Final Grant Close-Out Project Report

Development of a Stormwater Retrofit Plan for Water Resources Inventory Area (WRIA) 9 and Estimation of Costs for Retrofitting all Developed Lands of Puget Sound

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Seattle, Washington

Prepared by Jim Simmonds

Introduction

Stormwater from developed landscapes is one of the biggest threats to water quality and ecological health of the waters of Puget Sound, both fresh and marine. The goal of this project was to estimate the numbers of different types of stormwater treatment facilities, and their costs, necessary to rehabilitate stream flows and water quality to near-redevelopment conditions within the Water Resource Inventory Area (WRIA) 9. This final grant close-out project report summarizes the project output by task, provides a reflection on the lessons learned during the project, discusses next steps to achieve the long-term outcomes originally described in the project logic model, and discusses the overall impact of this project within King County and on Puget Sound restoration efforts.

Summary of Outputs

Below is an explanation of accomplishments by task, referencing significant output(s) and deliverable(s) for each task. All project reports and meeting notes are available at the project web page here: http://www.kingcounty.gov/services/environment/watersheds/green-river/stormwater-retrofit-project.aspx.

Task 1: Quality Assurance Project Plan

A quality assurance project plan (QAPP) was prepared at the beginning of the project. The QAPP describes how landowner permissions were secured to access sampling locations, how sites were selected for monitoring, and the methods used for collecting

continuous stream flow data, continuous turbidity and specific conductance data, field water quality measurements, and stream summer baseflow measurements. Quality assurance and control procedures were also described. The project QAPP was prepared following EPA guidance and submitted to EPA for review. EPA comments on the draft QAPP were addressed.

Task 2: Project Management Team

A Project Management Team (PMT) was comprised of representatives from King County, the cities of Auburn, Covington, and SeaTac, the Department of Ecology, the University of Washington, and the USEPA was assembled. The PMT met 12 times between May 19, 2011 and June 5, 2014. The PMT was responsible for directing the technical aspects of the data collection and reporting, the setting of in-stream flow and water quality indicators and targets, the watershed modeling, the SUSTAIN modeling, and development of the retrofit plan.

Task 3: Coordination with the WRIA 9 Watershed Ecosystem Forum

The WRIA 9 Watershed Ecosystem Forum is a multijurisdiction and multistakeholder committee made up of elected officials and technical staff and coordinates efforts related to salmon recovery in WRIA 9. The forum is the key decisionmaking body for salmon recovery in WRIA 9. The project leveraged this existing structure to avoid developing a separate stakeholder committee for this project. Project updates were presented to the Forum on a routine basis, and their input solicited throughout the life of the project. The PMT coordinated with the Forum representatives and WRIA 9 staff during development of the retrofit plan.

Task 4: Existing Data Review

Existing stream/river flow and water quality data that define current conditions and are necessary for calibration of the watershed models were compiled and organized. Compiled data included precipitation, stream flow, stream water quality, land use and land cover, and other atmospheric conditions to estimate evaporation and vegetative transpiration. All data sets were reviewed for data quality and appropriateness for use.

Task 5: New Data Collection and Report

The USGS and King County collectively maintain over 30 stream flow gages in WRIA 9. However, even with this extensive gage network, gage data are not available or insufficient for model calibration for some basins. To address this data gap, stream gages were deployed at priority new sites during the wet season of 2010/2011. Turbidity and specific conductance meters were deployed at both the existing gage locations and the new sites occupied to fill data gaps to support model calibration. Instantaneous summer base flow measurements at the priority new gaging sites will also be made in July-October 2011. Channel information needed for model calibration will also be gathered. Data are available via King County's database and web site at: http://green.kingcounty.gov/wlr/waterres/hydrology/.

Task 6: Development of In-Stream Flow and Water Quality Indicators and Targets

In-stream flow and water quality indicators and targets were developed for the project area. Water quality indicators and targets for copper, zinc, and turbidity were based on

Washington State Water Quality Standards. The flow-related indicators were based on various hydrologic metrics that measure the degree of basin flashiness that are also related to biological community health, including High Pulse Count, High Pulse Duration, High Pulse Range, and the ratio of the 2-year peak flow to the winter baseflow. A literature review on the relationship between flow, water quality and beneficial uses was completed to select indicators. A report describing the in-stream flow and water quality targets for this project was then prepared.

Task 7: Watershed Modeling and Report

To develop relationships between land use and land cover, weather, soils, and stream flow and water quality, the study area was modeled using EPA's watershed modeling platform, Hydrologic Simulation Program – Fortran (HSPF). The watershed modeling conducted for this project was built upon the modeling previously conducted under an existing research project in WRIA 9 funded by National Oceanographic and Atmospheric Administration (NOAA). In this project, the HSPF models developed under the NOAA project were further calibrated to include the new data collected by this study, and the area modeled was expanded to include the Central Puget Sound watershed drainages within the study area. Flows and water quality were assessed under three conditions, idealized fully-forested, current land use/land cover, and 2040 land use/land cover and climate change. A watershed model report was prepared that presents the model inputs, model calibration, and the model outputs.

Task 8: SUSTAIN Modeling and Report

Modeling stormwater retrofit needs using the SUSTAIN model (**S**ystem for **U**rban **S**tormwater **T**reatment and **A**nalysis **In**tegration) proved to be substantially more challenging and time consuming than anticipated. As a result, a series of activities and documents were prepared to complete this task.

- A pilot study application of the SUSTAIN model to a small urban catchment in Enumclaw as completed to demonstrate the ability to implement the model.
- Independent research was conducted to evaluate the potential for stormwater infrastructure to restore flow conditions similar to those under fully forested conditions. This research validated the output of the SUSTAIN model pilot study.
- An assessment of new and re-development rates by 2040 was completed to estimate the amount of stormwater infrastructure likely to be built by 2040 due to new and re-development.
- An assessment of the potential impacts of climate change on stormwater infrastructure sizing was completed to ensure that costs and sizing estimates accounted for changing rainfall patterns.
- SUSTAIN modeling was completed for hypothetical 100 acre catchments representing 135 different combinations of land use/land cover, soil type, slope, rainfall pattern, and land cost. These results were then used to estimate stormwater retrofit needs for the project area based on the area-weighted average of each combination of land use/land cover, soil type, slope, rainfall pattern, and land cost that was modeled.

Task 9: Watershed Retrofit Plan Report

A report was prepared that outlines the extent, composition, and estimated cost of stormwater retrofitting that would be needed in each catchment to meet flow and water quality indicators and targets representative of fully-forested conditions. The estimate

separately accounts for infrastructure anticipated to be constructed by 2040 as part of new and re-development associated with population growth and economic activity from infrastructure constructed as part of a hypothetical public program. The estimate also accounts for existing stormwater infrastructure and potential impacts of climate change. To construct all stormwater retrofits within WRIA 9 within 30 years, a public capital investment of $210 million per year (2013 dollars) would be required; to complete all retrofits within 100 years, a public capital investment of $46 million per year (2013 dollars) would be required. Inspecting, operating, and maintaining these facilities would increase over time as more facilities are constructed. The report also outlined types of policy choices and public program activities that would be required to build this infrastructure in 30 years, including:

- Strengthen stormwater requirements during new and redevelopment to lower thresholds requiring stormwater facilities and to require fee-in-lieu if complete stormwater mitigation is not achieved onsite,
- Build regional facilities,
- Retrofit all roads and highways,
- Retrofit all other non-forested lands not redeveloped within the next 30 years, and
- Operate and maintain public facilities and inspect private facilities.

The stormwater retrofit plan for the study area serves as the basis for development of future funding strategies and project planning and implementation.

Task 10: Stormwater Retrofit Cost Estimate for Puget Sound and Report

Based on the optimized costs of stormwater BMPs and LID techniques needed to meet the in-stream flow and water quality targets in the study area, a planning-level cost estimate was prepared for the Puget Sound region. This estimate was extrapolated from the WRIA 9 study area based on the square miles of different land uses within the Puget Sound watershed. These results were included in the report prepared for Task 9. To construct all stormwater retrofits within the Puget Sound region within 30 years, a public capital investment of $4 billion per year (2013 dollars) would be required; to complete all retrofits within 100 years, a public capital investment of $650 million per year (2013 dollars) would be required. Inspecting, operating, and maintaining these facilities would increase over time as more facilities are constructed.

Task 11: Outreach and Communication

Stakeholder outreach and communication was an essential component of this project. The outreach and communication strategy used multiple approaches to ensure that input from interested stakeholders was gathered in a timely and efficient manner, and that information generated was disseminated and opened for comment appropriately. Activities described under Task 2 (work with a multijurisdiction PMT) and Task 3 (coordinate with the WRIA 9 Watershed Ecosystem Forum) were critical components of the outreach and communication strategy. Routine coordination also occurred with staff from the Department of Ecology, the Puget Sound Partnership, and the Muckleshoot Indian Tribe. The project also used a project website, stakeholder workshops, and quarterly e-mail updates as part of the outreach strategy. This project did not include a public outreach and communication component.

Task 12: Project Management

This task included tracking the project scope, schedule, budget and quality, coordinating the project team, developing and processing contracts, agreements, and invoices, and reporting to EPA as required by the grant.

Reflections on Project

The project team was required to overcome multiple substantial hurdles to successfully complete the project. Several key successes and lessons-learned include:

Successful Collaboration with Large Project Team. Over 20 individuals, representing seven different agencies and organizations, participated on the project management team. The project team successfully met its objectives of guiding the project and making key decisions. The project team meetings were facilitated by a professional facilitator, which greatly contributed to the team's success.

Successful Stakeholder Outreach. Multiple stakeholders provided feedback during the project that they were particularly impressed with the project's stakeholder outreach effort. Primary reasons for this success are believed to be (1) the routine communication of project status to stakeholders, (2) the open and transparent process for reviewing and finalizing reports, (3) the solicitation of input at stakeholder workshops on key decision points, (4) the commitment to modify approaches and decisions based on stakeholder input, and (5) the communication back to stakeholders about *what we changed or did differently* based on their input to ensure that the stakeholders were aware of the importance of their participation.

Successful Application of the SUSTAIN Model. The project team had not previously used the EPA's SUSTAIN model, as it had been released only a couple of months before the project proposal was submitted. While it was anticipated that there would be a substantial learning curve in applying the new model, the effort required to implement the model, including time needed to work with the model developers (Tetra Tech), EPA, and other users, was substantially under estimated. The project team is extremely grateful to EPA and TetraTech support for completing this modeling.

Logic Model Outcomes

The long-term outcome for this project is improved stream habitat conditions in the Puget Sound region. The logic model states that improved conditions would be achieved by (1) improving stormwater management in urban areas, (2) improving flow conditions in urban streams throughout the Puget Sound region, and (3) improving water quality conditions in urban streams throughout the Puget Sound region. Excellent progress is being made towards these actions, as demonstrated by the allocation of $100M from Washington State last biennium for stormwater infrastructure, the development of watershed-scale stormwater management plans by Snohomish, King, and Pierce Counties, the existing requirements for stormwater infrastructure construction as part of new and redevelopment, and the development of Total Maximum

Daily Loads (TMDLs) based on flow metrics and stream benthos community health. Further progress is likely if:

- Ongoing, and possibly increased, state and federal funding for stormwater infrastructure,
- Future development of additional watershed-scale stormwater management plans,
- Possible future requirements in National Pollutant Discharge Elimination System (NPDES) permits for stormwater retrofits,
- Development of creative solutions for funding and constructing stormwater infrastructure as part of new and re-development, and
- Development of creative approaches to minimize the costs to operate, maintain, and inspect stormwater infrastructure.

Broader Perspective

This project has received a substantial amount of interest from a wide variety of stakeholders. As part of their efforts to restore Puget Sound, the Puget Sound Partnership is interested in understanding the overall cost estimates for comprehensive stormwater management. The results from this project will likely be used to support legislative requests, to support future updates of municipal NPDES stormwater permits, and to support the updating of capital programs.