Bailey's Brook

Watershed Description

This **TMDL** applies to the Bailey's Brook assessment unit (RI0007035R-01), a 4.8-mile long stream located in Middletown, RI (Figure 1). The Town of Middletown is located on Aquidneck Island and Bailey's Brook is situated in the southern portion of the Island. The Bailey's Brook watershed is presented in Figure 2 with land use types indicated.

Bailey's Brook has two stream branches flowing southerly to join at North Easton Pond at the southern boundary of the watershed. North Easton Pond is connected to South Easton Pond, which discharges directly to the Atlantic Ocean. North and South Easton Ponds provide drinking water to the residents of Aquidneck Island (Berger, 1999).

Due to its location within a drinking water supply, Bailey's Brook has been designated by RIDEM as a Special Resource Protection Water (SRPW), providing them with special protections under RIDEM's Antidegradation Provisions. SRPWs are high quality surface waters that have been identified as having significant ecological or recreational uses or are public water supplies.

The Bailey's Brook watershed covers 3.1 square miles and is highly developed, as shown in Figures 2 and 3. Approximately two-thirds (68%) of the Bailey's Brook watershed is developed land, including the Newport State Airport and other commercial, residential, and transportation land uses. Agricultural uses occupy 15% of the land area. Forests and other non-developed areas occupy 12%, wetland and surface waters occupy 4%, and other land uses combine to occupy 1%.

Developed (68%)

Non-Developed (12%)

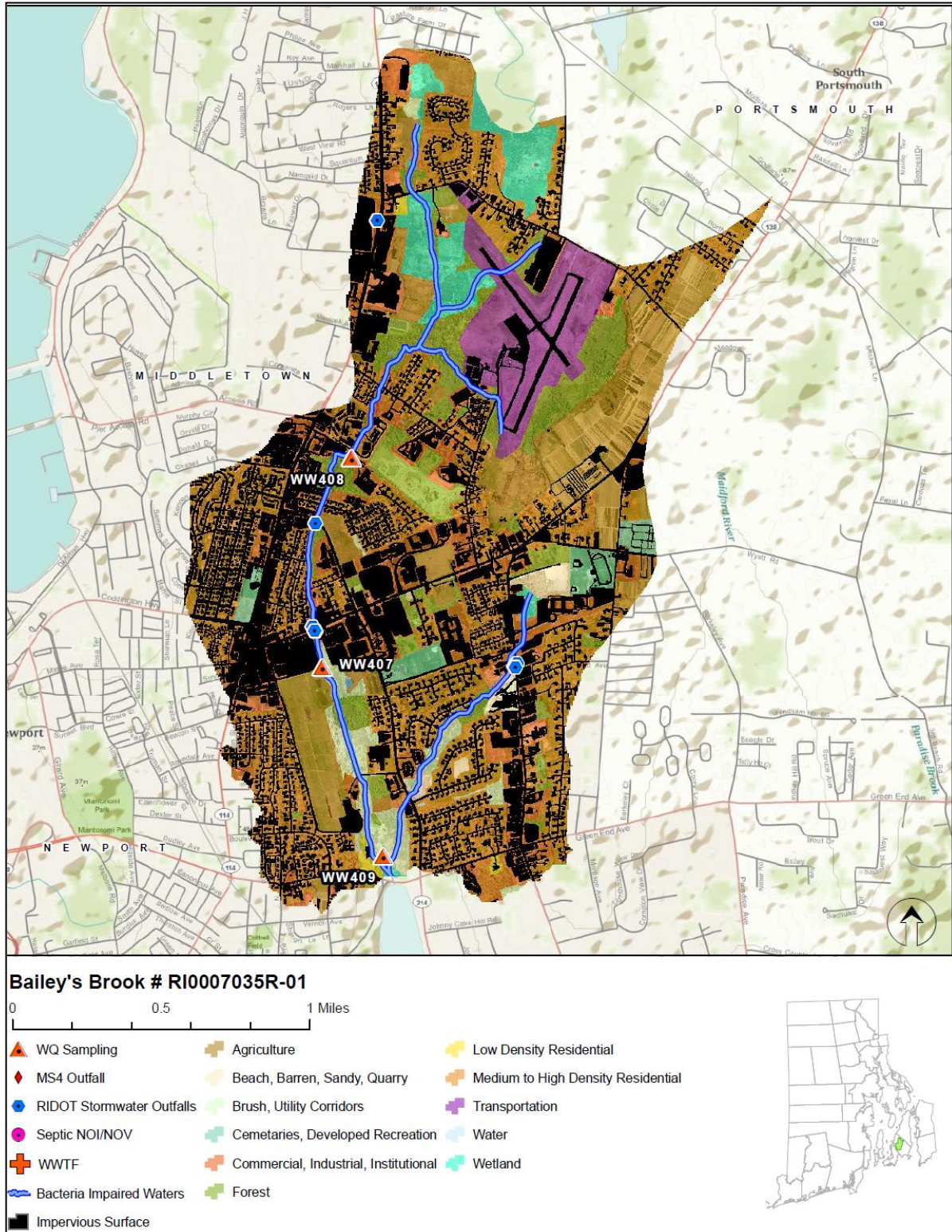Agriculture (15%)

Water/ Wetlands (2%)

Other (1%)
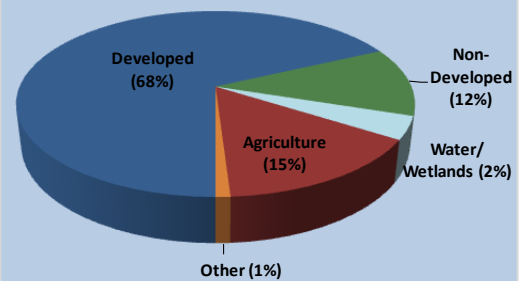
Watershed Land Uses
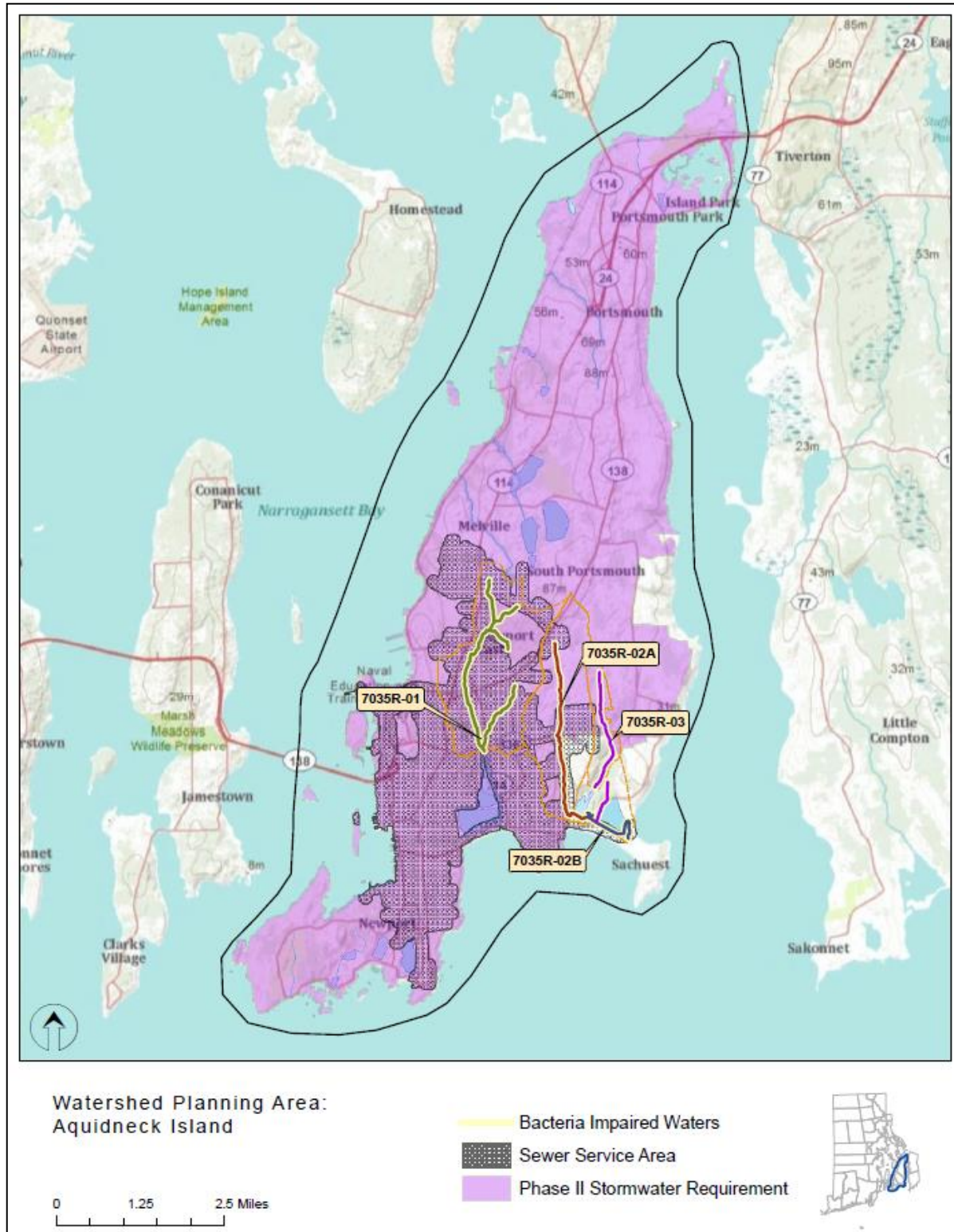
Figure 1: *Map of the Aquidneck Island Watershed Planning Area with impaired segments addressed by the Statewide Bacteria TMDL, sewered areas, and stormwater regulated zone.*

Figure 2: *Map of Bailey's Brook watershed with impaired segment, sampling locations, and land cover indicated.*

Why is a TMDL Needed?

Bailey's Brook is a Class AA fresh water stream and is a tributary within the Newport public drinking water supply system. However, as it is not a terminal reservoir, its applicable designated uses are primary and secondary contact recreation (RIDEM, 2009). During 2006-2008, water samples were collected from three sampling locations (WW407, WW408, and WW409) and analyzed for the indicator bacteria, enterococci. The water quality criteria for enterococci, along with bacteria sampling results from the 2006-2008 study and associated statistics are presented in Table 1. During all years sampled and at all three sampling locations, the geometric mean statistical metric for these data exceeded the water quality criteria value.

To aid in identifying possible bacteria sources, the geometric mean was also calculated for each station for wet-weather and dry-weather sampling days, where appropriate. Both wet and dry geometric mean values exceeded the water quality criteria for enterococci, with the dry-weather statistics higher than the wet-weather statistics.

Due to the elevated bacteria measurements presented in Table 1, the Bailey's Brook assessment unit was identified as impaired and was placed on the 303(d) list (RIDEM, 2008). The Clean Water Act requires that all 303(d) listed waters undergo a TMDL assessment that describes the impairments and identifies the measures needed to restore water quality. The goal is for all waterbodies to comply with state water quality standards.

Figure 3: *Partial aerial view of Bailey's Brook watershed. (Source: Bing Maps)*

Bailey's Brook has also been assessed by RIDEM as not meeting water quality standards for biodiversity and lead, though no TMDLs have been completed for these impairments. North Easton Pond, a pond fed by Bailey's Brook, has been assessed as impaired for phosphorus and is included in the 2007 Eutrophic Ponds Phosphorus TMDL (RIDEM, 2007). Bailey's Brook is recognized as a significant source of phosphorus to North Easton Pond. The approved Eutrophic Ponds TMDL triggered the Part IV.D stormwater requirements that are discussed in Section 6.2 of the Core TMDL Document. Implementation activities include identifying priority outfalls that discharge to North Easton Pond and its tributaries, including Bailey's Brook, as well as constructing structural BMPs.

Potential Bacteria Sources

Previous investigations have concluded that there are several potential sources of harmful bacteria in the Bailey's Brook watershed including stormwater runoff from developed areas, illicit discharges, and agricultural activities. A stream buffer survey found that 34% of the stream buffer was under high-intensity land use (Geosyntec, 2005). Intensive land use near the brook is likely to result in increased adverse impacts because the natural land buffering system of the stream has been removed. Each type of potential bacteria sources is described briefly below.

Developed Area Stormwater Runoff

The Bailey's Brook watershed has an impervious cover of 32%. Impervious cover is defined as land surface areas, such as roofs and roads that force water to run off land surfaces, rather than infiltrating into the soil. Impervious cover provides a useful metric for the potential for adverse stormwater impacts. Based on the Bailey's Brook watershed imperviousness, adverse stormwater impacts to the receiving stream appear likely. As discussed in Section 6.3 of the Core TMDL Document, as a general rule, impaired streams with watersheds having more than 10% impervious cover are assumed to be impacted by stormwater runoff. Soils in the watershed are 98% hydrologic group "C", characterized as slowly permeable and having a hardpan layer that restricts infiltration (Geosyntec, 2005).

As shown in Figure 2, five Rhode Island Department of Transportation (RIDOT) stormwater outfalls[1] have been identified in the Bailey's Brook watershed, with multiple outfalls directly on the brook. A watershed management plan was developed for Bailey's Brook and identified numerous locations where stormwater runoff was directly connected to the brook (Geosyntec, 2005). In the 2007 Eutrophic Ponds Phosphorus TMDL, these stormwater outfalls were also considered to contribute large amounts of phosphorus to Bailey's Brook, resulting in high concentrations in North Easton Pond (RIDEM, 2007). As stormwater is known to carry a suite of pollutants other than phosphorus, these locations are likely sources of bacteria to Bailey's Brook.

Onsite Wastewater Treatment Systems

Bailey's Brook is mostly sewered, but also relies partially on onsite wastewater treatment systems (OWTS) (i.e., septic systems). Failing OWTS can be significant sources of bacteria by allowing raw waste to reach surface waters (RI HEALTH, 2003). As shown in Figure 2, no OWTS Notices of Violation/Notices of Intent to Violate (NOV/NOIs) have been issued by the RIDEM Office of Compliance and Inspection in the Bailey's Brook watershed.

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[1] Note that additional outfalls discharge to the waterbody.

Sewer Leaks

Sewer system leaks and other illicit discharges have historically been reported in Bailey's Brook (Berger, 2008). In 2005, an interceptor sewer line that runs along Bailey's Brook was observed to be overflowing at multiple locations, causing a surge of wastewater from sewer manholes in very close proximity to the stream. Other areas along the sewer line had reports of odors and organic growth, indicating leaking. In 2007, the Town of Middletown inspected the sewer line and repaired the manholes and manhole connections. To date, no additional leaks have been reported in this particular sewer line (RIDEM, 2007). In 2010, three sewage discharges were reported in the vicinity of Bailey's Brook. In response to the unprecedented rainfall amount at the end of March, a manhole on Griffin Avenue surcharged. Debris and grease led to bypass on O'Neill Boulevard in May and on Haymaker Road in October. Dry weather sampling results show that Bailey's Brook continues to have elevated bacteria levels, suggesting the potential for additional leaks, illicit discharges, and/or failing OWTS (Table 1).

Agricultural Activities

Agricultural operations are an important economic activity and landscape feature in many areas of the state. Rhode Island Nursery is one of the largest agricultural operations in the Bailey's Brook watershed (Geosyntec, 2005). The Nursery has been suspected of contributing phosphorus from agricultural runoff to Bailey's Brook and North Easton Pond from two separate nursery operations (RIDEM, 2007). Agricultural runoff may contain other pollutants, such as bacteria. As agricultural land use makes up 15% of the Bailey's Brook watershed, agricultural runoff is a potential source of bacteria to Bailey's Brook.

Waterfowl, Wildlife, and Domestic Animal Waste

Waterfowl, wildlife, and domestic animals within the Bailey's Brook watershed represent another potential source of bacteria. Wildlife, including waterfowl, may be a significant bacteria source to surface waters. With the construction of roads and drainage systems, these wastes may no longer be retained on the landscape, but instead may be conveyed via stormwater to the nearest surface water. As such these physical land alterations can exacerbate the impact of these natural sources on water quality.

Existing Local Management and Recommended Next Steps

The Town of Middletown has developed and implemented programs to protect water quality from bacterial contamination. Future mitigative activities are necessary to ensure the long-term protection of Bailey's Brook. The existing watershed management plan (Geosyntec, 2005) and the Eutrophic Ponds Phosphorus TMDL (RIDEM, 2007) provide a strong technical basis for beginning to reduce a suite of pollutants, including bacteria. A brief description of existing local programs and recommended next

steps from the watershed management plan, the TMDL, a stormwater phase II report, a source water assessment, and other documents are provided below. Stakeholders should review these documents directly for more detailed information.

Stormwater Management

The Town of Middletown (RIPDES permit RIR040032) and the Rhode Island Department of Transportation (RIDOT) (RIPDES permit RIR040036) are municipal separate storm sewer system (MS4) operators in the Bailey's Brook watershed and both have prepared the required Phase II Stormwater Management Plans (SWMPP). The entire watershed is regulated under the Phase II program. Middletown's SWMPP (2008) outlines the goals for the reduction of stormwater runoff to Bailey's Brook through the implementation of Best Management Practices (BMPs). Many of these BMPs are now in place, including mapping all stormwater outfalls, instituting annual inspections and cleaning of the town's 1400 catch basins, implementing an annual street sweeping program, adopting construction erosion and sediment control and post-construction stormwater ordinances, and conducting public education activities (RIDEM, 2010a).

In 2006, the Town of Middletown adopted an illicit discharge detection and elimination ordinance, based on the model ordinance developed by the Center for Watershed Protection (Berger, 2008). This ordinance prohibits illicit discharges to the MS4 and provides an enforcement mechanism. The Town should continue to locate priority areas to identify and eliminate illicit discharges in the Bailey's Brook watershed (Geosyntec, 2005; Berger, 2008). Illicit discharges can be identified through continued dry weather outfall sampling and microbial source tracking.

RIDOT has completed a SWMPP for state-owned roads in the watershed. RIDOT's SWMPP and its 2011 Compliance Update outline its goals for compliance with the General Permit statewide. It should be noted that RIDOT has chosen to enact the General Permit statewide, not just for the urbanized and densely populated areas that are required by the permit. RIDOT has finished mapping its outfalls throughout the state and is working to better document and expand its catch basin inspection and maintenance programs along with its BMP maintenance program. Stormwater Pollution Prevention Plans (SWPPP) are being utilized for RIDOT construction projects. RIDOT also funds the University of Rhode Island Cooperative Extension's Stormwater Phase II Public Outreach and Education Project, which provides participating MS4s with education and outreach programs that can be used to address TMDL public education recommendations.

While these first steps are important to reduce the effects of stormwater runoff to Bailey's Brook, additional efforts are needed to restore the river's water quality. As mentioned previously, the Bailey's Brook watershed has an impervious cover of 32%, a level where stormwater impacts are expected. At this threshold, RIDEM is requiring the MS4 operators to revise their post-construction ordinances and

evaluate whether the six minimum measures alone are sufficient to meet the bacteria reduction targets. Per Part IV.D of the General Permit, the MS4 operators should ensure that their minimum measures are consistent with the recommendation of Section 6.2 of the Core TMDL Document. This includes ensuring that their post-construction ordinances are consistent with Section 6.2

Changes to the SWMPP should be documented in a TMDL Implementation Plan (TMDL IP) and should comply with the relevant provisions of Part IV.D of the RIPDES Stormwater General Permit (RIDEM, 2010b), which are summarized in Section 6.1 (Numbers 1-5) of the Core TMDL Document. Further detail is also included in Sections 6.3 of the Core TMDL Document. In addition, the 2007 Eutrophic Ponds TMDL required that the Town of Middletown and the RIDOT develop and implement appropriate infiltration, filtration, and/or retention BMPs to reduce the stormwater runoff volume to Bailey's Brook to reduce phosphorus loads to North Easton Pond (RIDEM, 2007). These BMPs must also target bacteria pollution as well. Conceptual stormwater BMP designs for several sites are provided in the 2005 Watershed Management Plan (Geosyntec, 2005). These BMPs would disconnect impervious areas and reduce pollutant loads to the Brook. One TMDL IP may be submitted to address both bacteria and phosphorus TMDL requirements.

The Town of Middletown should also continue to implement the goals of its Phase II Stormwater Management Plan (2008) including dry weather sampling, extensive street and catch basin cleaning programs, and public education activities (Berger, 2008). RIDOT should also continue to implement its Phase II Stormwater Management Plan.

Onsite Wastewater Management

Though the majority of the Bailey's Brook watershed is sewered, a portion of the watershed relies on OWTS. Currently, the Town of Middletown does not have an Onsite Wastewater Management Plan. As part of an onsite wastewater planning process, Middletown should adopt ordinances to establish enforceable mechanisms to ensure that existing OWTS are properly operated and maintained. RIDEM recommends that communities create an inventory of OWTS through mandatory inspections. Inspections help encourage proper maintenance and identify failed and sub-standard systems. Policies that govern the eventual replacement of sub-standard OWTS and cesspools within a reasonable time frame should be adopted. The Rhode Island Wastewater Information Systems (RIWIS) can help develop an initial inventory of OWTS and can track voluntary inspection and pumping programs (RIDEM, 2010b).

The Town of Middletown is not eligible for the Community Septic System Loan Program (CSSLP). The CSSLP program provides low-interest loans to residents to help with maintenance and replacement of OWTS. It is recommended that the town develop a program to assist citizens with the replacement of older and failing systems.

Sewer Leaks

As noted previously, the Town of Middletown inspected and repaired the interceptor sewer line that runs along Bailey's Brook in 2007. While no additional leaks have been reported in this particular sewer line, it is important for the town to conduct inspections and follow-up on observations (RIDEM, 2007). The Town of Middletown should also implement a program to evaluate its sanitary sewer and reduce leaks and overflows (Berger, 2008).

Agricultural Activities

If not already in place, agricultural producers should work with the RIDEM Division of Agriculture and the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) to develop conservation plans for their farming activities within the watershed. NRCS and RIDEM Division of Agriculture should continue to work with Rhode Island Nursery and other agricultural operations in the watershed to ensure that there are sufficient stream buffers, that fencing exists to restrict access of livestock and horses to streams and wetlands, and that animal waste handling, disposal, and other appropriate BMPs are in place.

Waterfowl, Wildlife, and Domestic Animal Waste

Middletown's education and outreach programs should highlight the importance of picking up after horses, dogs, and other pets and not feeding waterfowl, particularly in the lower portion of the watershed. Animal wastes should be disposed of away from any waterway or stormwater system. Middletown should work with volunteers from the town to map locations where animal waste is a significant and chronic problem. This work should be incorporated into the municipalities' Phase II plans and should result in an evaluation of strategies to reduce the impact of animal waste on water quality. This may include installing signage, providing pet waste receptacles or pet waste digester systems in high-use areas, enacting ordinances requiring clean-up of pet waste, and targeting educational and outreach programs in problem areas.

The town and residents can take several measures to minimize waterfowl-related impacts. They can allow tall, coarse vegetation to grow in areas along the shores of the Bailey's Brook that are frequented by waterfowl. Waterfowl, especially grazers like geese, prefer easy access to the water. Maintaining an uncut vegetated buffer along the shore will make the habitat less desirable to geese and encourage migration. With few exceptions, Part XIV, Section 14.13, of Rhode Island's Hunting Regulations prohibits feeding wild waterfowl at any time in the state of Rhode Island. Educational programs should emphasize that feeding waterfowl, such as ducks, geese, and swans, may contribute to water quality impairments in the Bailey's Brook and can harm human health and the environment. Middletown should ensure that discussion of this regulation is included in their SWMPPs.

Land Use Protection

Currently, the Bailey's Brook watershed is approximately 16% undeveloped (RI HEALTH, 2003) and only a small portion is protected as open space. As source waters to Newport's water supply, preserving these natural areas is particularly important. Woodland and wetland areas within the Bailey's Brook watershed absorb and filter pollutants from stormwater and agricultural runoff, and help protect both water quality in the stream and stream channel stability. It is important to preserve these undeveloped areas, and institute controls on development in Bailey's Brook watershed (RI HEALTH, 2003).

The steps outlined above will support the goal of mitigating bacteria sources and meeting water quality standards in Bailey's Brook.

Table 1: Bailey's Brook Bacteria Data

*Waterbody ID***:** RI0007035R-01

Watershed Planning Area: 1 – Aquidneck Island

Characteristics: Freshwater, Class AA, Tributary within a Public Drinking Supply, Primary and Secondary Contact Recreation, Special Resource Protection Water (SRPW)

Impairment: Enterococci (colonies/100mL)

Water Quality Criteria for Enterococci: Geometric Mean: 54 colonies/100 mL

Percent Reduction to meet TMDL: **97% (Includes 5% Margin of Safety)**

Data: 2006-2008 from RIDEM

Single Sample Enterococci (colonies/100 mL) Results for Bailey's Brook (2006-2008) with Geometric Mean Statistics

Station Name	Station Location	Date	Result	Wet/Dry	Geometric Mean
WW408	Bailey's Brook (SRU - 1)	10/25/2008	63	Dry	
WW408	Bailey's Brook (SRU - 1)	9/20/2008	816	Dry	
WW408	Bailey's Brook (SRU - 1)	8/19/2008	517	Dry	241
WW408	Bailey's Brook (SRU - 1)	7/12/2008	3226	Dry	
WW408	Bailey's Brook (SRU - 1)	6/4/2008	88	Wet	
WW408	Bailey's Brook (SRU - 1)	5/9/2008	26	Wet	
WW408	Bailey's Brook (SRU - 1)	10/20/2007	983	Wet	
WW408	Bailey's Brook (SRU - 1)	9/15/2007	9804	Dry	
WW408	Bailey's Brook (SRU - 1)	8/21/2007	980	Dry	180
WW408	Bailey's Brook (SRU - 1)	7/21/2007	62	Dry	
WW408	Bailey's Brook (SRU - 1)	6/16/2007	10	Dry	
WW408	Bailey's Brook (SRU - 1)	5/11/2007	6	Dry	
WW407	Bailey's Brook (Market)	10/25/2008	24	Dry	
WW407	Bailey's Brook (Market)	9/20/2008	221	Dry	
WW407	Bailey's Brook (Market)	8/15/2008	1414	Wet	186
WW407	Bailey's Brook (Market)	7/11/2008	245	Dry	
WW407	Bailey's Brook (Market)	6/7/2008	176	Dry	
WW407	Bailey's Brook (Market)	5/10/2008	130	Wet	

Single Sample Enterococci (colonies/100 mL) Results for Baileys Brook (2006-2008) with Geometric Mean Statistics (continued)

Station Name	Station Location	Date	Result	Wet/Dry	Geometric Mean
WW407	Bailey's Brook (Market)	10/20/2007	294	Wet	**713**[†] **(97%)***
WW407	Bailey's Brook (Market)	9/15/2007	9678	Dry	
WW407	Bailey's Brook (Market)	8/18/2007	626	Dry	
WW407	Bailey's Brook (Market)	7/20/2007	1203	Dry	
WW407	Bailey's Brook (Market)	6/15/2007	488	Dry	
WW407	Bailey's Brook (Market)	5/12/2007	126	Dry	
WW407	Bailey's Brook (Market)	10/28/2006	5	Wet	84
WW407	Bailey's Brook (Market)	9/30/2006	197	Wet	
WW407	Bailey's Brook (Market)	8/26/2006	517	Wet	
WW407	Bailey's Brook (Market)	7/29/2006	613	Dry	
WW407	Bailey's Brook (Market)	5/20/2006	13	Wet	
WW409	Bailey's Brook (SRU - 2)	10/25/2008	44	Dry	134
WW409	Bailey's Brook (SRU - 2)	9/20/2008	373	Dry	
WW409	Bailey's Brook (SRU - 2)	8/19/2008	249	Dry	
WW409	Bailey's Brook (SRU - 2)	7/12/2008	1664	Dry	
WW409	Bailey's Brook (SRU - 2)	6/4/2008	44	Wet	
WW409	Bailey's Brook (SRU - 2)	5/9/2008	20	Wet	
WW409	Bailey's Brook (SRU - 2)	10/20/2007	364	Wet	262
WW409	Bailey's Brook (SRU - 2)	9/15/2007	2178	Dry	
WW409	Bailey's Brook (SRU - 2)	8/21/2007	1203	Dry	
WW409	Bailey's Brook (SRU - 2)	7/21/2007	64	Dry	
WW409	Bailey's Brook (SRU - 2)	6/16/2007	548	Dry	
WW409	Bailey's Brook (SRU - 2)	5/11/2007	10	Dry	

Shaded cells indicate an exceedance of water quality criteria
*Includes 5% Margin of Safety
[†] Geometric mean used to determine percent reduction

Wet and Dry Weather Geometric Mean Enterococci Values for each Station

Station Name	Station Location	Years Sampled	Number of Samples		Geometric Mean		
			Wet	Dry	All	Wet	Dry
WW408	Bailey's Brook (SRU - 1)	2007-2008	3	9	208	130	243
WW407	Bailey's Brook (Market)	2006-2008	7	10	236	120	380
WW409	Bailey's Brook (SRU - 2)	2007-2008	3	9	187	68	263

Shaded cells indicate an exceedance of water quality criteria
Weather condition determined from rain gage at Newport County Airport in Middletown, RI

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