



# Volume III Technical Appendices

December 2018

## Eno River Watershed Improvement Plan

Durham, North Carolina

PREPARED FOR:



**City of Durham**  
Public Works Department  
Stormwater & GIS Services Division  
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## Acknowledgments

The Eno River Watershed Improvement Plan represents the combined effort of staff from the City of Durham, AECOM, Kimley Horn and Associates, and Three Oaks Engineering.

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# Introduction

The Eno River Watershed Improvement Plan (WIP) is divided into three volumes, similar to previous City of Durham (City) watershed studies. The three volumes and supporting reports are:

- **Volume I: Executive Summary.** Project goals, watershed evaluation methods, results of the watershed improvement scenarios, recommended projects, high-priority project fact sheets, and next steps in evaluating progress.
- **Volume II: Improvement Plan.** Summary of the approach used to develop the WIP, data used to develop watershed models, stream and SCM inventory and assessments, watershed improvement scenarios, watershed improvement project evaluation and prioritization, public outreach and involvement efforts, recommendations, implementation schedule, and measurable milestones.
- **Volume III: Technical Appendices.** Reports and memoranda with more detailed information on the technical approach used in the development of the WIP than in Volume II, including field surveys and the development of modeling.
- **Watershed Assessment Report.** The Eno River Watershed Assessment Report presents an analysis of the City of Durham's water quality monitoring data, existing and future land use, results of field assessments for streams and SCMs, and identification of impacts and sources to watershed functions. Pilot Study Areas and preliminary project opportunities are also identified.
- **Critical Area Protection Plan (CAPP).** The Critical Area Protection Plan (CAPP) identifies and prioritizes high-quality riparian preservation projects on private property throughout Durham. Properties were evaluated based on criteria that would enhance water quality and watershed health. The CAPP covers the entire city and provides an evaluation and summary of high-quality privately owned riparian buffer areas in Ellerbe Creek, Third Fork Creek, Northeast Creek, Crooked Creek, Little Lick Creek, and Eno River.
- **Riparian Area Management Plan (RAMP).** This citywide report focused on riparian buffer management projects on public land including parks, utility easements, and greenway corridors. Provides maintenance recommendations for personnel involved in managing these public areas. No updates were made to the RAMP under the Eno River WIP, but one of the recommendations in previous RAMPs was implemented as a pilot project under the Eno River WIP contract, which involved installing signage that defined "no-mow" zones and promoted riparian growth along utility corridors. The details of the implementation and preliminary findings are provided in a separate technical memorandum "No Mow Pilot Study Memorandum" dated March 5, 2018.

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# Appendix A:

## Data Control Plan

The purpose of the Data Control Plan is to describe the plan for managing the collection and use of the extensive amount of data required to support the development of the Eno River WIP. The plan addresses the management and use of Geographic Information Systems (GIS), databases, spreadsheets, and web applications that were used to prepare the WIP and other project deliverables.

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## Appendix B: Stream Assessment Field Plan

The Stream Inventory and Assessment Plan is a detailed work plan developed to guide field-based stream reach assessments that were used to support the development of the Eno River WIP. The plan describes the methods for Level 1 and 2 stream assessments, data management, and quality control.

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## Appendix C: Stormwater Control Measure Inventory and Assessment Field Plan

The Stormwater Control Measure Inventory and Assessment Field Plan is a detailed work plan developed to guide field-based stormwater control measure (SCM) evaluations that were used to support the development of the Eno River WIP. The plan focuses on acquiring data to meet the Eno River WIP goals, including the acquisition of pertinent SCM data to develop a watershed model, the identification of retrofits to existing SCMs to improve stormwater treatment, and the evaluation of potential new SCM locations to treat areas that are not currently served by an SCM.

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## Appendix D:

# Pilot Study Area Fact Sheets

Pilot Study Area (PSA) fact sheets are two-page descriptions of areas in the Eno River watershed that were selected for detailed field investigations and modeling to support the development of the Eno River WIP. The PSAs represent typical subwatershed conditions (e.g., land use, imperviousness, soil type, future development plans, presence of existing SCMs). The PSAs are evaluated to determine water quality benefits associated with the implementation of SCMs, stream restoration, and other water quality improvement strategies.

The following five final PSAs were recommended for detailed field evaluation and modeling:

- Residential and Commercial: ER12
- Medium to High Density Residential: ER38
- Well-Drained Mixed Residential: ER50
- Parks and Open Space: ER30
- New Development: ER33

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# Appendix E: Eno River Watershed Assessment Report

The Eno River Watershed Assessment Report presents an analysis of Durham's water quality monitoring data, existing and future land use, results of field assessments for streams and SCMs, and identification of impacts and sources to watershed functions. Pilot Study Areas and preliminary project opportunities are also identified.

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## Appendix F: Critical Area Protection Plan

The Critical Area Protection Plan (CAPP) identifies and prioritizes high-quality riparian preservation projects on private property throughout the City of Durham (City). Properties were evaluated based on criteria that would enhance water quality and watershed health. The CAPP covers the entire City and provides an evaluation and summary of high-quality privately owned riparian buffer areas in Ellerbe Creek, Third Fork Creek, Northeast Creek, Crooked Creek, Little Lick Creek, and Eno River. It is also available as a standalone report.

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# Appendix G: Technical Memorandum – Quality Assurance Project Plan

The Quality Assurance Project Plan presents the plan for data management and analysis to build a watershed model in support of the development of a watershed improvement plan. The plan describes the procedures that are required to ensure that the project is executed in a manner consistent with applicable modeling guidance documents and with generally accepted and approved quality assurance objectives. It also provides a general description of the modeling approach and related analytical work to be performed for the project, a description of the data requirements, data quality objectives, data quality control, and calibration approaches.

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# Appendix H: Technical Report – PCSWMM Model Development and Calibration

The PCSWMM Model Development and Calibration Technical Report describes the development and calibration of a Personal Computer Stormwater Management Model (PCSWMM) for the Eno River watershed. The model was developed using the Quality Assurance Project Plan (see Appendix G) as the technical guidance document.

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# Appendix I: Technical Report – Eno River WARMF Update and Calibration

The Eno River WARMF Update and Calibration Technical Report describes the update of Watershed Analysis Risk Management Framework (WARMF) model developed for Falls Lake in 2009 by the North Carolina Department of Environmental Quality. The WARMF model update involved redelineating the Eno River watershed boundary and model catchments, updating model inputs, updating model calibration data including streamflow and water quality, extending the model simulation period, and updating input time series for the Ellerbe and Little Lick watersheds.

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# Appendix J: Technical Memorandum – Prioritization of Proposed Watershed Improvement Projects

The Prioritization of Proposed Watershed Improvement Projects Technical Memorandum presents the evaluation, prioritization, and ranking process for the proposed SCM retrofit and stream restoration projects in the Eno River watershed. The 16 prioritization criteria, divided into six categories, were applied to the watershed improvement projects for the Eno River WIP. The criteria are based on the criteria used in the WIPs prepared for Ellerbe Creek, Third Fork Creek, Northeast Creek, Crooked Creek, and Little Lick Creek.

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## Appendix K: Technical Memorandum – Summary of Previous Watershed Scenarios and Proposed Eno River Watershed Scenarios

The Summary of Previous Watershed Scenarios and Proposed Eno River Watershed Scenarios Technical Memorandum provides a summary of the watershed scenarios that were evaluated during watershed planning studies conducted by the City of Durham in the Ellerbe Creek, Third Fork Creek, Northeast Creek, Crooked Creek, and Little Lick Creek watersheds. The scenarios have been used to evaluate the effectiveness of water quality improvement practices, including stormwater control measures (SCMs) retrofits, stream restoration projects, sanitary sewer system rehabilitation, stormwater performance standards for new development and redevelopment, land conservation, and low impact development (techniques to improve watershed-wide water quality). The memorandum also discusses the scenarios that were selected for evaluation in the Eno River watershed, the methodology, and the results.

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# Appendix L: Aquatic Vegetation Survey Report in the Eno River

An aquatic vegetation survey was conducted during the development of the Eno River WIP as a follow-up to the City of Durham's 2013 submerged aquatic vegetation survey for hydrilla, parrot feather, and riverweed in the same study area that was analyzed for the Eno River WIP. The Aquatic Vegetation Survey Report in the Eno River describes the approach used for the field survey, and the results are compared to the 2013 results. Any changes in distribution or presence in aquatic vegetation are noted.

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# Appendix M: Fish Studies Report

The Fish Studies Report presents results from freshwater fish surveys that were conducted at select locations in the Eno River and Ellerbe Creek as part of the Eno River WIP in Durham County. Both quantitative and qualitative surveys were conducted.

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# Appendix N:

## Public Education and Outreach Materials

Appendix N presents the materials that were prepared to support the public education and outreach efforts by the City for the Eno River WIP. The materials include:

- Meeting summaries of the three Public Information Sessions held on March 21, 2017, November 2, 2017, and July 31, 2018
- Three Project Fact Sheets prepared for each Public Information Session
- Two city-wide Green Stormwater Infrastructure fact sheets developed for use by the Stormwater & GIS Services Division staff
- Three videos were prepared during this project and are available at:
  - <https://youtu.be/CdgevXy5cyM>
  - <https://youtu.be/UOEpbTx5QL0?list=PL5760F8572BE4AD39>
  - <https://youtu.be/um2dRkrxUEY>
- A radio spot was developed in Spanish and broadcasted on the channel La Ley 101.1FM to reach the Spanish-speaking population. The radio message was focused on best practices when using paint brushes to prevent paint pollution from entering storm drains and streams. The recorded message is available at: <https://durhamnc.gov/2890>.

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# Appendix O: North Carolina Nine Element Plan Checklist

Appendix O is a checklist that shows how the Eno River Watershed Improvement Plan meets the nine elements that are required in watershed plans by Section 319 of the Clean Water Act. The checklist is required if the City applies for grant funding to implement any future projects identified under the plan.

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