Example of Rhode Island Effort to Address Stormwater Impairments with Structural Controls

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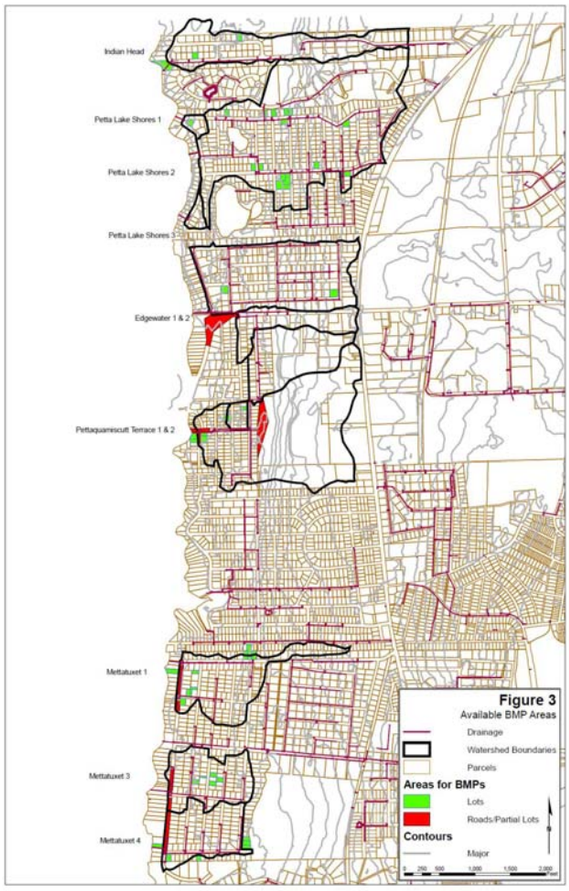
Introduction

The State of Rhode Island is a relatively urbanized state. As a result, stormwater is a significant cause of impairments to that state's surface waters. The Narrow River is a good example of a surface water in Rhode Island which has an urbanized watershed and stormwater is the source of the impairment (pathogens).

The Rhode Island Department of Environmental Management (RIDEM) targeted this watershed as a demonstration project on how to implement stormwater controls to address water quality impairments from an urbanized watershed. This project began with a study to develop a plan to implement controls in selected subwatersheds to address the pathogen loadings causing this impairment. The selected controls were then designed and construction is scheduled to be completed in Fall 2010. The purpose of this presentation is to focus on the plans and controls that have been implemented.



Background

The Narrow River drains to the southern end of Narragansett Bay into its West Passage. Elevated bacteria levels in this tidally influenced stream have been a problem since water quality monitoring began more than 40 years ago. These elevated bacteria levels have resulted in closed shellfish beds for decades. The watershed is about 36 square kilometers in size and about 35% of the watershed is developed.

This waterhsed has been the focus of many studies and environmental plans over the years such as the Narrow River Special Area Management Plan (SAMP) (CRMC, 1987) and the Narrow River Stormwater Study (Tritown Study) (ASA et al 1991). A fecal coliform Total Maximum Daily Load (TMDL) has been developed for this river which was approved on April 29, 2002. Section 8 of the TMDL provides recommendations to address the pathogen impairments to the Narrow River. These recommendations focus on addressing bacterial loads from storm water discharges to the river.

The *Narrow River Stormwater Abatement Study* dated November 2006 (2006 study) identified the Edgewater 1 and 2 (EC) and Pettaquamscutt Terrace 1 and 2 (PTC) subwatersheds as having the greatest potential for structural best management practices (BMPs) to begin mitigating the bacteria impairment. The types of controls that were selected to remove bacteria from stormwater generally consisted of infiltration and filtration practices. BMPs were chosen based on the available soils and space constraints in the subwatsheds. The western portion of the subwatersheds contains very sandy Hydrologic Soil Group (HSG) Type A soils, which are excellent for infiltration controls. The eastern portion of the subwatersheds contains HSG Type C soils which are poor soils for in situ infiltration and thereby no infiltration controls were sited in those areas.

Construction of these improvements were initiated in July 2010 and are planned to be completed by November 2010.

Description of Proposed Controls

This project involves the construction of a series of storm water quality control structures throughout the subject subwatersheds to the Narrow River (the river). The BMPs that are proposed will treat portions of the water quality volume (WQV) from the existing storm drain network. Diversions to direct the WQV to the controls are required in the existing storm drain system, so replacement of select pipes in the existing storm water drainage systems, in both subwatersheds, is proposed in order to maintain the existing capacity of the systems after water quality controls are installed.

Table 1 below summarizes the proposed BMPs and their respective locations. Further description of the BMPs and other proposed work follows.

Table 1
Summary of Proposed BMPs

BMP	Subwatershed	Locations
Infiltration Chambers	Edgewater	Tanglewood Trail
Infiltration Chambers	PTC	Beach Avenue, Isabelle Drive and Lakeview Drive
Level Spreader	PTC	Southwest of the Intersection Of Shore and Wilson Drives
Sand Filter	Edgewater	West of the Intersection of Lakeside Drive and Bridgetown Road
Bioretention System	Edgewater	South terminus of Tanglewood Trail

Edgewater BMPs

The Edgewater subwatershed contains two drainage systems discharging to the river. The northern pipe system conveys drainage from Edgewater 1 (E1) along Tanglewood Trail and Bridgetown Road, and the southern pipe system conveys runoff from Edgewater 2 (E2) along Bridgetown Road. Both E1 and E2 then discharge to two outfalls located west of the intersection of Lakeside Drive and Bridgetown Road. The catchments to these outfalls have been fully built out with moderately dense residential development. As part of this project, debris and deposited sediment will be removed from both outfalls.

A series of subsurface storm water infiltration chambers are proposed in Tanglewood Trail to reduce bacterial loading from E1. Additionally, a bioretention system will be located in the right of way at the south terminus of Tanglewood Trail. A sand filter is proposed to be located in close proximity to the Edgewater outfalls, west of the intersection of Lakeside Drive and Bridgetown Road. The sand filter will treat the entire WQV from E2 and the remainder of the WQV that is not treated by the infiltration infiltration systems and bioretention system in E1.

Pettaquamscutt Terrace BMPs: The PTC subwatersheds also contain two drainage systems discharging to Narrow River. Both drainage systems convey stormwater along Pettaquamscutt Avenue to the outfalls, located slightly southwest of the intersection of Shore and Wilson Drives, in line with Pettaquamscutt Avenue. The northern outfall discharges runoff from the southern subwatershed, Pettaquamscutt Terrace 1 (PT1); and the southern outfall discharges runoff from the northern subwatershed Pettaquamscutt Terrace 2 (PT2). The catchments to these outfalls are densely populated residential areas on the western or down-gradient side and sparsely developed forested land that slopes steeply up to the east on the eastern or up-stream side

The WQV from PT1 and PT2 will be combined and treated by a series of subsurface infiltration chambers in Beach Avenue, Isabelle Drive, and Lakeview Drive to reduce bacterial loading from this subwatershed. The developed area that is down-gradient of the most downstream collection point will be directed overland to discharge over a level spreader and filter strip that will be located in close proximity to the PTC outfalls, just slightly southwest of the intersection of Shore and Wilson Drives. The road that is currently at this location will be removed to install the filter strip, and a new road to provide access to the river and the residences on this road will be located along the north edge of the right of way, narrowed to 12 feet wide, and surfaced with permeable asphalt per University of New Hampshire specifications. The level spreader is designed so that the velocity of flow for the 25 year storm over the level spreader is less than 2.5 feet per second.

As part of construction of these controls there will be replacement of some existing pipes and construction of a new pipe segment and outfall along Beach Avenue. This pipe system will discharge to an existing grouted rock channel which will be expanded to accommodate the increased velocities from the additional flow. The new pipe is proposed to alleviate the additional flooding that would occur from diversions in the storm drain system in an area where significant flooding already occurs.

Expected Pollutant Removal Efficiencies

The target goal of this project is to reduce bacterial loading into the Narrow River, in accordance with the TMDL for this impaired waterbody. Proposed controls were chosen and designed primarily for bacterial removal although additional pollutant removal may be achieved through these control structures. *Table 2* below identifies the controls and the associated removal rates each is capable of. The WQV treated by each control is also provided. The hydrologic modeling was performed using

Hydraflow Hydrographs®, the results of which are provided in *Attachment H*.

Table 2
Removal Efficiencies of Proposed Water Quality Control Structures[1]

Water Quality Control Structure	Bacteria	Nitrogen	Metals	TSS	Water Quality Volume Treated (ft^3)
Infiltration Chambers	99-95[2]	0-65	60-90	60-95	
E1-1 Chambers					3,200
E1-2 Chambers					2,300
E1-3 Chambers					4,100
PTC Chambers without PT-S[3]					32,700
PT-S					800
Level Spreader/ Filter Strip[4]	<0[5]	20	50-55	84	4,000
Bioretention System	20-80	40-55	40-100	15-75	2,700
Sand Filter	35-70	30-50	35-95	80-90	30,400

Note:

1 Range of removal rates as reported in the Center for Watershed Protection Urban Stormwater Retrofit Practices version 1.0, dated August 2007.

2 The low end of reported removal efficiency is 25 percent, but the range shown is the median to high end removal rates.

3 These are added subwatersheds from the original study.

4 Level spreader/filter strip removal efficiencies for nitrogen, metals, and TSS are taken from the Stormwater Manager's Resource Center (SMRC).

5 Bacteria removal for this BMP type is not well documented, or evidence indicates that bacteria levels may increase. Increases are typically due to wildlife use of the vegetated areas. Plant species and maintenance are designed to deter waterfowl by keeping long growth.