only the above parameters. In general, if loading values based on the literature or on actual watershed-specific calibrations can be assigned to logical land use categories or to average conditions across entire catchments, a model can yield reasonable, useful predictions. Land use categories may be simple such as “predominantly agricultural” or complex such as “predominantly mixed agricultural and forest, significantly low-density residential.” In order to run some models, average

conditions across catchments may be calculated for characteristics such as slope, impervious cover, or soil erodibility.

Table 5. Examples of channel and riparian zone assessment methodologies

Bank Erosion Hazard Index	Site-Specific	Multiple parameters are estimated by field personnel and input into an index equation; measures are typically estimated by sampler, therefore more experience is better (Rosgen, 2001)
Bank Height Ratio	Site-Specific	Empirical measure of potential bank instability based on slope measure and rise; rapid method lends itself to large watersheds; requires minimal training
Center for Watershed Protection, Unified Subwatershed and Site Reconnaissance	Reach, Catchment, Site-Specific	Detailed information collected at sites along sampling reaches; time consuming and expensive if performed for entire watershed; requires moderate training (CWP, 2005a)
Center for Watershed Protection, Unified Stream Assessment	Subwatershed	Typically performed for entire watersheds; costly and time-consuming but provides ample information to compare subwatersheds; requires extensive training (CWP, 2005b)
Natural Resources Conservation Service, Stream Visual Assessment Protocol	Reach, Catchment	Multiple parameters are each rated according to a uniform numerical scale with detailed descriptions; method requires moderate training but more experience is better (USDA, 1998)
Eastern Carolina University, Coastal Riparian Assessment Methodology	Reach, Subwatershed	A reference-based method developed for the inner coastal plain. Assesses 100 yd reaches, observing 9 indicators that are aggregated logically into scores reflective of the current understanding between indicators and ecosystem function for the riparian zone (Rheinhardt et al., 2005)
NC Division of Water Quality, Habitat Assessment	Reach	Data collected by DWQ during biological assessments; estimates measures related to instream and riparian habitat within the sampling reach; requires minimal training (NCDWQ, 2001)

Table 6. NCWAM types and corresponding general wetland group

WETLAND GROUP	NCWAM TYPE
CAMA Coastal wetland	Salt/Brackish Marsh
Riparian, Riverine	Riverine Swamp Forest, Non-Tidal Freshwater Marsh, Tidal Freshwater Marsh
Riparian, Non-Riverine	Bottomland Hardwood Forest, Headwater Forest, Floodplain Pool, Bog, Estuarine Woody Wetland
Non-Riparian	Non-Riverine Swamp Forest, Seep, Basin Wetland, Pocosin, Pine Flat, Pine Savanna, Hardwood Flat

Examples of models used in previous LWPs are described in **Table 7**. Choice of a model should be based on the question to be answered and the precision required. In general, best model results can be achieved when additional data is collected during the LWP process that is specifically intended to calibrate portions of the model. General summary

Table 7. Examples of water quality models used in LWPs

Model	Purpose	Example LWP
Model for Stormwater Improvement Conceptualization (MUSIC)	Evaluate pollutant removal effectiveness of stormwater BMPs	Fishing Creek LWP; Middle Tar Pam LWP; Little River & Bledsoe Creek LWP
Various pollutant loading models	Estimates of TSS, BOD, total N, total P from specific land uses.	Pasquotank LWP; Upper Swift Creek LWP; White Oak LWP
Spreadsheet Tool for Estimating Pollutant Load (STEP-L)	Evaluate pollutant removal performance of stream projects and BMPs.	Indian and Howards Creek LWP
GIS Pollutant Load (PLOAD)	Predict annual runoff and pollutant concentrations under various scenarios.	Lockwoods Folly LWP
SWAT (Soil & Water Assessment Tool)	Sediment and nutrient loading estimates determined to assess landuse impacts to water quality and provide baseline estimate of watershed conditions.	Middle Cape Fear LWP
Loading Simulation Program in C+ (LSPC) Modeling System	Address urban and rural watershed hydrology, surface water quality analysis and pollutant decay and transformation.	Swift Creek LWP
Unified Stormwater Treatment Model (USTM)	Evaluate pollutant removal effectiveness of stormwater BMPs.	Little River & Bledsoe Creek LWP
Watershed Management Model (WMM)	Estimate event mean concentrations based on land use/cover; existing and future land use scenarios.	Upper Rocky River & Clarke Creek LWP
HEC-HMS	Conduct stream stability assessments.	Troublesome & Little Troublesome Creek LWP
HEC-RAS	Conduct stream stability assessments.	Troublesome & Little Troublesome Creek LWP
EUTROMOD	Predicted sediment trapping and nutrient loadings in local lakes.	Troublesome & Little Troublesome Creek LWP
USGS Sparrow	Estimate the portion of nutrient load delivered from subwatersheds for existing and buildout conditions.	Morgan & Little Creek LWP
Generalized Watershed Loading Function (GWLF)	Assess contribution of upland sediment and nutrient loads under existing and buildout scenarios.	Morgan & Little Creek LWP; Rocky River LWP
USLE combined with spreadsheet model	Determine sediment and nutrient loading sources	Peachtree-Martins Creek LWP

statistics that may be incorporated into some models can be developed using ArcGIS and its extensions.

In watersheds where Total Maximum Daily Load (TMDL) development is required by DWQ, data collection should be coordinated with the DWQ TMDL Program to support both EEP and DWQ goals. Guidelines for TMDL development and supportive data

collection can be found in the Environmental Protection Agency's guidance for developing watershed plans (USEPA, 2005).

C. Data Analysis

GIS and field data should be analyzed to determine the overall functional integrity of the watershed (and its component subwatersheds) and the key stressors responsible for stream and/or wetland degradation. Analysis can be performed to determine the level of hydrologic, habitat, and water quality function of streams and subwatersheds in the LWP area. From this larger functional analysis, key problem areas can be identified.

1) Stream, wetland and riparian integrity and stressor identification

Stream, wetland, and riparian area integrity should be characterized using both field and GIS data. Field data will be available for a subset of streams and wetlands; thus GIS data on land use and potential stressors can be used to extrapolate field data to streams and wetlands of similar character. In determining overall system health, emphasis should be placed on measures that indicate overall system function and integrity (e.g., biological community ratings). However, specific measures of hydrological, habitat, and water quality function should also be used to characterize integrity and determine key factors that limit function in subwatersheds and specific streams and wetlands.

During Phase I, preliminary stressors that limit stream integrity and some possible sources were identified. In Phase II, additional data should be used to support and expand upon the Phase I findings. The thorough synthesis of new and old data will likely indicate specific stressors and the relative degree to which each is influencing normal watershed function. Particular effort should be made to prioritize and quantify these stressors. The ones causing the most negative impact should be addressed to the maximum extent practical in the Watershed Management Plan.

Additional data that refute or do not support prior conclusions from previously existing data must be especially well documented. These data are sometimes used by other agencies to reexamine their findings (e.g., DWQ use support ratings). Special efforts should be made to identify and rank stressors for impaired and degraded streams. This should be performed in collaboration with DWQ staff.

The following datasets should be used to determine stream integrity and key stressors:

Biological conditions

The biological community may provide the best synthesis of stream integrity of any dataset. Results from fish and benthic studies performed by DWQ or other biologists should be analyzed to characterize biological integrity for streams sampled. Key stressors identified for biological communities should also be summarized.

Habitat data

Habitat data collected during biological surveys and channel and wetland assessments should be summarized and any links to biological community degradation determined. For streams, parameters including pool and riffle frequency and quality, in-stream

microhabitat, particle size distribution of bed sediment, riffle embeddedness, degree of channelization, and riparian vegetation should be characterized.

Physical/chemical water quality conditions

Physical/chemical water quality conditions should be summarized and interpreted, and water quality problems/stressors identified. Pollutants should be linked to aquatic functions or uses. Identifying those pollutants that contribute to biological community degradation or impairment is a priority. However, some contaminants do not necessarily impact fish and benthic populations, but can impact human uses (e.g., fecal coliform bacteria).

Channel and riparian conditions

Data from both field assessments and GIS analysis should be used to characterize stream channel and riparian area conditions. Factors influencing channel stability should be characterized for streams, including channel sinuosity and corresponding extent of channelization, riffle-pool integrity and sequencing, and channel incision and ability to access the floodplain. Describe channel stability in terms of level of incision, aggradation, and widening. The width and vegetative type of the riparian buffers should also be characterized. Causal relationships among these factors, specific habitat limitations, and biological communities should be determined to the fullest extent practical, given available data quantity and quality.

2) Key problem areas

When identifying key problem areas in the watershed, multiple data sources can provide support for hypotheses developed earlier in the process. GIS datasets, field observations during the Phase I windshield surveys, and especially information on stream and riparian area condition collected during stream walks yield clues that help identify problem areas.

Water quality data collected at strategic sampling locations in the watershed can contribute to problem area identification also. Nutrients and other chemical data may be attributed to particular land-uses upstream or may be traced to a specific source during field investigations. Similarly, biological data represent water quality conditions upstream and in-stream habitat conditions at the particular sampling site.

Qualitative information should also be explored. Stakeholders and other resource professionals frequently identify key areas that may not appear in data sets. Significant problem areas should be investigated and verified in the field. Combine verified problem areas with those from previously identified sources for a more comprehensive list.

One possible next step is to rank or assess the data for patterns. Cluster analysis or similarity index assessment can identify groups of adjacent catchments with similar issues. Sometimes it may make sense to treat these as a single management unit. In some instances, it may be sufficient to rank the problem areas in order of relative contribution to overall watershed dysfunction.

Key problem areas can be ranked in a number of ways based on weighted criteria that reflect program policy or resource management practices. GIS or simulation models can show less obvious concentrations of problem areas. These tools may also demonstrate how combinations of parameters contribute synergistically to watershed degradation or they may be used to show how different configurations of projects contribute synergistically to watershed functional improvement.

3) Functional Assessment

LWP efforts should be geared towards a reasonably comprehensive assessment of the most important local watershed functions, as presented in the Watershed Needs Assessment Team (WNAT) report (2003). A highly functioning system provides consistent support for ecological processes. When a system is exposed to stress, it can lose its ability to support ecological processes. Water quality, hydrology, and habitat functions can be assessed with a number of indicators, some of which are summarized in the WNAT report. Hydrologic function can be assessed using various channel, riparian, and land characteristics, including but not limited to degree of channelization, channel stability, in-stream habitat, impervious cover, floodplain encroachment, impoundments and other flood control structures, storm sewers, wetland extent and location, and growth and development trends. Habitat function can be assessed with in-stream habitat, biological community indicators and extent of forested riparian buffers. Water quality function can be characterized with water and sediment chemistry data, biological community indicators, and a range of land use-related data, such as degree of impervious cover and forested area.

Functional integrity can be determined for wetlands, stream reaches, and subwatershed areas. Because field data are only collected for a subset of stream reaches, they should be extrapolated to represent streams of similar character in other areas.

An example matrix of functional indicators and corresponding GIS and field measures for the rural and mountainous Bald Creek LWP area is shown in **Table 8**. The Bald Creek LWP effort used a relatively rich set of GIS and field data; in some LWPs, there may not be enough data to analyze function in this way.

Indicators should be evaluated using qualitative and quantitative criteria to gauge the relative degree of function, using the ratings of high, moderate, and low. Determining the thresholds to use for high, moderate, and low values for these metrics can be a challenging task. These should be developed by the lead planner or consultant with input from the planning team and other technical staff that may have experience with the metrics used (e.g., DWQ biologists). Thresholds can be determined in a number of ways, including using those established in literature (e.g., impervious cover), making comparisons to values from reference streams or subwatersheds in the LWP, using benchmarks or standards established by state or other government agencies, and best professional judgment informed by experience in the LWP.

At a minimum, functional assessment should result in a table and corresponding map of ratings of overall ecological function for each subwatershed (see **Table 9** and **Figure 5**

for an example from the Franklin to Fontana LWP); depending on when the data are available, this may be performed during Phase I or Phase II. If enough data are available, ratings should be provided for each megafunction (habitat, hydrology, and water quality).

Table 8. Summary of watershed function indicators used in the Bald Creek LWP (EEP, 2006)

Functional Area	Indicator	Measure and Data Source
Hydrology	Stream Bank Erosion Potential	Mean BEHI score (Equinox field survey)
	Channel Incision	Mean bank height ratio (Equinox field survey)
	Forest Area Extent	% total sub-watershed area forested (GIS analysis)
	Extent of Stream Channelization	% of low gradient streams channelized (GIS analysis)
Habitat	Overall Aquatic Habitat Quality	Mean total habitat score, NCDWQ stream habitat protocol (Equinox field survey)
	Pool Frequency and Variety	Mean pool score, NCDWQ stream habitat protocol (Equinox field survey)
	Microhabitat Diversity and Abundance	Mean microhabitat score, NCDWQ stream habitat protocol (Equinox field survey)
	Riparian Forest Area Extent	% of stream length with forested riparian zone ≥ 100 ft ¹ wide (GIS analysis)
Water Quality	Specific Conductance	Mean specific conductance (Equinox field measurement)
	Bacterial Contamination	Geometric mean fecal coliform concentration (NCDWQ sampling)
	Riparian Forest Area Extent	% of stream length with forested riparian zone ≥ 30 ft ¹ wide (GIS analysis)
	Housing Density	Homes per square mile (Equinox windshield survey)

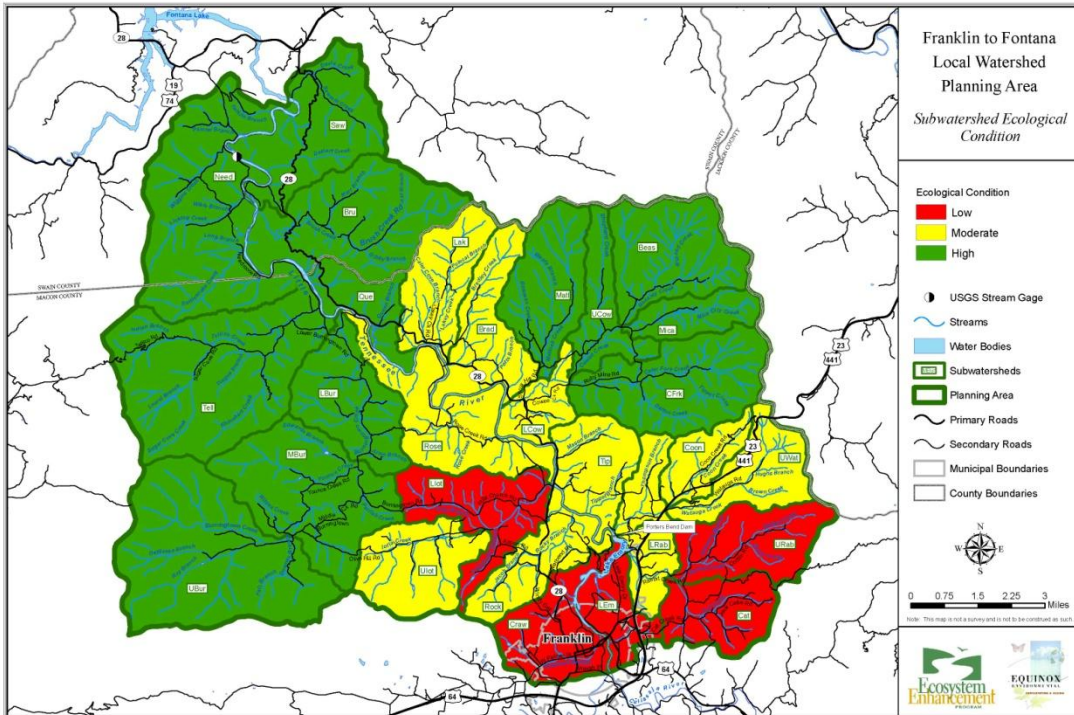
¹Width of forested riparian zone used should vary depending on data available, ecoregion, and stream and watershed characteristics.

Table 9. Subwatershed ratings of individual attributes and overall ecological condition for the Franklin to Fontana LWP

SubWS ID	SubWS Code	Attribute Ratings				Rating of Overall Ecological Condition
		Forest Cover	Riparian Condition	Biological Communities	Conductivity	
9	Beas	H	H		H	H
10	Mica	H	H		H	H
11	UCow	H	H	H	H	H
12	CFrk	H	H	H	M	H
13	Matl	H	H	M	H	H
17	Que	H	H		H	H
104	UBur	H	H		H	H
105	MBur	H	H	H	H	H
106	LBur	H	H	H	H	H
107	Tell	H	H	H	H	H
108	Need	H	H	H	H	H
109	Bru	H	H	H	M	H
110	Saw	H	H	M	M	H
4	LRab	H	M	M	M	M
5	UWat	H	H	M	L	M
6	Coon	H	M	M	M	M
7	LWat	H	L	M	L	M
8	Tip	H	M		M	M
14	LCow	M	L	H	H	M
15	Brad	H	M	M	H	M
16	Lak	H	M	M	H	M
18	Ulot	H	H	M	M	M
102	Rock	H	M	M	M	M
103	Rose	H	M	M	H	M
1	LEm	M	L		M	L
2	URab	H	M	L	L	L
3	Cat	M	L	L	L	L
19	Llot	M	L	M	L	L
101	Craw	M	L	L	L	L

(1) Key: L=low, M=moderate, H=high. See text for sources and criteria.

Figure 5. Subwatershed ecological condition in the Franklin to Fontana LWP



The mapped ratings should be color-coded with standard colors--green for high, yellow for moderate, and red for low.

Results of the functional assessment can be used to determine **focus areas**, prioritized for particular management strategies that protect and/or restore watershed integrity. Some subwatershed or catchment prioritization can be performed at this point based on degree of degradation and stressor type; however, prioritization of areas for certain management strategies is typically a Phase III activity. See "Identification of Focus Areas" in the Phase III section of this document.

4) Identification of watershed assets

Watershed assets can be identified through use of the GIS and field datasets collected during Phase I and II as well as the overall functional assessment described above. This can be general (e.g., Significant Natural Heritage Areas in the LWP) or more specific (e.g., wavy-rayed lampmussel populations in Chunky Creek). Stakeholder input is important in identifying watershed assets, as their protection is best achieved with a combination of land preservation activities, local programs, and education that can only be achieved with the participation of numerous entities.

D. Watershed Assessment Report

The watershed assessment phase results in a technical report, the Watershed Assessment Report (WAR) as referenced in **CPF Section (iv)**. This report is developed by the planning team and summarizes the data collected, describes watershed integrity and function, identifies and prioritizes stressors and their sources, and pinpoints key problem

areas as well as watershed assets. If task-specific memos are developed for each major step of Phase II, these can be pulled together and integrated into the WAR.

The WAR should be reviewed internally as designated in the most recent version of the EEP Watershed Planning Document Review Assignment table. Once finalized and approved, the Watershed Assessment Report should be presented to the stakeholder group as referenced in **CPF Section (viii)** and the Interagency Review Team (IRT).

E. Watershed Assessment Report Outline

An outline of the minimal elements of the Watershed Assessment Report is provided below:

Executive Summary

I. Introduction

- A. LWP process and background
- B. Summary of Phase I findings and recommendations
- C. Goals and objectives of Phase II watershed assessment

II. Methods

A. Stream Data

1. Biological data
2. Water column data
3. Habitat and channel data
4. GIS data
5. Models

B. Wetland Data

III. Results and Discussion

A. Results

Stream Data

- Biological data
- Water column data
- Habitat and channel data
- GIS data
- Modeled data

Wetland Data

- B. Stressors and sources
- C. Problem areas
- D. Functional assessment
- E. Watershed assets

Appendices

DWQ reports/technical memos

List of GIS datasets developed and used

Detailed datasets and methods, if needed

Interim deliverables

PHASE III: Development of Watershed Management Plan and Project Atlas

Phase III focuses on the development of management strategies that include both specific project sites as well as recommendations on institutional measures that address identified stressors and have the best opportunity for bringing about functional improvement to the watershed. The final products of Phase III are the **Watershed Management Plan** and **Project Atlas**.

A. Goals and Objectives

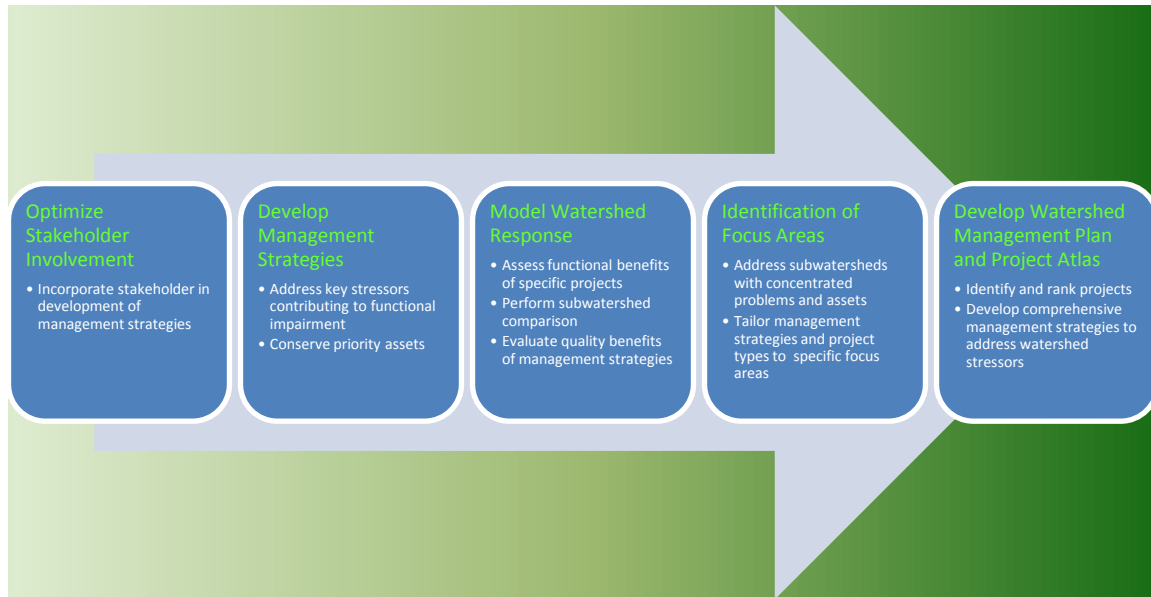
The major goal of Phase III is to develop management strategies that address watershed stressors identified during Phases I and II.

Specific Phase III objectives typically include the following:

- 1) Review the Phase I and II findings with local stakeholders and finalize the list of major problems and assets to be addressed in the Watershed Management Plan
- 2) Work collaboratively with local stakeholders, in-house staff and technical consultants to
 - finalize the selection and/or classification of focus areas for project management strategy implementation;
 - develop priorities (rankings and/or tiers) for mitigation and non-mitigation projects to be included in the final Project Atlas;
 - develop consensus recommendations for management strategies (projects and institutional measures) to address the major problems and to conserve/protect major assets;
 - begin developing an implementation strategy for the major plan recommendations, including identification of a long-term (Phase IV) local watershed advisory team.

Local watershed planning is a process that unfolds over a two to three year period with assessment data and stakeholder input being received at multiple points in the process. Therefore, the activities of all three Phases overlap to a certain degree. The planning team, in collaboration with local stakeholders, should ideally begin to develop elements of the Watershed Management Plan before the end of the Phase II work. The planning team should identify major LWP goals, objectives and end-products during Phase I and then at least *begin* the work of identifying focus areas, selecting criteria for project ranking and developing consensus recommendations for the final plan during Phase II as information about major problems and assets becomes available. **Figure 6** summarizes the major steps taken to achieve these goals and objectives.

Figure 6. Phase III Local Watershed Planning Process



B. Optimizing Stakeholder Involvement

EEP planners must ensure that opportunities for local stakeholder input are provided at key points across all phases of the LWP effort (see **CPF Section (viii)**), and such input is especially important during the development of the Project Atlas and final Watershed Management Plan. One way to begin developing consensus recommendations for watershed projects and institutional measures early on (during Phase II, or early in Phase III) is to form subgroups within the larger stakeholder group that are assigned to address particular topics. For instance, during Phase II of the Indian Creek and Howards Creek LWP (Catawba 03050102) effort many of the stakeholders agreed to serve on one of three specialized workgroups: Rural Preservation/Protection; Local Ordinances and Stormwater Management; and Source Water Protection. These workgroups consisted of two to four resource professionals who met on their own time, usually immediately before the quarterly stakeholder meetings. Their general task was to consider current needs related to local watershed problems and assets, and then develop specific written recommendations for consideration by the larger group, and then for eventual inclusion in the final Watershed Management Plan.

C. Stressors and Applicable Strategies

The most important outcomes of Phase III are a Watershed Management Plan and Project Atlas that, when implemented, are likely to address both the stressors contributing to functional impairment within and downstream of the LWP watershed(s) as well as the priority **asset** areas for conservation within the LWP. Conservation strategies are intended, in part, to prevent functional stressors from becoming significant problems within priority areas by protecting tracts of land containing riparian areas, wetlands and stream reaches that provide important habitat (e.g., subwatersheds with headwater tributaries).

Management strategies should be developed in collaboration with the stakeholder team to address the major stressors areas identified in Phase II. Stressors causing the most significant watershed problems (i.e., stressors responsible for the greatest functional impacts within the LWP area) should be addressed by developing specific recommendations to be included within the final WMP.

Recommended management strategies will include a combination of site-specific, subwatershed-specific and watershed-wide strategies. Management strategies generally fall into two broad categories: site specific projects and institutional measures. Site-specific projects include traditional mitigation projects (stream and wetland restoration/enhancement and preservation), as well as agricultural and urban best management practices (BMPs) designed to control impacts from specific land use practices in certain focus areas. Institutional measures include regulatory strategies (policies, rules, ordinances) and programs related to natural resources management that are undertaken by state and local governments and public schools. Institutional measures may also include actions by non-government groups such as land trusts, neighborhood associations, civic groups, and private businesses that are intended to address some special objective related to local watershed protection, but which aren't site-specific in nature. An important subset of institutional measures is watershed education and awareness programs.

Table 10 presents an example of stressors and applicable management strategies developed for the [Lower Creek LWP](#) (EEP, 2006b) (Catawba 03050101). A table like this should be included in the Executive Summary of every final WMP.

Table 10. Key stressors and applicable management strategies for the Lower Creek LWP (EEP, 2006b)

Stressor	Management Strategy
Stream bank erosion	Stream restoration, riparian buffers, livestock exclusion, sand dredging BMPs
Lack of adequate forested buffer	Stream restoration, riparian buffers
Stream channelization	Stream restoration
Impervious cover	Stormwater BMPs, stormwater ordinance, low impact development
Upland erosion	Agriculture & forestry BMPs, erosion and sedimentation control ordinance, subdivision ordinance modifications, steep slope ordinance, public education
Livestock access to streams	Livestock exclusion
Floodplain development	Floodplain development ordinance
Urban toxicants	Illicit discharge program, landfill strategy, watershed education program, stormwater BMPs
Nutrients	Illicit discharge program, ag BMPs, riparian buffers, watershed education program, stormwater BMPs, additional studies

Fecal coliform bacteria

Retrofit wastewater collection system, agricultural BMPs, illicit discharge program, watershed education program, stormwater BMPs

D. Modeling Watershed Response

Watershed modeling may be a useful tool if there are still critical questions to be answered in support of Phase III objectives. Examples of Phase III questions that watershed modeling may help address include:

- What functional benefits (pollutant load reductions, decreased hydraulic stresses) are likely to result from specific project types within specific subwatersheds?
- In which subwatersheds should mitigation projects, BMPs and/or institutional measures be focused for greatest long-term benefit to water quality or other functions?
- What water quality benefits will result from different land use scenarios in the future, as determined by various watershed management decisions (e.g., ‘no action – build out under current rules/ordinances’ versus ‘limit development within key subwatersheds’)?

A model’s output might consist of a list of recommendations ranked according to how much each will improve the watershed functions. The most impacted or most functionally impaired areas should rank the highest when allocating management resources related to watershed improvement. Logically, high-ranking areas are the most likely improved by watershed restoration and enhancement projects. Similarly, the most asset-rich or functionally unimpacted areas should rank the highest when allocating resources related to conservation of local watershed resources.

Watersheds with a particularly complex array of problems may require more detailed modeling. For example, simulation models can demonstrate which combinations of catchments should receive the most treatment to maximize functional uplift. In some instances, implementing strategic combinations of management options can yield better results than simply implementing a rank-order list of project sites or institutional measures.

Simulation models predict assorted outcomes for a watershed based on different input scenarios. One type is the build out model which illustrate water quality and habitat conditions as they likely will occur under different future land development options. This type of model can be quite complex, allowing a planner to incorporate many variables that change independently across a watershed. As with loading models, assumptions need to be explicit and are best identified in advance of any data collection.

An example of such a model is MUSIC ([Model for Urban Stormwater Improvement Conceptualisation](#)), which was used in the [Middle Tar-Pamlico Local Watershed Plan](#) (Tar-Pamlico 03020103). Outcomes predicted by the model for this plan include water quality conditions under four different management scenarios: (1) all recommended projects implemented, (2) all projects on public lands implemented, (3) all projects with three or fewer landowners implemented, and (4) no projects implemented. By examining parameter values for major stressors under different configurations of projects (e.g.,

stormwater BMPs aligned as “treatment trains”), the added value of individual projects or groups of projects can be predicted. For projects and groups of projects that provide little improvement, it may make sense to lower their priority. This type of model can also provide planners with a *sensitivity analysis* tool, helping to illustrate which factors have the most influence on watershed functions, both locally (specific subwatersheds or stream reaches) and across the entire LWP study area. Models like [CommunityViz](#), used in the [Pasquotank River Local Watershed Plan](#) (Pasquotank 03010205), can incorporate the management actions suggested by other stakeholders, consultants and officials. These predicted outcomes should be incorporated into the recommendations of the final Watershed Management Plan as well.

The input data must be as realistic and accurate as possible in order for the model to produce realistic results. Certain data require special understanding in the context of the model. For example, impervious cover must be fully understood as it exists in the landscape. Despite equal total percentages, patchy imperviousness throughout a subwatershed is quite different from one or two major contiguous impervious areas. A good model outcome needs to account for this. Despite a simulation model’s inherent shortcomings, *relative* comparisons of potential outcomes in different subwatersheds can prove helpful and can assist in the identification of focus areas within the larger study area. Whereas *best professional judgment* might leave a planner less certain over where to apply resources, a simulation model can indicate better results in one subwatershed over another under similar resource management strategies. The latter case can improve confidence in decisions, but a model is only one tool in this process.

E. Identification of Focus Areas

To make watershed restoration most effective, focus areas should be prioritized for different management activities and project types. Focus areas are those subwatersheds identified as priority areas for the development and implementation of management strategies to address concentrated areas (of one to 10 square miles) of key problems or assets. Focus areas can also be catchments (less than one square mile) or stream reaches within a subwatershed in which there is a concentration of problems or assets. Focus area identification spans both Phase II and III (see **Functional Assessment** in the Phase II section of this document). In fact, even as early as Phase I, local stakeholders may begin to identify focus areas that they would like the LWP to help address. However, final prioritization of areas for management activities is primarily a Phase III activity. The identification of focus areas for management strategies should be based on the following principles:

➤ *Stressors are not evenly distributed throughout the watershed*

A stressor can be land use/cover-specific or stream-specific. Stormflow scour and pollutants linked to impervious cover are most important in urban areas, for example. Thus, subwatersheds with large amounts of impervious cover can be prioritized for stormwater BMPs and stormwater ordinances.

Stream- or reach-specific stressors concentrated within certain subwatersheds should be prioritized for appropriate project types. For example, agricultural BMPs and appropriate institutional measures should be incorporated into watersheds with agricultural impacts. If impacted sites are relatively isolated or spread out across the LWP area, then it may be more appropriate to identify them as individual priority ‘focus areas’ for management strategies/solutions, regardless of their particular subwatershed priority classification.

➤ *Watershed size precludes effective application of some management practices*
Because financial and staff resources are limited, it is often impossible to apply some management practices to *all* problem areas in a watershed. In this case, areas should be prioritized where these practices and projects will be most effective in providing functional uplift. These areas can be of varying scales, from a single catchment to several subwatersheds in size. Current status of aquatic resources should be considered — are streams so degraded that efforts may not result in substantial recovery, or are they at a functional level that would measurably improve with reasonable inputs of resources?

The actual methodology for finalizing the selection and ranking of focus areas will vary depending on (a) the types and quantity of data that exists across the study area, and for specific subwatersheds; (b) stakeholder input; and (c) the specific objectives of the prioritization.

Most often, final subwatershed prioritization is accomplished through a simple spreadsheet-based approach, in which indicators for specific problems and assets are compiled for each of the delineated subwatersheds within the LWP study area. Points are assigned to subwatersheds based on ranges of values for indicator parameters and differential weighting is applied based on stakeholder and EEP priorities. Subwatersheds receiving point totals above a certain threshold score are identified as priority focus areas, without regard to individual rank scores. This method, or something similar, is appropriate to determine the subwatersheds in greatest need of management strategies.

Subwatersheds are assigned to High, Medium and Low priority tiers based on functional status indicators (see Phase II **Functional Assessment** section) and stakeholder input. The final selection and ranking of priority subwatersheds and focus areas is presented to EEP’s Watershed Planning Oversight Committee (WPOC) for internal review and approval. Final approved subwatershed classifications and/or priority rankings should be included in Watershed Management Plan and the project-specific information contained within the Project Atlas.

F. Project Atlas Development

1) Identification

Potential projects are identified through GIS screening, field assessment, and stakeholder input. Projects should meet certain criteria, set by EEP staff or, if applicable, other

resource professional staff and local stakeholders who may undertake the projects. The following criteria should be considered:

- Size of the project
- Drainage area
- Number of landowners
- Location: in a focus area?
- Site constraints
- Future use of site or build-out of the drainage area.

Typically, projects include: stream restoration, enhancement, and preservation; wetland restoration, enhancement, and preservation; stormwater BMPs; and agricultural BMPs. Projects identified can include those to be implemented by EEP and other organizations and are compiled in a **Project Atlas** as referenced in **CPF Section (v)**. The Project Atlas is developed by EEP or the planning consultant and will vary in format depending upon the objectives of EEP and stakeholders. In some watersheds, EEP may develop general project recommendations to address identified stressors in focus areas. In other watersheds, the Project Atlas will include a list, ranking and large-scale map of all watershed projects as well as a site-specific map and site information for at least each of the highest ranking projects. The EEP planner should coordinate closely with project managers and strategic planning staff during development of the format and content of the Project Atlas.

2) Prioritization/Ranking

Projects should be ranked according to both ecological and feasibility criteria (**CPF Section (vi)**). Initial prioritization of projects should be based on the amount of functional uplift and benefit to the subwatershed that could be achieved by implementation of the project(s). This initial prioritization can be performed via modeling (e.g., projected amount of sediment reduction) or through more qualitative methods, both of which ideally are informed by field knowledge of the sites. The methods for prioritization will depend upon the level of detail needed in the final Project Atlas. Highly ranked projects should also be within focus areas. The highest ranking sites should be those that provide the greatest functional uplift, either alone or in combination with other identified sites, and are in the most optimal landscape position (e.g., headwaters) within the subwatershed. Watershed planning efforts that support more detailed Project Atlas development should include feasibility criteria such as the number of landowners, site constraints (e.g. utility lines, road/bridge crossings) and landowner willingness. Local stakeholders may develop additional project site ranking criteria not directly related to feasibility or ecological function (e.g., proximity to schools/parks for educational purposes); and it's possible that a separate (non-EEP) project ranking system may be developed and presented in the final Project Atlas. Example Project Atlases for reference are available in the Little River and Brush Creek LWP (EEP, 2007a) (New 05050001) and the South Hominy Creek LWP (EEP, 2007b) (French Broad 06010105).

G. Timing of Project Identification and Implementation

Projects can be identified at any point in the LWP process; however, the final set of prioritized projects should be developed during Phase III. In some cases a *preliminary* Project Atlas may be developed during Phase I or Phase II based primarily on GIS screening criteria. A limited number of projects may be implemented before the final Project Atlas is developed due to immediate mitigation needs. Although this is not ideal, it is in the best interest of the state since it is better to implement a project that is likely to be included among high priority focus areas in the watershed than to spend the resources outside the watershed and reduce opportunities for synergistic effects for functional improvement. It can also be advantageous for EEP to have a project underway during LWP development, as it is useful to provide a local example of restoration as a ‘demonstration’ project.

H. Watershed Management Plan

The **Watershed Management Plan (WMP)** (see **CPF Section (v)**) is the final document of the LWP effort, and it is the main document that is used by LWP stakeholders. The WMP can be a valuable tool for stakeholders seeking support of funding proposals for non-mitigation projects. As such, it should summarize the entire LWP effort and be written for a moderately technically knowledgeable audience. It is developed by the EEP planner or consultant with input from the planning team. The draft and final versions of the WMP should undergo internal review as designated in the most recent version of the Watershed Planning Document Review Assignments table. The WMP is presented to EEP’s WPOC for final approval. Once approved, the final WMP is presented to the stakeholder group as referenced in **CPF Section (viii)** and the Interagency Review Team (IRT) (**CPF Section (x)**).

I. Watershed Management Plan Implementation Strategy

Section V of the final Watershed Management Plan addresses plan implementation. Watershed plans only succeed if they are implemented. A key element in WMP implementation is charging an individual or an organization, ideally guided by a long-term advisory group, with the responsibility to follow through with the actions and recommendations outlined in the plan. Therefore, a formal WMP Implementation Strategy should be developed as part of the final plan, or as an addendum to the final plan.

In some instances this implementation strategy may be developed by the long-term advisory group following completion of the final plan. At a minimum, the broad goals and recommended structure of a Implementation Strategy should be sketched out in Section V of the final WMP. Specific roles and responsibilities for implementing various components of the final plan, and a timeline of key milestones for plan implementation, should be determined as soon as possible after the final plan is developed. Two examples of follow-up (Phase IV) LWP advisory groups are the Lower Creek Advisory Team (LCAT) in Catawba 01 and the Indian/Howards Creek Local Watershed Advisory Committee (LWAC) in Catawba 03050102, both of which meet quarterly to coordinate and report upon local plan implementation activities.

Key elements of a Plan Implementation Strategy include:

- Implementation of compensatory mitigation projects;
- Presentation of LWP efforts to local officials (e.g., Town Councils, County Commissioners, Soil & Water Boards) to educate and seek endorsement/adoption of final plan recommendations;
- Preparation of grants to fund the design, construction and monitoring of high-priority projects and/or the hiring of a local watershed coordinator position;
- Development of a local watershed education/outreach plan, focusing on key target audiences such as local schools, farmers, homeowners associations, the media.

Following completion of the WMP, EEP staff will follow up with LWP stakeholders, at a minimum, biannually to share information on WMP implementation efforts.

J. Watershed Management Plan Outline

The minimum elements required for the final Watershed Management Plan document are outlined below:

Executive Summary

(include Table of Key Stressors & Applicable Management Strategies)

List of Acronyms & Abbreviations

I. Introduction

A. EEP Background

(EEP background and general mission)

B. EEP's Local Watershed Planning Approach

(overall LWP goals and process; summary of three phases)

C. Planning Area Description

(brief; include rationale for selection as LWP area; include figure showing LWP HUs with county and basin boundaries and any major municipalities)

D. LWP Timeline

E. LWP Goals and Objectives

II. Stakeholder Involvement

(summary of stakeholder process and key input; include list of all invited stakeholders here or in one of the appendices)

III. Watershed Characterization

(summarized and/or excerpted from the Phase I PFR, Phase II WAR and DWQ Integrated Report)

A. Assessment Methodology

(GIS, water quality monitoring, field assessments, modeling)

B. General Watershed Characteristics

(drainage area, dominant land uses; subwatershed delineation)

C. Subwatershed Prioritization and Identification of Focus Areas

D. Stream, Wetland and Buffer Conditions (summary of major functional stressors and sources)

IV. Plan Recommendations

A. Management Strategies

(brief overview of management strategies applicable to watershed stressors)

B. Projects (summary of Project Atlas)

1. Stream, wetland and buffer restoration/enhancement

2. Stream, wetland and buffer preservation

3. BMPs (agricultural; stormwater; other)

C. Institutional Measures (ordinances, regulations, programs)

V. Watershed Management Plan Implementation

(coordinated strategy for integrating and implementing plan recommendations)

VI. Technical Resources and Funding Sources

VII. References

Appendices

Glossary of Technical Terms

GIS Data Sets

Other Appendices (if needed)

PHASE IV: Watershed Management Plan and Project Atlas Implementation

Phase IV describes implementation of the Watershed Management Plan and Project Atlas. It also provides recommendations for stakeholder coordination and communication to help foster and support implementation of watershed management strategies that go beyond mitigation projects.

A. Goals and Objectives

The Watershed Management Plan is a comprehensive document that includes recommendations on a diverse suite of management strategies to be implemented by EEP and local stakeholders. EEP's goal is that each Watershed Management Plan be fully utilized. Phase IV objectives include:

- identify and support implementation of priority watershed projects that address watershed stressors;
- implement landowner outreach and stakeholder participation strategies; and
- document watershed improvement and protections activities and project feasibility over time.

The term "Phase IV" implies that it will take place after Phase III and the completion of the Watershed Management Plan and Project Atlas, but outreach strategies should be integrated into the planning process as early as possible. Project implementation at EEP is a multi-faceted process that includes many staff.

B. Stakeholder support in Phases I-III

Gaining support during Phases I-III will ensure that a strong group of local stakeholders carry on implementation in Phase IV. In the Franklin to Fontana LWP (Little Tennessee 06010202), for example, the planner engaged key stakeholders early in the process and incorporated goals and objectives into the plan. Little Tennessee Watershed Association biomonitoring staff, USFWS and WRC biologists, Western Carolina University geomorphologists, and USGS scientists participated in developing Phase II assessment objectives. The Project Atlas incorporated conservation projects to be considered and implemented by the local land trust, Soil and Water Conservation District (SWCD), USFWS and the Little Tennessee Watershed Association.

General recommendations to draw stakeholder interest include the following:

- Incorporate the stakeholders' local watershed goals, which may be environmental, social or economic;
- Help seek funding for local stakeholder needs early in the process;
- Mix up the format of the meetings by bringing in special speakers;
- Involve stakeholders in planning activities outside of the meeting setting;
- Allow time for one-on-one conversations or watershed outings; and
- Reciprocate by assisting stakeholders with their watershed related projects.

C. Transfer leadership

Planners should clearly state at project initiation that EEP is providing technical abilities and planning skills during the Phase I-III time period but that the stakeholder group will ultimately be responsible for leading plan implementation with EEP as another stakeholder. Planners should be consistent with the message and identify a few key figures that may lead Phase IV efforts. For the Lower Creek LWP (Catawba 03050101), the planners are continuing quarterly Lower Creek Advisory Team (LCAT) meetings with the stakeholders. Funding was obtained for a watershed coordinator through an EPA 319 grant. In contrast, the Little River and Brush Creek LWP (New 05050001) did not have a stakeholder/advisory group that continued Phase IV efforts beyond some initial applications for the funding of plan-identified stormwater BMPs, but the local SWCD has been an active partner in working with EEP to reach landowners for the implementation of mitigation projects.

D. Community Outreach

The purpose of community outreach efforts is to reach beyond those represented by LWP stakeholder group. The goal is to bring awareness to the community about EEP's mission and the specific planning effort. Below are examples of outreach techniques:

1) Letters of Intent or Memorandum of Agreement (MOA)

In the past EEP developed MOAs with local governments but it now use Letters of Intent (LOI). A LOI is a tool to inform the local government about EEP, the plan and the process. The LOI briefly describes EEP's intentions while defining the local government's role in the planning process and project implementation efforts. Depending on the size of the government, the LOI may go to the local governing board for signature or the town/county manager (see **Appendix D** for examples).

2) Local Government Board Acceptance of Watershed Management Plan

Similar to the LOI, this is a way to get the LWP formally presented to county commissioners or town boards. The planning director, county or town manager, or someone else familiar with the local process should be consulted early regarding the best presentation format of the plan. A presentation to town councils and/or county commissioners, seeking formal adoption/endorsement of the final plan and its recommendations, should be conducted after Phase III is complete.

3) Public Meeting

A public meeting is an informational meeting that is advertised to the wider watershed community. This is the opportunity to attract potential local leaders that were missed in the initial stakeholder search and to inform the community about the plan and EEP. A public meeting should be held in the evening or on a Saturday in order to provide the most opportunity for attendance.

4) News Outlets

Use local stakeholder input to determine who the watershed audience is and how they get their news. Utilize the local newspaper or local government newsletters and websites.

Releasing information on the stages of the plan and its progress is an excellent way to engage the general public about EEP LWP efforts.

E. Activating Previously Completed LWPs

Activating a Phase IV strategy for a plan that has been completed for more than a year requires an assessment of stakeholder activity. Planners should contact stakeholders that participated during the planning phases and attempt to identify additional stakeholders that may be actively using the plan. It is important to develop an updated contact list for the original stakeholders and research additional land trusts, watershed groups, municipalities, etc. that are currently using the plan or may be in the future. Planners should hold a coordination meeting to review the Watershed Management Plan and Project Atlas and determine next steps for an implementation strategy.

F. Implementation of Non-EEP Local Watershed Plans

In an effort to build upon watershed planning efforts developed by other agencies and organizations throughout the state, EEP developed a process through which non-EEP organizations may [submit](#) watershed plans for EEP acceptance. Watershed plans will be considered for acceptance if they demonstrate the following six key elements: local stakeholder involvement, monitoring, identification of watershed stressors, development of comprehensive management strategies, prioritized project sites and post-plan monitoring.

If any of the six elements are absent or deficient, EEP may fund missing components to augment the plan and pursue Phase IV implementation efforts within the watershed if the proposed plan aligns with EEP's strategic plan. Examples of plans developed by other organizations that EEP supported with Phase IV funding are the [Muddy Creek LWP](#) (Catawba 03050101) and [Lick Creek LWP](#) (Neuse 03020201).

G. Phase IV Evaluation

Phase IV evaluation incorporates documentation of education and outreach efforts, grants received in support of the watershed plan and projects implemented in watershed planning areas. Water quality, hydrologic and habitat monitoring and analyses conducted by public, private or not-for-profit organizations within the watershed should be documented. This provides EEP with data necessary to compare pre-and post-watershed conditions and document watershed improvement.

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Glossary of Key Terms and Acronyms Associated with EEP Local Watershed Planning

319 – Refers to federal and state grants available under the authority of Section 319(h) of the federal Clean Water Act. The Section 319 NPS Grant Program within the NC Division of Water Quality (DWQ) seeks to fund innovative non-point source (NPS) management strategies. For further information, visit <http://portal.ncdenr.org/web/wq/ps/nps/319program>.

Aerial imagery – includes photography and derived/digitized coverages depicting land cover, hydrography, etc. Typically processed into DOQQ (digital orthophoto quarter quads) products.

Ambient monitoring – refers to NC DWQ’s statewide network of over 370 stream, lake and estuarine permanent, long-term monitoring stations. These stations are regularly sampled for various physical/chemical parameters by DWQ personnel and the resulting data are periodically compiled and evaluated, with water quality interpretations presented in DWQ *Basinwide Assessment Reports* and *Basinwide Water Quality Plans* (see <http://portal.ncdenr.org/web/wq/ps/bpu>). Core ambient monitoring parameters for Class C freshwater streams in NC include: pH, dissolved oxygen, specific conductance, temperature, turbidity, TSS, nutrients (N and P), fecal coliform, and certain metals. For more information, including station locations in each river basin, go to <http://portal.ncdenr.org/web/wq/ess/eco/ams>

APNEP–Albemarle-Pamlico National Estuary Program. – This program, formerly known as the Albemarle-Pamlico Estuarine Study (APES), was among the first National Estuary Programs established by the US EPA in 1987. The mission of APNEP is to identify, restore, and protect the significant resources of the Albemarle-Pamlico estuarine system. APNEP is administered within the Office of Conservation and Community Affairs in the North Carolina Department of Environment and Natural Resources (DENR). For further info, visit <http://www.apnep.org/>

Assessment tools – specific methods, techniques and protocols for conducting detailed evaluation of local watersheds, priority sub-watersheds or identified focus areas during Phase II tasks. These “tools” include the collection of field data related to water quality, aquatic habitat, channel condition, integrity of riparian buffers or other important field metrics (e.g., bank erosion hazard indices or BEHI). The term can also apply to specific water quality and/or hydrologic/hydraulic *models* that may be used for characterizing or predicting current or future functional stressors in specific high-priority sub-watersheds or catchments.

Asset – any watershed feature or characteristic that *demonstrates* or *contributes to* a high level of function of natural systems. Examples include fish or benthic community ratings of Good or Excellent by DWQ, presence of rare or sensitive species, NHP designated Significant Natural Heritage Areas, High Quality Waters (HQW), Outstanding Resource Waters (ORW), SA (commercial shellfish) waters, intact forested buffers, low levels of impervious cover (IC).

Basin – the largest watershed management unit for planning, typically range in size from 500 to 10,000 square miles. There are 17 major river basins in NC, the largest being the Cape Fear and the Yadkin-Pee Dee, and the smallest the Savannah and the Watauga.

Biological monitoring – refers to the collection and assessment of benthic macroinvertebrates and fish. Data on the number and types of taxa of benthic species are used as indicators of stream reach health per standard DWQ Bioclassification criteria (excellent; good; good/fair; fair; poor). Fish sampling and fish tissue analyses are used to assess aquatic ecological integrity and as indicators of possible surface water and stream sediment contamination. For information on DWQ biological monitoring efforts (and protocols), go to <http://portal.ncdenr.org/web/wq/ess/bau>

BMPs – Best Management Practices. Any land or stormwater management practice or structure used to reduce erosion and sedimentation, or otherwise control water pollution from runoff; includes urban stormwater management BMPs and agriculture/forestry BMPs

Catchment – per the Center for Watershed Protection, this is the smallest watershed management unit. This area corresponds to the delineated watershed area for a project site and is typically less than one square mile in area (640 acres).

CGIA – North Carolina’s Center for Geographic Information & Analysis. This program serves as the clearinghouse of NC Geographic Information System (GIS) data and provides free downloads of multiple data layers including natural resource datasets, statewide infrastructure data and demographic data, among others. Visit <http://www.cgia.state.nc.us/> .

Channelization – the manmade alteration of natural stream and river channels, typically resulting in the deepening, straightening and/or realignment of natural waterways. Historically, this was a technique used in hopes of improving land drainage, increasing agricultural production and reducing losses from flooding. Channel modifications often result in one or more of the following: stream channel instability, increased bank erosion, altered sediment dynamics (bed degradation or aggradation), adverse effects downstream (e.g., channel scour), damage to riparian buffer zones and general esthetic degradation of streams, wetlands and riparian vegetation.

CHPPs – Coastal Habitat Protection Plans. As part of the Fisheries Reform Act of 1997, the N.C. General Assembly required the Coastal Resources, Marine Fisheries and Environmental Management commissions to approve plans to help protect and restore resources critical to North Carolina's commercial and recreational fisheries. The Department of Environment and Natural Resources (DENR) developed the Coastal Habitat Protection Plan (CHPP), to protect habitats including water quality, wetlands, shell bottom, submerged aquatic vegetation, ocean hard bottom and soft bottom; and enhance and protect water quality from point source and non-point source pollution. The Coastal Resources, Marine Fisheries and Environmental Management Commissions approved the plan in December 2004. The CHHP is updated every five years and the associated Implementation Plan is updated every two years. For additional information, go to <http://www.ncfisheries.net/habitat/index.html>

CFR– Code of Federal Regulations. This document references 40 CFR Part 230 and 33 CFR Parts 325 and 332 Compensatory Mitigation Losses for Aquatic Resources, effective June 9, 2008 which addresses compensatory mitigation for activities authorized under permits issued under the Department of the Army permits.

Compensation Planning Framework (CPF) – the set of guidelines required in the CFR that defines how EEP accomplishes its charge of identifying high quality, watershed based mitigation projects. (see Appendix I of the EEP In-Lieu-Fee Instrument document at http://www.nceep.net/pages/pdfs/interim_final_instrument_8_2_10.pdf)

CREP - The Conservation Reserve Enhancement Program (CREP) is a joint effort of the North Carolina Division of Soil and Water Conservation, the NC Clean Water Management Trust Fund, the NC Division of Forest Resources, and the United States Department of Agriculture (USDA) initiated in 1999 to address water quality problems of the Neuse, Tar-Pamlico and Chowan river basins as well as the Jordan Lake watershed area. The North Carolina Division of Water Quality (DWQ) classified these basins and the Jordan Lake watershed as nutrient sensitive waters (NSW). In 2008, the CREP expanded to include the White Oak, Cape Fear, Lumber, Yadkin-Pee Dee, Roanoke and Pasquotank river basins. CREP is a voluntary program that seeks to protect land along watercourses that is currently in agricultural production. For more information, visit <http://www.enr.state.nc.us/DSWC/pages/crep.html>

CU – Cataloging Unit - U.S. Geological Survey-designated 8-digit Hydrologic Units, typically comprised of multiple smaller 14-digit HUs; total area ranges from about 500 to 2,000 square miles. There are 54 individual CUs in NC; they can be considered regional subbasins within the larger river basins. CUs represent the watershed unit within which permitted impacts to waters and wetlands, and associated compensatory mitigation credits, are accounted for within EEP.

CWMTF – refers to North Carolina’s Clean Water Management Trust Fund program, a funding agency for water quality protection & improvement projects. For additional info, go to <http://www.cwmtf.net>

CWP – Center for Watershed Protection – a non-profit corporation that provides local governments and watershed organizations around the country with the technical tools for protecting streams, lakes and rivers; the CWP’s multi-disciplinary strategy for watershed protection includes watershed planning, watershed restoration, stormwater management, watershed research, better site design, education & outreach, and watershed training

DCM – Division of Coastal Management; Division of DENR charged with protecting, conserving and managing North Carolina’s coastal resources. See <http://dcm2.enr.state.nc.us/>

Degradation – term usually associated with physical deterioration of aquatic habitat and declining biological indicators of stream health due to various watershed stressors, (e.g., channel scour from excessive storm water flows, unstable/eroding stream banks due to channel incision and/or lack of adequate riparian vegetative cover, embedded riffle zones). Not to be confused with *impairment*, which relates specifically to a decline in water quality use support ratings for a given stream or stream reach as measured by physical/chemical parameters (e.g., dissolved oxygen, metals, turbidity, fecal coliform).

Detailed assessment – the second major phase of EEP Local Watershed Planning, which generally includes in-depth field evaluation of watershed conditions along representative stream reaches and within high-priority subwatersheds, including application of visual assessment protocols for stream habitat and riparian buffers, measurements of channel stability and bank erosion hazards indices (BEHI), collection of water quality and biological monitoring data, and may also include the use of computer models to predict future hydrologic and water quality conditions under different watershed management scenarios.

DEMs – Digital Elevation Models; a regular array (raster) of elevation data, a common GIS product created at a variety of scales that are often used as topographic base maps. The USGS produces such digitized cartographic data files as part of their National Mapping Program, derived from topographic quadrangle maps ranging from large scale (7.5-minute) to small scale (1-degree DEMs). *National Elevation Datasets* (NEDs) are available as free downloads via the *USGS Seamless Data Viewer*; however, the cell size of 30 meters is considered a rather coarse resolution for many watershed assessment applications.

DENR – NC Department of Environment and Natural Resources- The lead stewardship agency for protection of North Carolina’s natural resources. Multiple agencies and special programs are part of DENR, including EEP, NC Division of Water Quality, the NC Natural Heritage Program, among others.

DMF –NC Division of Marine Fisheries; a division within DENR charged with sustainable marine and estuarine fisheries and habitats for North Carolina. See <http://portal.ncdenr.org/web/mf/>

DO – dissolved oxygen content of water samples, typically reported as ppm or mg per liter; often used as a general indicator of stream health, as low DO levels are often caused by excessive loads of organic waste and/or algal blooms associated with nutrient pollution. In slow-flowing or stagnant waters of certain coastal swamps and streams, relatively low DO (i.e., below 4.0 to 5.0 mg/L) is a naturally occurring condition.

Digital Orthophoto Quadrangles (DOQs) –a computer-generated image of an aerial photograph in which image displacement caused by terrain relief and camera tilts has been removed. It combines the image characteristics of a photograph with the geometric qualities of a map. The standard DOQ’s produced by the U.S. Geological Survey (USGS) are either grayscale or color-infrared (CIR) images with a 1-meter ground resolution For additional info, see <http://nationalmap.gov/digitalbackyard/doqbkyd.html>

DOT –NC Department of Transportation; department responsible for providing high quality transportation, including highway, rail, aviation, bicycle ferry, pedestrian and public transit across North Carolina. See <http://www.ncdot.org/>

Drainage district – political subdivisions, established under the authority of Chapter 156 of the NC General Statutes, which are created by local courts to “locate and establish levees, drains or canals, and cause to be constructed, straightened, widened or deepened, any ditch, drain or

watercourse, and to build levees or embankments and erect tidal gates and pumping plants for the purpose of draining and reclaiming wet, swamp or overflowed land”.

DWQ –NC Division of Water Quality; a division within DENR responsible for the statewide regulatory programs for surface water and groundwater in North Carolina. See <http://portal.ncdenr.org/web/wq>

Ecoregion –Areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources (Griffith et al. 2002). In North Carolina, references to ecoregions generally refer to Level III and IV ecoregion delineation.. More information on North Carolina ecoregions, including Level III and IV maps, is available at the following website: http://www.epa.gov/wed/pages/ecoregions/ncsc_eco.htm#Principal%20Authors

EEP (or NC EEP) – NC Ecosystem Enhancement Program; created by a three-agency Memorandum of Agreement (between NC DENR, NC DOT and US Army Corps of Engineers) – or “Tri-Party MOA” -- in July of 2003 to develop a comprehensive approach to watershed protection in the state, to increase the ecological effectiveness of compensatory mitigation projects, and to provide mitigation projects and strategies in advance of permitted impacts based on a watershed planning approach. For more info, go to: <http://portal.ncdenr.org/web/EEP/>

EEP In-Lieu Fee Instrument – In July 2010, a new legal document for the operation and use of the Ecosystem Enhancement Program's In-Lieu Fee programs for stream and wetland mitigation was signed by the U.S. Army Corps of Engineers and the N.C. Department of Environment and Natural Resources. The [instrument](#) complies with federal rules governing compensatory mitigation 33 CFR PARTS 325 and 332 that became effective in June 2008 and includes as Appendix I, the Compensation Planning Framework which outlines EEP’s watershed planning processes.

EA or EIS – Environmental Assessment or Environmental Impact Statement; as may be required under provisions of the National Environmental Policy Act of 1970 (NEPA) and North Carolina’s State Environmental Policy Act of 1971 (SEPA) for any federal- or state-funded “actions” or “undertakings” (e.g., highway construction projects) with the potential to detrimentally impact the environment. Visit <http://www.epa.gov/compliance/basics/nepa.html> or <http://portal.ncdenr.org/web/wq/ps/sepa>

Element Occurrences – terminology utilized by the NC Natural Heritage Program that refers to locations of rare and endangered species populations and occurrences of exemplary or unique natural ecosystems (terrestrial and palustrine) and special wildlife habitats.

Enhancement –the manipulation of the physical, chemical, or biological characteristics of an aquatic resource to heighten, intensify, or improve a specific aquatic resource function(s). Enhancement results in the gain of selected aquatic resource functions(s), but may also lead to a decline in other aquatic resource functions(s). Enhancement does not result in a gain in aquatic resource area (33 CFR Parts 332.2).

FSA –Farm Service Agency; agency located within the US Department of Agriculture responsible for equitably serving all farmers, ranchers, and agricultural partners through the delivery of effective, efficient agricultural programs; for additional info, visit <http://www.fsa.usda.gov/FSA/webapp?area=about&subject=landing&topic=ham>

Focus areas –those priority subwatersheds identified for the development and implementation of management strategies (projects and/or institutional measures) to address concentrated areas (one to 10 square miles) of key stressors or assets. Focus areas can also be catchments (less than one square mile) or stream reaches within a subwatershed in which there is a concentration of problems or assets.

Functions – the results of the interaction of the physical, biological, and chemical components, including external factors, of the ecosystem. The three primary functions considered during the LWP planning process include: water quality, habitat, and hydrology.

Functional Assessment – the process whereby the status or quality of important watershed functions is determined at various scales of study/measurement.

GIS - Geographic Information System; computer hardware, software and data designed for capturing, storing, updating, manipulating, analyzing and displaying all forms of geographically reference information; in EEP, desktop GIS is an important tool used in the assessment of various sets of watershed-related information (e.g., land cover, property parcels, roads, municipal boundaries, streams, designated natural heritage areas, wetlands, soils, etc.) used in identifying the best locations for watershed project sites and management strategies.

Goals–targeted end results associated with a watershed plan or project. For local watershed planning efforts, these tend to relate to improvement of the major watershed functional categories (water quality, habitat and hydrology).

Groundwater Incident Sites –areas identified and investigated by the *Aquifer Protection Section* (formerly the *Groundwater Section*) of the NC Division of Water Quality (DWQ), at which violations of the state’s groundwater standards (aka “Subchapter 2L” rules) have been documented due to chemical releases to soil and groundwater. Violations of the state’s groundwater standards trigger field investigations and possible enforcement action, including a requirement to conduct site-specific hydrogeologic assessments and possible long-term corrective actions to clean up contaminated soils and groundwater. For additional info, visit; <http://portal.ncdenr.org/web/wq/aps/gwpro>

Hydrologic modification – general term for the human alteration of natural waterways, including channel dredging/straightening, stream bank armoring, channel re-location; sometimes also used to refer to any modification or disturbance to land cover in a watershed that has local hydrologic impacts, e.g., increases in impervious cover associated with new construction, resulting in decreased infiltration and increased stormwater runoff rates and volumes.

Hydrologic Unit (HU) – refers to the 14-digit Hydrologic Unit Codes used by the Natural Resources Conservation Service (NRCS) to identify local watersheds typically ranging from 10 to 100 square miles in total drainage area; used by NC EEP as synonymous with “local watershed”

Instrument – see **EEP In-Lieu Fee Instrument**.

Impacts – (1) in the context of EEP Strategic Planning, this refers to the projected amount of 401/404 permitted stream feet, buffer acres or wetland acres negatively affected by the construction of NCDOT highway projects (TIPs) and other public or private development projects; (2) more generally, the term *impact* is used to describe any negative effect to a watershed function resulting from human activities, including habitat degradation, water quality impairment, altered hydrology, etc.

Impairment – used by NC DWQ to describe a stream (or stream reach) with decreased water quality to the degree that it is “not supporting” its designated uses (e.g., swimming, fishing, shellfishing, water supply, secondary recreation) because of point source or nonpoint source pollution and/or aquatic habitat degradation. For additional information about NC DWQ’s use support ratings methodology, see the Appendices to any of DWQ’s Basinwide Water Quality Plans; <http://portal.ncdenr.org/web/wq/ps/csu>

Institutional Measures – regulatory strategies (policies, rules, ordinances) and programs related to natural resources management/protection that are undertaken by federal, state and local governments. Institutional measures may also include actions by non-government groups (e.g., land trusts, neighborhood associations, civic groups, private businesses) intended to address some special objective related to local watershed protection, but which aren’t project/site-specific in nature.

Impervious Cover (IC) - a human-created or –modified surface (e.g., concrete, asphalt) that does not allow water to percolate (or infiltrate) through it; examples include parking lots, rooftops, roadways, driveways, sidewalks, compacted soils or lawns with compacted subsoils. Urbanization and development are typically associated with significant increases in the impervious cover of a given area, which result in increased rates of storm water runoff and inputs of non-point source pollutants into local streams.

Indicator – a measurable characteristic that can be used to evaluate the level at which a particular watershed function is operating. Examples of *watershed functional indicators* include: channel stability, riparian buffer disturbance, nutrient and sediment loads, habitat integrity, water quality, etc. Indicators are associated with specific metrics (measurable parameters) used to describe or quantify them -- for instance, dissolved oxygen (DO) and number of pollution-intolerant macro-invertebrate species as measures of aquatic habitat quality.

Indirect and Cumulative Impacts - the indirect effects of proposed federal transportation and development projects which include impacts to an area’s social and economic conditions, natural/environmental, cultural and historical resources. Indirect effects of transportation projects include project-induced economic growth and development, changes in land use patterns

and population density/growth, and secondary effects related to this growth. For more information, see <http://www.ncdot.org/doh/preconstruct/pe/neu/NEUProcedures/ICI.html>

Interagency Review Team (IRT) –group of federal and state agencies that is responsible for review and approval of compensatory mitigation under the NCEEP In Lieu Fee Program. The US Corps of Engineers District Engineer is Chair of the IRT. Major responsibilities include review of monitoring reports, evaluation of mitigation plans, recommendation of remedial measures, approval of credit releases and approval of modifications to the ILF Instrument.

LIDAR – Light Detection and Ranging, a remote sensing technology (typically employed as aircraft-mounted sensors) that can be used to produce very high resolution Digital Elevation Models (DEMs), with important applications in natural resource management, topographic mapping, watershed planning, hydrologic modeling, etc.

Local Resource Professionals (or RPs) – staff of state, federal, regional or local (city, county) natural resource agencies – including planners, water resources and storm water engineers, parks & recreation departments, water quality programs, regional councils of government, local/regional land trusts or other non-profit groups with knowledge/expertise and/or interest in local watershed issues and initiatives. These RPs are often recruited by EEP to form the core of technical advisory groups providing support & input to EEP Local Watershed Planning initiatives.

Local Watershed – For purposes of EEP, local watersheds are defined as 14-digit Hydrologic Units (HUs), which typically range in area from ~10 to 100 square miles; see the definition for *Hydrologic Unit*. This is the scale at which most EEP Local Watershed Planning efforts are conducted.

Local Watershed Planning – process whereby local stakeholders (and/or a specific group of local resource agency professionals) are brought together to help assess local watershed conditions, identify sources of watershed impairment, identify high-priority sub-watersheds and good candidate sites for mitigation projects, develop solutions to watershed problems, and implement watershed management strategies for the long term protection of important watershed functions. EEP focuses local watershed planning efforts on one or more Hydrologic Units identified as Targeted Local Watersheds within 8-digit CUs where significant NC DOT impacts are projected to occur.

LOI – Letter of Interest- a tool to inform the local government about EEP and the local watershed planning process. The LOI briefly describes EEP’s intentions while defining the local government’s role in the plan and project implementation.

Management strategies – specific actions that are determined to be most effective in addressing the problems or in protecting the assets identified during the LWP process. Recommended actions generally include two major categories: (1) specific on-the-ground projects, such as BMPs and EEP mitigation projects and (2) institutional measures. Management strategies are presented as consensus recommendations (identified jointly by the EEP planning team and the LWP stakeholders) in the final Watershed Management Plan.

MOU - Memoranda of Understanding (MOUs) – Signed, written agreements between parties (e.g., government agencies, Land Trusts, etc.) that can be used to define roles and responsibilities; in the context of local watershed planning, MOUs are often used to help ensure cooperation among local stakeholders in exploring solutions/alternatives in water quality management issues and in the creation of committees or task forces for the implementation of those solutions. These are often created as informal agreements (i.e., not legally enforceable) between parties/agencies. Sometimes called *Memoranda of Agreement (MOAs)*.

Models and Modeling –computer programs used to simulate the response (e.g., pollutant loading to streams) of a natural system to various management scenarios. These tools are useful in assessing which types of watershed protection techniques will yield the greatest benefit to water quality, habitat, or hydrology, and in determining which locations within the watershed are optimal for such practices or project sites.

NOAA – the National Oceanic and Atmospheric Administration, whose programs include the National Weather Service, the National Marine Fisheries Service and the National Environmental Satellite, Data & Information Service. Visit <http://www.noaa.gov>

NC GAP – A project initiated through the Biological Resources Division of the US Geological Survey (USGS) that involves mapping of landcover, predicted terrestrial species distribution and stewardship layers to determine how much of a target species habitat is conserved. This information is used to inform planning decisions for further protection (<http://gapanalysis.usgs.gov/gap-analysis/process/>). To find out more about the process and products of the **NC GAP** analysis program -- which include data & GIS coverages on vegetation, vertebrate species and land stewardship -- go to <http://www.basic.ncsu.edu/ncgap/>

NHP – the NC Natural Heritage Program, a part of the [Office of Conservation and Community Affairs](#) within the [NC Department of Environment and Natural Resources](#) (DENR). The program inventories, catalogues, and supports conservation of the rarest and the most outstanding elements of the natural diversity of our state. For additional information, visit <http://www.ncnhp.org/>

NPDES - The National Pollutant Discharge Elimination System (NPDES) is the federally established program for controlling point-source discharges of pollution. The NPDES Unit of North Carolina's Division of Water Quality (DWQ) is responsible for administering the program for the state, from which both individual and general wastewater discharge permits are issued. For additional info, visit <http://portal.ncdenr.org/web/wq/swp/ps/npdes>

NRCS –Natural Resources Conservation Service; Agency within the U.S. Department of Agriculture that works with landowners through conservation planning to benefit soil, water, plants, air and animals that results in productive lands and healthy ecosystems. Go to <http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/about>

NWI – the National Wetlands Inventory, an ongoing project by the U.S. Fish and Wildlife Services to classify and map the remaining wetland areas throughout the Continental United States. For additional information, visit <http://www.fws.gov/wetlands/>

Objectives – a means or method by which Goals are implemented. These are often narrow in scope and relate to specific tasks that may be validated.

Phase II Storm Water Rules – From <http://portal.ncdenr.org/web/wq/ws/su> : Phase II of the National Pollutant Discharge Elimination System Stormwater Program was signed into law in December 1999. This regulation builds upon the existing Phase I program by requiring smaller communities and public entities that own and operate a municipal separate storm sewer system (MS4) to apply and obtain an NPDES permit for stormwater discharges. EPA requires permittees at a minimum to develop, implement, and enforce a stormwater program designed to reduce the discharge of pollutants from the MS4 to the maximum extent practicable. More information and links to EPA stormwater regulations is available at the following website: http://cfpub1.epa.gov/npdes/regresult.cfm?program_id=6&type=1&sort=name&view=all

Planning team – the group assigned to guide the LWP development including EEP planner(s) (a lead planner and possibly a co-planner), an EEP project manager, and possibly a DWQ Watershed Assessment Team representative and a consultant.

Pour point – the GIS point identified as the most downstream location at which all water exits a defined watershed. This point is relatively easy to identify for single channel streams but may be more difficult in swamps and braided headwater channels.

Preservation – the long term protection of an area with high habitat value (e.g., wetlands, riparian buffers, identified habitat corridors for key species), generally effected through the purchase or donation of a conservation easement by or to a government agency or non-profit group; such areas are left in their natural state, with minimal human disturbance or management activities.

Priority subwatersheds – subwatersheds selected for detailed assessment activities, typically identified during Phase I. These areas can be chosen to represent areas of the LWP in which certain functional stressors and associated deficits are occurring or are most likely to occur. These areas may also be subwatersheds or catchments with specific issues that are identified for detailed assessment.

Problems – any watershed feature or characteristic that *demonstrates* or *contributes to* a low level of functioning of natural systems or watershed functional impacts (e.g., 303(d)-listing stream segments, benthic or fish community ratings of Fair or Poor by DWQ, closed shellfish harvesting areas, high levels of impervious cover (IC), stream channelization).

Re-establishment: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former aquatic resource. Re-establishment results in rebuilding a former aquatic resource and results in a gain in aquatic resource area and functions (33 CFR Parts 332.2).

Reference stream (or condition) – a pristine (ideally) or relatively undisturbed stream reach (or area of wetlands or riparian buffer) whose physical and biological conditions can serve as a baseline to judge the success of nearby restoration projects and other watershed management efforts.

Regulated riparian buffer – an area adjacent to a stream, wetland, or shoreline where development activities (e.g., buildings, logging) are restricted or prohibited. These areas may be managed as streamside (riparian) zones where undisturbed vegetation and soils act as filters of pollutants in stormwater runoff. Buffer zone widths vary depending on current state and local rules, but are typically a minimum of 25 to 50 feet on each side of perennial streams. In NC, buffer rules have been established for all, or portions of, the upper Cape Fear, lower Catawba, Neuse and Tar-Pamlico river basins. For more information on NC regulated buffers, visit: <http://portal.ncdenr.org/web/wq/swp/ws/401/riparianbuffers>

Rehabilitation: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions to a degraded aquatic resource. Rehabilitation results in a gain in aquatic resource function, but does not result in a gain in aquatic resource area (33 CFR Parts 332.2).

Restoration – the manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former or degraded aquatic resource. For the purpose of tracking net gains in aquatic resource area, restoration is divided in to two categories: reestablishment and rehabilitation (33 CFR Parts 332.2).

Riparian area – relating to the land adjacent to a waterbody such as a streams, rivers or lakes; important streamside zones of natural vegetation.

SAV – submerged aquatic vegetation are rooted vascular plants and macroalgae that live under tidal waters; they include high-salinity grasses such as Eel grass and low-salinity species such as pondweed; SAV habitat provides several critical ecosystem benefits in coastal watersheds, bays and estuaries. For additional info, visit <http://www.ncfisheries.net/habitat/chppSAV.html>.

Screening level data - Preliminary information collected to inform watersheds that are lacking data. Information may include physical or chemical data collected with field meters during initial watershed reconnaissance.

SWCDs –Soil and Water Conservation Districts; local organizations in North Carolina, which operate in partnership with the federal Natural Resources Conservation Service (NRCS; formerly the Soil Conservation Service) and the Division of Soil and Water Conservation within NC Dept. of Agriculture and Consumer Services to protect and conserve the state’s soil and water resources. For additional information, go to <http://www.ncagr.gov/sw/> or <http://www.ncaswcd.org/>

Significant Natural Heritage Areas – areas identified and inventoried by the NC Natural Heritage Program that contain ecologically significant natural communities or rare species; an

important GIS data layer used by EEP in assessing the habitat value/sensitivity of local watersheds.

Source - cause of a problem or origin of stressor. For example, large amounts of fertilizer washing from a row crop field or chemical runoff from a parking lot may be sources of water quality problems in a stream.

Stakeholder – for purposes of this document, any agency, organization, or individual involved in or affected by the decisions made in the development of a watershed plan. Watershed plan stakeholders typically include: *primary stakeholders* such as watershed residents, farmers, developers, local government or resource agency staff with a direct say in the planning process; and *secondary stakeholders* such as state or regional resource agency staff who can serve as technical resources/advisors to the local planning process. (see Appendix I, Section viii of *EEP's Compensation Planning Framework* at http://www.nceep.net/pages/pdfs/interim_final_instrument_8_2_10.pdf).

Stream classifications – refers to the statewide system used by NC DWQ's Classifications & Standards Unit to classify streams, lakes, estuarine and tidal saltwater systems in NC according to their designated best use(s) and special or supplemental characteristics – including: Water Supply (WS) waters, Class B waters (primary recreation), Class C waters (secondary recreation and propagation of aquatic life), Swamp waters (SW), Trout waters (TR), High-Quality Waters (HQW), Outstanding Resource Waters (ORW); and commercial shellfish harvesting (SA) waters. For additional information, go to <http://portal.ncdenr.org/web/wq/ps/csu>.

Stream order - Strahler's (1952) stream order system is a simple method of classifying stream segments based on the number of tributaries upstream. A stream with no tributaries (headwater stream) is considered a first order stream. A segment downstream of the confluence of two first order streams is a second order stream. Thus, a n^{th} order stream is always located downstream of the confluence of two $(n-1)^{\text{th}}$ order streams.

Stressor – a problem that contributes to poor biological or physical condition of a stream or associated terrestrial habitat and induces an adverse response in watershed functioning. Examples range from broad watershed processes such as storm water runoff from areas with high impervious cover to specific point source water quality pollutants affecting a stream reach.

Subbasin – federal and state classification for 8-digit Cataloging Units that generally range in area from about 500 to 2,000 square miles.

Subwatershed – a component drainage area within a local watershed (14-digit NRCS hydrologic unit); typically about one to 5 square miles in area, these areas are considered the most appropriate and effective geographic scale for local watershed planning and management.

Technical Advisory Committee (TAC) – the group of experts assembled to guide the scientific assessment and data interpretation for an LWP process.

T and E species – refers to federal- or state-listed threatened or endangered species, per provisions of the Endangered Species Act of 1973. Visit <http://www.fws.gov/endangered/>

TIP – refers to the NC DOT Transportation Improvement Program and the projects funded and managed by this program. TIP projects include new highway and bypass construction, roadway widening, bridge construction/repair, etc.; visit <http://www.ncdot.org/planning/development/TIP/>

TMDL (total maximum daily load) – the maximum amount of a given pollutant that a water body can receive without exceeding water quality standards; the objective of a TMDL is to estimate, through modeling, allowable pollutant loads to be allocated to various point and nonpoint sources so that a given stream or stream reach may be restored to its classified best use(s). For additional information about the modeling and development of TMDLs by NC DWQ for impaired waters, go to <http://portal.ncdenr.org/web/wq/ps/mtu/assessment>

Use Support – refers to the DWQ system for classifying surface waters based on their designated best use(s). For additional information, go to the website for DWQ’s Basinwide Planning Program at <http://portal.ncdenr.org/web/wq/ps/bpu/about> and DWQ’s Classifications and Standards Unit at <http://portal.ncdenr.org/web/wq/ps/csu>.

USFWS – U.S. Fish and Wildlife Service; agency within the US Department of Interior charged with conserving, protecting and enhancing fish ,wildlife, plants and their habitats for benefit of the American people. http://www.fws.gov/help/about_us.html

USTs – underground storage tanks, including those containing gasoline, oil and other petroleum products. Leaking USTs (LUST) are a potential source of soil, groundwater and surface water contamination. For additional information, go to <http://portal.ncdenr.org/web/wm/ust/ustmain>

Watershed Assessment Team (WAT) – this refers to the team of DWQ field sampling staff assigned to support EEP Local Watershed Planning initiatives. Tasks performed by the DWQ WAT teams include biological sampling, physical/chemical water monitoring, and field assessments of stream and riparian buffer conditions.

Windshield survey - a cursory field exercise, typically performed by a planner and project manager during Phase I, intended to provide a general impression of watershed conditions.

WRC (or NC WRC) – NC Wildlife Resources Commission; program within the NC Department of Environment and Natural Resources responsible for conservation of fish and wildlife resources in North Carolina. <http://www.ncwildlife.org/about.aspx>

VI. Scope of Work

Scope of Work

**NC Division of Water Quality
Water Quality Assessments**
supporting the development of
**NC Ecosystem Enhancement Program
Local Watershed Plans**

NC Division of Water Quality
Watershed Assessment Team
June 23, 2010
Version 1.0

Introduction

This scope of work represents a portion of the outcome from the Watershed Assessment Forum held on June 9 and 10, 2009 in Raleigh NC, and subsequent discussions with the NC Department of Transportation (DOT). During this forum, NC Department of Transportation staff expressed a need for a written description and estimated costs for a standard suite of water quality assessments that could be conducted by the NC Division of Water Quality to support the development of local watershed plans by the NC Ecosystem Enhancement Program (EEP). This scope of work is a description of a standard suite of water quality assessments supporting the development of local watershed plans by the EEP. It was developed partially as a result of the discussions during the Forum and through subsequent discussions with the DOT. The assessments described below address the goal of a “watershed approach: *“The ultimate goal of a watershed approach is to maintain and improve the quality and quantity of aquatic resources within watersheds through strategic selection of compensatory mitigation sites.”* Additionally, the types and intensity of the assessments described below will vary among watersheds, but in all cases the strategy will be to answer these questions: 1) Are there water quality issues within the watershed? 2), If so, what are those issues/stressors? And, 3) where within the watershed are the sources of water quality stressors?”

This scope of work will:

- A. Identify specific state or federal legislation or administrative rules and goals that apply to watershed planning.
- B. Identify the key agencies and their roles/responsibilities.
- C. Identify and describe water quality assessments supporting the development of local watershed plans developed by the EEP.
- D. Describe the processes for quality assurance for water quality assessments.
- E. Identify risks to the successful completion of water quality assessments.
- F. Provide an estimate of costs.

A. State and Federal Legislation or Administrative Rules

North Carolina Statutes

NC General Statutes¹ § 143-214.8 through § 143.13 discuss watershed planning.

§ 143-214.10. Ecosystem Enhancement Program: development and implementation of basinwide restoration plans.

Develop Basinwide Restoration Plans. – The Department shall develop basinwide plans for wetlands and riparian area restoration with the goal of protecting and enhancing water quality, flood prevention, fisheries, wildlife habitat, and recreational opportunities within each of the 17 major river basins in the State. The Department shall develop and implement a basinwide restoration plan for each of the 17 river basins in the State in accordance with the basinwide schedule currently established by the Division of Water Quality. (1996, 2nd Ex. Sess., c. 18, s. 27.4(a); 2005-386, s. 3.3.)

Federal Regulations

The U.S. Army Corps of Engineers and U.S. Environmental Protection Agency jointly released a new rule “*Compensatory Mitigation for Losses of Aquatic Resources; Final Rule*”² to clarify how to provide compensatory mitigation for unavoidable impacts to the nation's wetlands and streams. The rule will enable these agencies to promote greater consistency, predictability and ecological success of mitigation projects under the Clean Water Act. The rule encourages that compensatory mitigation decisions be made from a watershed perspective in which the type and location of compensatory mitigation follows from an analytically-based watershed assessment to assure that the proposed compensation furthers watershed goals. This assessment may take the form of a watershed plan, which typically involves an intensive regional planning effort involving many stakeholders. It may also be a less formal “watershed approach,” involving the analysis of data concerning regional environmental issues, efforts to inventory historic trends in aquatic resource condition, and the prioritization of aquatic resource restoration opportunities. Such an approach involves consultation with stakeholders, resource agencies and environmental experts as appropriate.

The US Environmental Protection Agency's website (<http://www.epa.gov/wetlandsmitigation/>) provides information on the rule in addition to a hyperlink to the rule itself: http://www.epa.gov/owow/wetlands/pdf/wetlands_mitigation_final_rule_4_10_08.pdf

B. Agencies Involved and Responsibilities

1. *NC Division of Water Quality (DWQ)* -- The North Carolina Division of Water Quality (DWQ) in the NC Department of Environment and Natural Resources is the agency responsible for statewide regulatory programs in groundwater and surface water protection. The mission of the DWQ is “to protect and enhance North Carolina's surface waters and groundwater resources for the citizens of North Carolina and future generations.”

Within this scope of work, the DWQ supports the development of the NC Ecosystem Enhancement Program (EEP) local watershed plans by conducting water quality assessments funded through financial support provided by the EEP (and/or the DOT). Currently, direct support represents the funding for the salaries of seven DWQ staff, the supplies and equipment needed

¹ http://www.ncleg.net/EnactedLegislation/Statutes/HTML/ByChapter/Chapter_143.html

² DEPARTMENT OF DEFENSE, Department of the Army, Corps of Engineers, 33 CFR Parts 325 and 332 and ENVIRONMENTAL PROTECTION, AGENCY40 CFR Part 230

to conduct watershed assessments, and any information needed regarding the concentrations of pollutants in surface waters provided by the DWQ Laboratory Section. Five staff supported by the EEP represent the Watershed Assessment Team (WAT). The sixth staff member is in the DWQ Biological Assessment Unit.

In addition to the direct support, DWQ provides indirect support – that is, DWQ efforts NOT funded by EEP and/or DOT. This indirect support includes the coordination of watershed planning efforts between the EEP and the DWQ Basinwide Planning Unit and Modeling/TMDL Units. The indirect support also includes the efforts provided by, but not limited to, DWQ management (Central and Regional Offices) and Administration (e.g. budget office).

The DWQ Laboratory Section is used to perform the chemical analyses of water samples. The Laboratory Section provides results for analytes such as nutrients, fecal coliform bacteria and turbidity.

2. NC Ecosystem Enhancement Program (EEP): The mission of the EEP is “to restore, enhance, preserve and protect the functions associated with wetlands, streams, and riparian areas, including but not limited to those necessary for the restoration, maintenance and protection of water quality and riparian habitats throughout North Carolina.” The EEP was created through a tri-party agreement among the NC Department of Transportation, NC Department of Environment and Natural Resources, and the US Army Corps of Engineers. The EEP fulfills many of the NCDOTs compensatory mitigation needs and serves as the lead agency in the development of local watershed plans.
3. NC Department of Transportation (DOT). The mission of the DOT is “Connecting people and places in North Carolina – safely and efficiently, with accountability and environmental sensitivity.” The DOT relies on the EEP to fulfill many of its compensatory mitigation obligations required under COE permits and/or Section 401 water quality certifications issued by the DWQ. Additionally, the DOT supports the development of local watershed plans by the EEP by providing qualified staff to conduct surveys of aquatic organisms (e.g. fish, mussels).
4. US Army Corps of Engineers (COE) The mission of the COE is to “Provide vital public engineering services in peace and war to strengthen our Nations security, energize the economy, and reduce risks from disasters.” Within the context of this scope of work, the COE promulgated, in partnership with the EPA “Compensatory Mitigation for Losses of Aquatic Resources; Final Rule” 33 CFR Parts 325 and 332. Additionally, the COE was a signatory partner in the tri-party agreement which created the EEP.
5. US Environmental Protection Agency (EPA) The mission of the EPA “is to protect human health and the environment.” Within the context of this scope of work, the EPA promulgated, in partnership with the COE, the “Compensatory Mitigation for Losses of Aquatic Resources; Final Rule” 40 CFR Part 230.
6. Others: Others may include:
 - a. Universities (e.g. North Carolina State University; NCSU),
 - b. Councils of Government (COGs),
 - c. County Governments,
 - d. Municipal governments,
 - e. Private consultants,

Agencies/organizations in this group usually serve, in addition to the EEP and the DWQ, as part of the planning team. The planning team generally oversees the planning needed to develop a local watershed plan.

C. Water Quality Assessment Tasks

The following tasks represent an outline of the assessment approach along with *estimated* costs base upon past watershed monitoring efforts conducted by the DWQ for the EEP. Actual costs will vary depending on watershed size, location of the watershed, and assessment needs.

1. **Review of Existing Data**

Product: Report; GIS data

Purpose: The goal of this report is to gather information regarding what is known about a watershed through a review of existing water quality data from the LWP planning area. Results will be used to help identify where assessments efforts should be directed.

Description: The intent of this review is to summarize existing water quality information from DWQ reports (e.g. DWQ basin assessment reports, and DWQ basinwide plans) and review water quality data collected within the LWP area. Water quality data collected from the LWP area are reviewed in order to identify existing problems, determine temporal patterns (trends) and identify spatial patterns of the results from any previous water quality assessments. It is possible that some data sources may not be summarized simply due to the fact that the source(s) of the data were not known (e.g. articles published by scientists).

The data review will include summaries of water quality data collected from the DWQ's ambient monitoring system, any coalition of NPDES dischargers, results of previous DWQ biological assessments, and any other water quality data collected from any organization including universities, the NC Department of Transportation, the US Geological Survey, and citizen monitoring groups. Additionally results from water quality assessments close to, but outside the LWP area, may be summarized too. This is done mainly since many LWP areas have few to no results available from existing water quality management programs. Obtaining these data aid in the interpretation of the results acquired from assessments completed to support the development of the local watershed plan.

The DWQ Basinwide Information Management System (BIMS) will be queried for information on permitted wastewater and stormwater dischargers. The Potential Contaminant Sources (PCS) database³ will be queried to determine the locations of potential contaminants.

Once existing data have been obtained, a comprehensive list of identified data sources will be developed and shared with the planning team overseeing the development of the local watershed plan. The watershed planning team will determine if any additional data sources exist and whether causes and sources of any water quality problems or impairments can be identified. The existing data summary may be presented to stakeholders to help develop watershed goals.

Estimated Time for completion: Six weeks (allows for external reviews and subsequent revisions).

Estimated Cost: 240 hours x \$31/hour = \$7,444

2. **Watershed Reconnaissance**

Product: Memorandum; GIS data

³ Database maintained by the NCDENR Public Water Supply Section.
http://swap.deh.enr.state.nc.us/Swap_app/viewer.htm

Purpose: The goals of a watershed reconnaissance are to: 1) ascertain existing and likely water quality problems and their sources, and 2) to identify opportunities for compensatory mitigation. Outcomes include: 1) identifying where more focused water quality assessments should occur, 2) determining whether sites have sufficient flow for taking chemical samples and/or conducting biological assessments, and 3) determining whether sites are safely accessible for future assessments.

Description: A reconnaissance survey consists of driving through the watershed, making a written record of observations, obtaining the latitude and longitude of sites visited, taking photographs, and documenting spatial patterns from the observations and results of the field measurements. Approximately 30 to 90 sites will be visited. A "site" is usually a bridge crossing that provides safe and convenient access to surface waters.

Field measurements for dissolved oxygen, pH, specific conductance and water temperature will be done at bridge crossings or other easily and publicly available access points. If warranted, the field crew may take water samples or use alternative methods ([Hach](#) or [CHEMets](#) kits) to estimate concentrations of parameters of concern.

Time for completion: Four weeks

Estimated Cost:

Field work: ten days, two staff: 160 hours x \$31/hour = \$4,960
Office-Technical memorandum writing and internal review:
10 days, one staff: 80 hours x \$31/hour = \$2,480
Total Estimated Costs (\$4,960+ \$2,480) = \$7,440

3. **Physical/Chemical Assessments**

Product: Memorandum; GIS data

Purpose: Physical and chemical assessments may determine specific pollutants that may be an issue and the watersheds from which they originate. The goal is to identify the sources of pollution at the smallest geographic scale possible.

Description: Focus will be on determining whether nutrient and fecal coliform pollution are present and identifying the sources of the pollution. Metals and organic contaminants will not be sampled unless potential problem areas for these are identified through the review of existing data, the field reconnaissance, and/or stakeholder input.

Sites will be selected for data collection (usually this consists of ten to twelve but may vary, up or down, depending on the watershed and goals of the local watershed plan) to be assessed, usually ranging two to three months. Afterwards data collection at these sites will cease. New sites could be selected and data collected for two to three months (upstream of the original sites) after the initial data collection with the goal of identifying the sources of pollution. In conjunction with, or as an alternative to submitting water samples to the DWQ Laboratory Section, measurements could be taken in the field using [Hach](#) or [CHEMets](#) kits.

Explicit reasons why sites were selected for monitoring/assessment will be stated in an assessment plan.

Parameters to be monitored (and reasons why):

Field measurements:

- i. Dissolved oxygen (DO), (easily measured; there is a NC state standard for DO)
- ii. pH, (easily measured; there are NC state standards for pH)
- iii. Water temperature, (easily measured)
- iv. Specific conductance (easily measured; high values can suggest pollution)

Nutrients (Nutrients are a widespread water quality problem)

- i. Ammonia as nitrogen (NH₃)
- ii. Total Kjeldahl nitrogen (TKN)
- iii. Nitrite+nitrate as nitrogen (NO₂+NO₃)
- iv. Total phosphorus (TP)

Fecal Coliform Bacteria (There is a NC state water quality standard for fecal coliform bacteria)

Turbidity (There is a state water quality standard for turbidity; results are also used to help interpret results for nutrients)

Time for completion: Seven to nine months

Estimated Costs:

Minimal costs for field measurements⁴

Laboratory Costs (current cost is \$12.56 per result) for nutrients, fecal coliform bacteria, and turbidity.

Six results per site (NH₃, TKN, NO₂+NO₃, TP, fecal coliform bacteria, turbidity), 10 initial sites, 10 follow up sites, each site monitored once during three consecutive months

6 results x (10 initial sites + 10 follow-up sites) x 3 (months) x \$12.56 = \$4,522

Staff time for field work

Four hours, 1 staff, for preparation (getting supplies ready) for each sampling trip
4 hours x 6 trips = 24 hours x \$31/hour = \$744

Eight hours, 2 staff for sampling
8 hours x 2 staff x 6 trips x \$31/hour = \$2,976

Staff time for office work

Eighty hours, 1 staff for data entry, compile GIS data, write/revise memoranda including internal reviews.

80 x \$31/hr = \$2,480

Total Estimated Costs = \$4,522 + \$744 + \$2,976 + \$2,480 = \$10,722

⁴ Costs include, but are not limited to calibration standards, equipment depreciation, maintenance, etc.

4. **Biological Assessments**

Biological assessments can include 1) benthic macroinvertebrate assessments and/or 2) fish community assessments. Biological assessments for benthic macroinvertebrates can be conducted by the NC Division of Water Quality – Biological Assessment Unit (DWQ-BAU) and/or DWQ Watershed Assessment Team (DWQ-WAT) staff. Fish assessments resulting in indices of biological integrity are conducted only by DWQ-BAU. DOT staff have also conducted fish and mussel assessments.

Product: Memorandum; GIS data

Purpose: Biological assessments will determine how well a body of water supports aquatic life and may help identify types of impacts to instream communities.

Description: Biological assessments are evaluations of the condition of waterbodies using surveys and other direct measurements of resident biological organisms (macroinvertebrates and/or fish). Biological assessment results are used to answer the question of whether waterbodies support survival and reproduction of desirable fish, shellfish, and other aquatic species -- in other words, if the waterbodies meet their designated aquatic life uses. The number of sites that can be sampled by three BAU biologists varies depending on transportation time and the type of sample method⁵ being used. Estimates of the number of sites that can be sampled in one week are:

- 20 sites using the EPT sample method.
- 17 sites using the Qual-4 sample method.
- 13 sites using the Swamp sample method
- 12 sites using the Full Scale (Standard Qualitative Method) sample method
- 10 sites using the Coastal B (Boat) sample method

Site Selection: Many factors are considered in order to select sites for sampling. These include:

- Sites provide safe access to surface waters for staff.
- Sites may have been sampled as part of DWQ's basinwide sample program in which sites may be sampled on a 5-year rotation.
- Information from the review of existing data and/or watershed reconnaissance.
- Sites may be co-located with any physical and chemical assessment sites.
- Sites may be located in subwatersheds with a range of land uses (e.g. urban vs. rural).

Explicit reasons why sites were selected for monitoring/assessment will be stated in an assessment plan

Time for completion: One week for field work; Report completed within three months after field work:

⁵ Sample methods are described in "Standard Operating Procedures for Benthic Macroinvertebrates. Biological Assessment Unit. July 2006. <http://h2o.enr.state.nc.us/esb/BAUwww/benthossop.pdf>

Estimated Costs (Benthic Macroinvertebrate): Number of sites assessed within an LWP planning area can vary.

Field work: Three DWQ-BAU staff 40 hours. 3 staff x 40 hours = 120 hours

Taxa ID, data entry: One staff 120 hours

Technical memorandum writing and internal QA/QC: 40 hours

280 hours x \$31/hour = \$8,680

5. **Stressor Source Identification/Follow-up**

Product: Memoranda; GIS data

Purpose: Purposes are to identify: 1) the smallest geographic area or specific location of any pollution source, 2) areas of water quality and/or habitat degradation, 3) high quality areas, and 4) opportunities for compensatory mitigation. Some of these may be achieved through the field reconnaissance.

Description: This task may include walking portions of streams to identify areas of concern and opportunities for compensatory mitigation. Hach kits and/or field measurements may be used to in this process. Staff in the field have the primary responsibility to identify sources of water quality stressors, but also have the opportunity to identify high quality areas and opportunities for compensatory mitigation.

Estimated Costs:

Field work: Staff time: Two staff members working together for three weeks; 2 x 120 hours = 240 hours x \$31/hour = \$7,440

Office work: Staff time: One staff member – 60 hours x \$31/hour = \$1,860

Total cost estimate = \$9,300

6. **Other Assessments**

Product: Memoranda; GIS data

Purpose: Purposes may be specific to watershed area and the type of assessment chosen. Types of other assessments include, but are not limited to:

Description: Description is dependent on the purpose and the assessment method chosen to address the purpose.

- i. NC Wetland Assessment Method (NCWAM)⁶
- ii. DWQ aquatic habitat assessment,
- iii. Bank Erosion Hazard Index (BEHI),
- iv. Identification of Stream Origins and Flow regimes⁷ "NC "Methodology for Identification of Intermittent and Perennial Streams and their Origins"
- v. Others, e.g. Center for Watershed Protection's "Unified Stream Assessment" (USA) and "Unified Subwatershed and Site Reconnaissance" (USSR)
- vi. Stream walks/visual assessments/photographs

⁶ Two DWQ-WAT staff have been trained to use NCWAM

⁷ Six DWQ-WAT staff have been certified through the Surface Water Identification Training and Certification (SWITC) program mandated by NC Session Law 2001-404 to make a legal determination of stream origins and identify surface waters subject to buffer rules enacted by the NC Environmental Management Commission.

Estimated Costs: Costs will vary depending on assessment needs and the type of assessment chosen.

7. **Planning and Stakeholder Meeting Attendance**

Product: In most cases there is no specific product. PowerPoint presentations may be developed to convey the results of the assessments. In all cases, results of meetings organized by the DWQ will be summarized and will include a copy of the agenda, a list of participants and the agencies they represent and a summary of the discussion including outcomes, action items and the date/time and location of any follow-up meetings. These meeting minutes will be disseminated to all invited participants.

Purpose: Communication among members of the planning team and stakeholders

Estimated Costs:

Staff time: 160 hours – meeting/PowerPoint preparation, meeting attendance
160 hours x \$31/hour = \$4,960

8. **Final Report**

Product: Report

Report Content: The final report will represent a compilation of any memoranda produced, any new material, and an executive summary.

Purpose: The report will integrate the results of all the assessments completed, referencing source memoranda as needed.

Intended Recipients: EEP, DWQ (e.g. Basinwide Planning Unit, Modeling/TMDL Unit), DOT. Report will be posted on the DWQ-WAT website. Once the report is posted, an email will be sent to interested parties advising them that the report is available.

Estimated Costs:

Staff time: 160 hours (including internal reviews)
160 hours x \$31/hour = \$4,960

D. **Quality Assurance**

1. Benthic macroinvertebrate sampling will be completed in accordance with current DWQ Standard Operating Procedures. (<http://h2o.enr.state.nc.us/esb/BAUwww/benthossop.pdf>)⁸
2. Any benthic macroinvertebrate assessments conducted by DWQ-WAT staff that will result in the assignment of bioclassifications will have a sampling plan completed in conjunction with, and approved by the DWQ-Biological Assessment Unit. DWQ-WAT staff will have been trained in DWQ-BAU methodology.
3. DWQ-BAU will have the opportunity to review any DWQ-WAT report pertaining to macrobenthos

⁸ Hyperlinks with “h2o.enr.state.nc.us” as part of the URL may be changed due to the DWQ implementing a new web pages in early 2010.

4. Chemical sampling will be completed in accordance with current DWQ Laboratory Section and Intensive Survey Unit Standard Operating Procedures (see: <http://portal.ncdenr.org/web/wq/lab> and (<http://h2o.enr.state.nc.us/esb/documents/PHYSICAL-CHEMICAL%20SOP.pdf>))
5. A “blind” duplicate set of chemical samples will be collected from one site and submitted to the Laboratory Section. This does not represent a split sample, but represent results from two samples from the same site taken at the same time or within minutes of one another, and are referred to as duplicates in this document.
6. Field meters will be calibrated daily. If post sampling calibrations do not meet documented QA criteria (see SOPs), then all results for that sampling event will be qualified. Field notes and meter calibration logs will be maintained.
7. Data entry will be checked manually and by graphing data (checking for outliers, or atypical results). Raw data will be forwarded to EEP and/or third parties upon request. If any results appear atypical, then DWQ will investigate possible reasons (e.g. data entry error) and correct if needed. If any other results are deemed atypical, and for which a reason cannot be found, EEP will be informed.
8. Written deliverables (memoranda/reports) will be reviewed by at least one other person other than the author.

E. Risks

These represent some of the factors that may prevent DWQ from performing work on schedule:

1. Staff changes: Staff could resign or other factors (e.g. sickness or injury) could prevent staff from performing work. The DWQ will attempt to identify alternative staff for sample collection if unforeseen events prevent primary staff from completing sample collections.
2. State budget: State budget issues could result in curtailing equipment purchases and/or nonessential travel. The term “nonessential” would likely be defined for NC government staff by administrators. The DWQ will provide written communication (email) to the DOT and the EEP if travel and/or any state imposed travel restrictions affect any activities that require travel.

F. Cost Estimates - Summary

A summary of the cost estimates for monitoring and assessment for a “typical” LWP project is shown in the table below.

Task	Description	Estimated Cost
1	Review of Existing Data	\$7,440
2	Watershed Reconnaissance	\$7,440
3	Physical/Chemical Assessment	\$10,722
4	Biological Assessment	--
	Benthic Macroinvertebrate	\$8,680
	Fish	To be determined
5	Stressor Source Identification/Follow-up	\$9,300
6	Other Assessments ^a	To be determined
7	Planning/Stakeholder meetings	\$4,960
8	Final Report	\$4,960
Tasks: Subtotal		\$53,502
Indirect Costs	13.10%	\$7,009
Subtotal	Cost for Tasks + Indirect Costs:	\$60,511
Estimate-Total Costs:		\$60,511

Other Costs NOT included above include, but are not limited to:

Management, coordination, tracking (5%)	?
Transportation (example:5000 miles at \$0.45/mile) ^b	\$2,225
Overnight travel per staff per day ^c	\$101.05
Consumables (calibration standards)	\$200
Equipment depreciation	?
Office Supplies	\$50

^a One week of work (40 hours) for one staff is 40 x \$31 = \$1,240 (field work does not include preparation in the office, or data entry, etc.).

^b 5000 miles is an estimate. Costs per mile depend on vehicle used.

^c Travel Subsistence Rate Revision Effective July 1, 2009 (Charles E. Perusse Memo: July 7, 2009)

List of Acronyms

Acronym	Definition
BAU	Biological Assessment Unit
BEHI	Bank Erosion Hazard Index
BIMS	Basinwide Information Management System
BMP	Best Management Practice
CFR	Code of Federal Regulations
CHPP	Coastal Habitat Protection Plan
COE	Corps of Engineers
COG	Council of Government
DENR	Department of Environment and Natural Resources
DO	Dissolved Oxygen
DOT	Department of Transportation
DWQ	Division of Water Quality
ECU	East Carolina University
EEP	Ecosystem Enhancement Program
EIA	Ecological Integrity Assessment
EPA	Environmental Protection Agency
EPT	Ephemeroptera, Plecoptera, and Trichoptera
GIS	Geographic Information System
HU	Hydrologic Unit
LWP	Local Watershed Plan
MOA	Memorandum of Agreement
NC	North Carolina
NCSAM	North Carolina Stream Assessment Method
NCSU	North Carolina State University
NCWAM	North Carolina Wetland Assessment Method
NGO	Non-Governmental Organization
PCS	Potential Contaminant Source
QA/QC	Quality Assurance/Quality Control
RBRP	River Basin Restoration Plan
SOP	Standard Operating Procedure
SWITC	Surface Water Identification Training and Certification
TJCOG	Triangle J Council of Governments
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
US	United States
USA	Unified Stream Assessment
USGS	United States Geological Survey
USSR	Unified Subwatershed and Site Reconnaissance
WAT	Watershed Assessment Team