2019 Annual Bacteria TMDL Assessment

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URS ESA JOINT VENTURE

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SECTION ONE INTRODUCTION

1.1 BACKGROUND

Anne Arundel County (the County) currently has 19 waterways with U.S. Environmental Protection Agency (EPA)-approved Total Maximum Daily Loads (TMDLs) associated with bacteria impairments. Fecal coliform is identified as the cause of impairment in the TMDLs for 15 of the 19 waterways. E. coli and Enterococci are identified as the impairments for two TMDLs each. The County is required by its National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit (11-DP-3316, MD0068306) to develop a TMDL Restoration Plan to address the Stormwater Waste Load Allocations (SW-WLAs) identified in the TMDL reports developed by the Maryland Department of the Environment (MDE). The Anne Arundel County Department of Public Works (DPW) Watershed Protection and Restoration Program (WPRP) developed a combined Draft Bacteria TMDL Restoration Plan to address the 19 bacteria TMDLs. The restoration plan was submitted to MDE on February 12, 2015. The County received comments from the MDE on May 19, 2015, and comments were addressed in the February 2016 submittal. The revised Bacteria TMDL Restoration Plan was made available for public review and comments for 30 days from June 15 to July 14, 2016.

1.2 OVERVIEW OF PROGRESS REPORT

The County implemented multiple restoration strategies within the first year of submitting the Draft Bacteria TMDL Restoration Plan in February, 2015. Several additional restoration strategies are currently in the planning stages and are included as part of the Capital Improvement Program (CIP) projects. These include restoration strategies that address human sources of bacteria (Tier A) as well restoration strategies that address non-human sources of bacteria (Tier B).

This report documents the progress made during fiscal year (FY) 19, July 1, 2018 – June 30, 2019, by the County towards achieving the bacteria TMDL goals. This report was prepared in consultation with several County departments, including the Department of Health and the DPW's WPRP and Technical Engineering divisions within the Bureau of Engineering, using existing County data and other reports.

1.3 TIER A STRATEGIES

Tier A strategies are those that address potential human sources of bacteria, such as septic system effluent from poorly maintained septic systems, sanitary sewage overflows, and illicit connections that discharge household human wastewater into the MS4. The progress in implementing Tier A strategies during the past year is described below.

1.3.1 Elimination of Household Illicit Connections

Restoration Plan Goal

Under the household illicit connection program, the Restoration Plan states that approximately 150 outfalls are evaluated each year, resulting in detection and elimination of 2 percent of the outfalls that have illicit connections.

Progress

The County currently conducts field screening of outfalls to identify illicit connections from residences and businesses. This process of illicit discharge detection and elimination (IDDE) is required to meet the County's NPDES MS4 permit requirement. As a part of this program, approximately 150 outfalls are sampled every year, and all identified illicit connections are investigated and eliminated immediately.

During the 2019 reporting period, the County conducted targeted outfall sampling in areas east of Route 2, generally between I-695 and U.S. Route 50. In 2019, the County evaluated 154 outfalls and confirmed that 5 outfalls had illicit connections. From FY2005 through FY2019, 56 illicit connections were detected out of 2,268 outfalls surveyed, as documented in the County's Annual NPDES MS4 reports. Based on this, the countywide illicit discharge detection and elimination (IDDE) program has resulted in the elimination of illicit dischargers at a rate of 2.47 percent, up from 2.00 percent as identified in the plan and up from the FY 2018 rate of 2.42 percent. Table 1 shows IDDE rate and associated estimation of bacteria load reductions for each bacterial TMDL watershed.

Table 1. IDDE Rate per TMDL Watershed and Estimated Bacteria Load Reductions.

TMDL Watershed	IDDE Rate (%)	Bacteria Load Reduction (%)
Magothy River Mainstem	0.188	10.81
Magothy River/Forked Creek	0.011	1.39
Magothy River/Tar Cove	0.019	0.83
Patapsco River Lower North Branch	0.255	13.92
Patapsco River/Furnace Creek	0.186	10.29
Patapsco River/Marley Creek	0.153	13.28
Patuxent River Upper	0.038	1.40
Rhode River/Bear Neck Creek	0.009	0.65
Rhode River/Cadle Creek	0.004	0.33
Severn River Mainstem	0.451	22.36
Severn River/Mill Creek	0.029	1.90
Severn River/Whitehall and Meredith Creek	0.022	1.17
South River/Duvall Creek	0.009	0.81
South River Mainstem	0.248	13.50
South River/Ramsey Lake	0.005	0.14
South River/Selby Bay	0.005	0.20

TMDL Watershed	IDDE Rate (%)	Bacteria Load Reduction (%)
W. Chesapeake Bay/Tracy and Rockhold Creeks	0.024	0.30
West River Mainstem	0.023	1.71
West River/Parish Creek	0.004	0.24

1.3.2 Abatement of Sanitary Sewer Overflows

Restoration Plan Goal

Abatement of sanitary sewer overflows through wastewater projects that are designed to improve the reliability of the sanitary system. Table 4-2 in the Restoration Plan listed the active sewage pump stations upgrade projects.

Progress

The status of specific wastewater projects that are considered sewage pumping station (SPS) upgrades or otherwise designed to improve the reliability of the sanitary system was provided by the Technical Engineering Division (G. Heiner, pers. Communication August 26, 2019) and are listed in Table 2. In addition to including the updated status and budget of the SPS projects listed in Table 4-2 of the Restoration Plan, Table 2 also includes new sanitary system improvement projects as identified by DPW. As shown in Table 2, fac gen replacement projects Phase 5 and Phase 6 were completed in FY19. The number of SPS upgrade projects in each TMDL watershed included in the Center for Watershed Protection's (CWP) Watershed Treatment Model (WTM; Caraco 2013) and the estimated percent bacteria load reductions are provided in Table 3.

Table 2. Discrete Sewage Pumping Station Upgrade Projects Active or Completed in FY 2019 in Bacteria TMDL Watersheds.

Project	Project Title	Current Status	Description	TMDL Watershed	Qty. of Pump Stations Being Upgraded	Total Budgeted Costs[3]	Expended and/or Encumbered as of 8/26/2019
S797800	Furnace Barn Sewer Replacement[2]	Active	Construct a new sewer line under Sawmill Creek	Patapsco River / Furnace Creek	0	$154,000	$60,014
S799200	Mayo Collection Sys Upgrade[2]	Active	Expansion of Mayo Wastewater Collection and Conveyance System to accommodate planned growth within Mayo Sewer	Rhode River/Cadle Creek	18	$11,722,829	$5,767,401
S804300	Jennifer Road SPS Upgrade[2]	Active	Upgrades to Jennifer Rd sewage pump station; pump station force main replacement	Severn River Mainstem	1	$9,360,000	$9,081,652
S805300	Cinder Cove SPS Mods[2]	Active	Pump station reliability improvements necessary to minimize risks of sanitary sewer overflows	Patapsco River / Furnace Creek	1	$9,534,000	$8,309,269
S805400	Marley SPS Improvements[2]	Active	Various upgrades to Marley SPS	Patapsco River/Marley Creek	1	$217,689	$4,138,289
S806201	SPS Fac Gen Replacement[2]	**Complete**	Generator Replacement (Phase 4 contract)	South River Mainstem, Forked Creek, Mill Creek	5	$52,559,000[4]	$2,372,643
S806202	SPS Fac Gen Replacement[2]	**Complete**	Generator replacement (Phase 5 contract)	Magothy River Mainstem, Duvall Creek	5	$52,559,000[4]	$1,050,090
S806203	SPS Fac Gen Replacement[2]	Active	Generator replacement (Design 1 and Phase 6 contracts)	Patapsco River LNB*	2	$52,559,000[4]	$2,650,851
S806204	SPS Fac Gen Replace[2]	Active	Generator replacement (Design 2 and Phase 7 contracts)	West River Mainstem	5	$52,559,000[4]	$1,451,197

Project	Project Title	Current Status	Description	TMDL Watershed	Qty. of Pump Stations Being Upgraded	Total Budgeted Costs[3]	Expended and/or Encumbered as of 8/26/2019
S806205	SPS Fac Gen Replace[2]	Active	Design of replacement and installation of generators at SPS throughout the County (Design 1 contract)	Countywide	-	$52,559,000[4]	$2,951,932
S806206	SPS Fac Gen Replace[2]	Active	Design of replacement and installation of generators at SPS throughout the County (Design 2 contract)	Countywide	-	$52,559,000[4]	$2,975,813
S806207	SPS Fac Gen Replace[2]	Active	Generator replacement/CMI services at all sites	Countywide	-	$52,559,000[4]	$2,140,812
S806208	SPS Fac Gen Replacement[2]	Active	Generator Replacement (Phase 8 contract)	Severn Mainstem	7	$52,559,000[4]	$647,774
S806209	SPS Fac Gen Replacement[2]	Active	Generator Replacement and Installation (Phase 9 contract)	Severn River Mainstem	5	$52,559,000[4]	$2,060,165
S806210	SPS Fac Gen Replacement[2]	Active	Generator Replacement and Installation (Phase 10 contract)	Severn Mainstem, Parish Creek, Tracy/Rockhold Creeks	4	$52,559,000[4]	$1,728,824
S806211	SPS Fac Gen Replacement[2]	Active	Generator Replacement and Installation (Phase 11 contract)	Magothy River Mainstem, Severn River Mainstem	3	$52,559,000[4]	$1,933,882
S806212	SPS Fac Gen Replacement[2]	Active	Generator Replacement and Installation (Phase 12 contract)	Severn River Mainstem, Marley/Furnace Creeks	5	$52,559,000[4]	$3,767,280
S806213	SPS Fac Gen Replacement[2]	Active	Generator Replacement and Installation (Phase 13 contract)	Severn River Mainstem, Marley/Furnace Creeks	6	$52,559,000[4]	$1,472,571
S806200	SPS Fac Gen Replacement[2]	Active	Generator Evaluation, Replacement, Installation (Phase 14 contract)	Marley/Furnace Creeks, Bear Neck Creek	3	$52,559,000[4]	$9,871
S806215	SPS Fac Gen Replacement[2]	Active	Installation of electrical feeders for back-up power	Severn River Mainstem	4	$52,559,000[4]	$907,627

Project	Project Title	Current Status	Description	TMDL Watershed	Qty. of Pump Stations Being Upgraded	Total Budgeted Costs[3]	Expended and/or Encumbered as of 8/26/2019
S806216	SPS Fac Gen Replacement[2]	Active	Installation of portable generators at select pump stations (Phase 15 contract)	Severn River Mainstem	5	$52,559,000[4]	$1,128,020
S806217	SPS Fac Gen Replacement[2]	Active	Design of replacement and installation of generators at SPS throughout the County (Design 2 contract)	Countywide	-	$52,559,000[4]	$7,423
S806700	Cinder Cove FM Rehab[2]	Active	Construction of 10,000 linear feet of 30" force main	Patapsco River / Furnace Creek	0	$12,499,000	$9,694,438
S806900	Rolling Knolls ES Sewer Extension[2]	Active	Design and construction of sanitary sewer extension to accommodate new elementary school	South River Mainstem/Severn River Mainstem	0	$3,134,700	$3,029,603
S808100	CATTAIL CREEK FM REPLACEMENT[2]	Active	Construction of the replacement of 17,000 lf of 24" and greater force main (FM) beginning at the Cattail Creek SPS and ending at a gravity manhole in College Parkway. This project will replace aging, at-risk infrastructure to increase the reliability of the conveyance system and reduce risks for spills resulting from infrastructure failures	Magothy River Mainstem	0	$17,121,000	$241,223
S808200	GRINDER PUMP REPL/UPGRD PRGM[1]	Active	Multi-year sewer infrastructure investigation, rehabilitation and replacement program to ensure the adequacy of the County's Wastewater Collection System	Countywide	0	$3,000,000	$7,384
X7388000	Sewer Main Replace/Recon[2]	Active	Maintenance and replacement of sewer main lines countywide	Countywide	0	$105,818,246[4]	$59,208,046
				Total	____	**$222,120,464[5]**	**$128,794,094**

[1] Indicates new project.
[2] Data have been updated since being listed in Table 1 of the Total Maximum Daily Load Restoration Plan for Bacteria 2016 Annual Report (January 2017).
[3] Total Budgeted Cost derived from FY2016 Anne Arundel County Approved Capital Budget and Program and includes current and prior appropriation and approved program totals through FY 24

[4] Total Budgeted Cost for this project includes completed and active SPS upgrades countywide; however, the total budget is not broken down at the level of individual projects. Some individual projects may be outside of bacteria TMDL watersheds. Therefore, only the total project cost is listed.

[5] Total budgeted costs for all projects includes only one count of the Countywide upgrades active and completed with a total budget of $52,559,000.

Table 3. SPS Upgrade Projects in TMDL Watersheds from FY 2015 through FY 2019.

TMDL Watershed ID	Number of SPS Upgrades	Bacteria Load Reductions (%)
Magothy River Mainstem	11	1.82
Magothy River/Forked	1	6.20
Magothy River/Tar Cove	N/A	N/A
Patapsco River Lower North Branch	2	2.54
Patapsco River/Furnace Creek	4	2.29
Patapsco River/Marley Creek	5	2.93
Patuxent River Upper	N/A	N/A
Rhode River/Bear Neck Creek	2	4.60
Rhode River/Cadle Creek	18	17.04
Severn River Mainstem	30	1.11
Severn River/Mill Creek	0	0
Severn River/Whitehall and Meredith Creek	0	0
South River/Duvall Creek	1	6.40
South River Mainstem	9	0.40
South River/Ramsey Lake	0	0
South River/Selby Bay	0	0
W. Chesapeake Bay/Tracy and Rockhold Creeks	5	0.22
West River Mainstem	5	2.00
West River/Parish Creek	1	12.90

N/A – SPS upgrade projects are not applicable as these are rural watersheds

In FY19, there were 14 sanitary sewer overflows (SSOs) reported in the County's Bacteria TMDL watersheds, down from 24 in FY18 (Figure 1). The net volume of spilled material in Bacteria TMDL watersheds in FY19 was 63,241 gallons, up from 61,030 gallons in FY18 (Figure 2). Sewage blockages due to roots, rags, grease, and debris resulted in spills totaling 46,500 gallons. Mechanical or structural failure contributed to approximately 14,600 gallons spilled. In June 2019, Anne Arundel County Department of Public Works (DPW) Bureau of Utility Operations launched a mapping application to track sanitary sewer overflows (SSOs) in the County. The interactive geographic information system (GIS) plots known overflows over the last two years from sanitary sewer collection systems owned and maintained by DPW. The map can be found here: http://annearundelmd.maps.arcgis.com/apps/webappviewer/index.html?id=118c2cc77748459590f57b41cb8fda5a

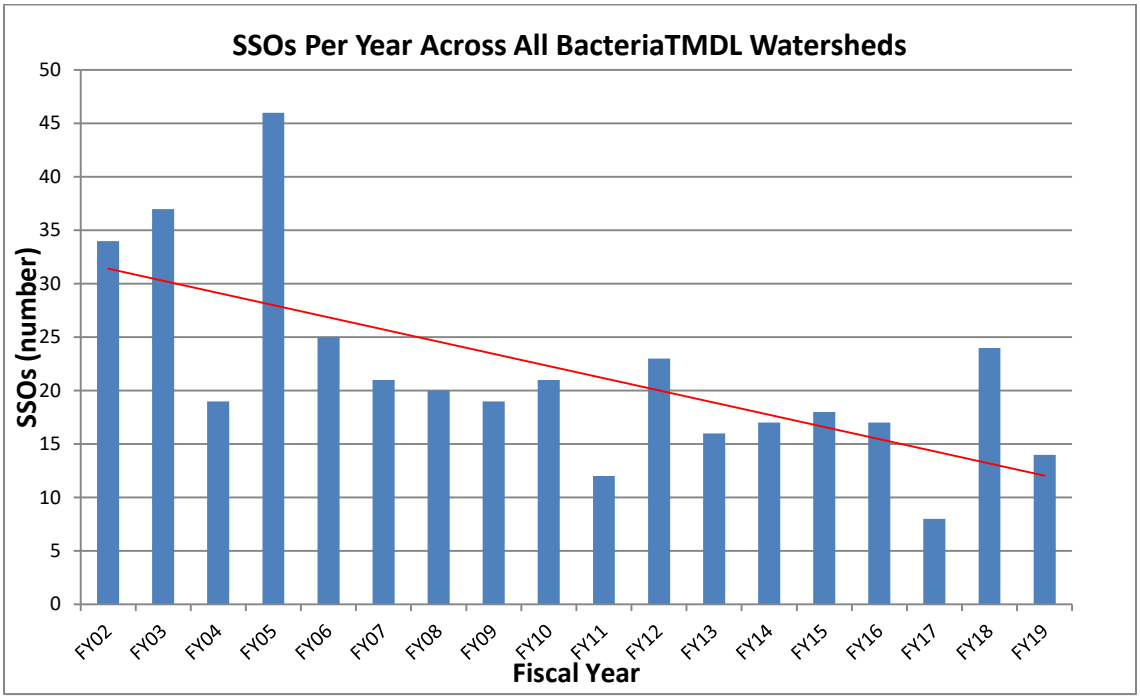

Figure 1. Number of SSOs per year across all Bacteria TMDL watersheds, FY02 – FY19.

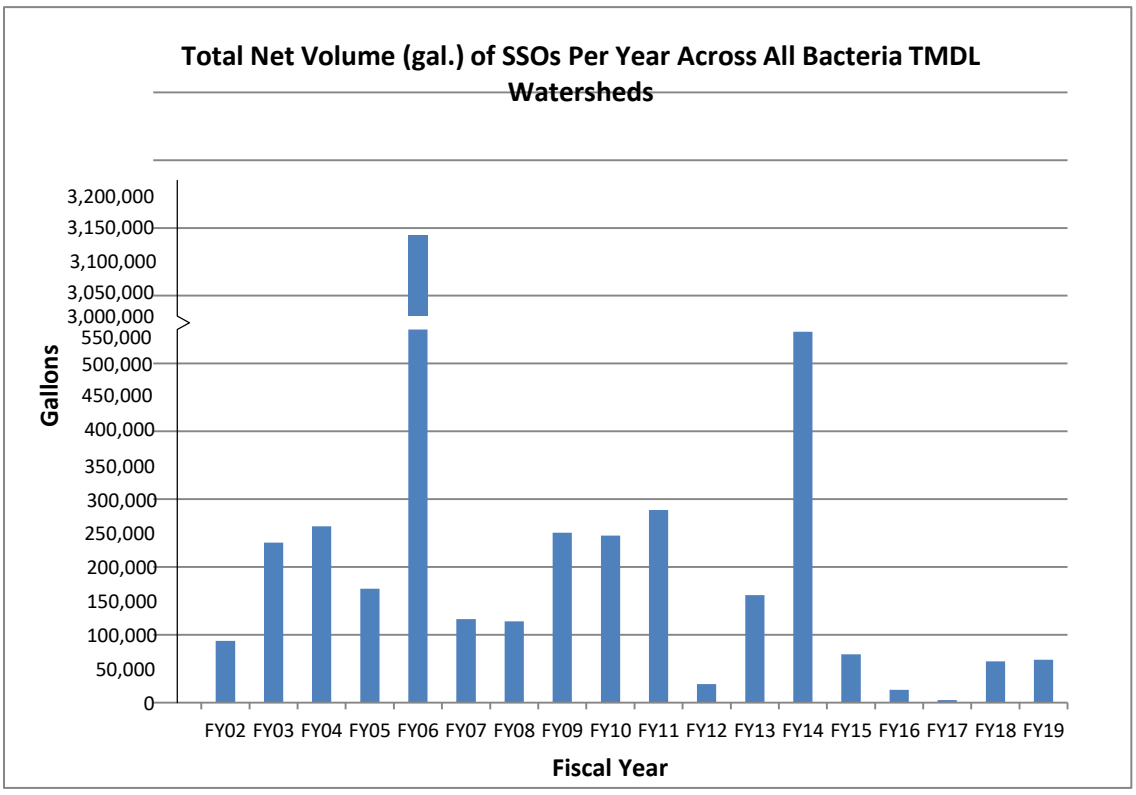

Figure 2. Total Volume (gallons) of SSOs per year across all Bacteria TMDL watersheds, FY02 – FY19.

1.3.3 Retirement of County Septic Systems

Restoration Plan Goal

The Restoration Plan presents the retirement of septic systems at a rate of 20-40 systems per year.

Progress

The County has undertaken the initiative to reduce the number of onsite disposal systems. The Bureau of Engineering large and small Capital Improvement Programs (CIPs) initiated development of conceptual layouts to connect approximately 20,000 OSDS identified in the County, 16,000 of which are located in the bacteria impaired watersheds (Anne Arundel County, 2008). According to the Department of Health, approximately 5,000 of these connections are located within Health Department Problem Areas (HDPAs) – areas with poor soils, steep slopes, high groundwater tables, and well set-backs. Being located within a bacteria impaired watershed is also one of the factors used to prioritize HDPAs. The cost - $35,000 to $40,000 per connection – along with homeowner participation are identified as the primary constraints for retiring OSDSs and connecting to the public sanitary sewer system.

Septic systems that are "retired" are connected to the County's sanitary sewer system that has the capacity to handle the increased load. Within TMDL watersheds, The County retired 21 On-Site Disposal Systems (OSDS) in FY 2019, eight (8) in FY18, 20 in FY 2017, nine (9) OSDS in FY 2016, 21 OSDS in FY 2015, and 35 OSDS in FY 2014. From FY 2014 to FY 2019, the County has averaged 19 retired OSDS per year within TMDL watersheds. An additional 7 OSDS were retired in non-TMDL watersheds in FY 2019. Table 4 shows the projected number of OSDSs to be retired by 2025 in each bacteria TMDL watershed along with estimated bacteria load reductions. As the rate of conversion of OSDS has not changed since the development of the Final Bacteria TMDL Restoration Plan (January 2017), the potential load reductions from this strategy remain unchanged from 2015 to 2019.

Table 4. Projected Number of OSDS to Be Retired by 2025 in Each TMDL Watershed and Estimated Bacteria Load Reductions.

TMDL Watershed ID	Number of Septic Systems That Would Be Retired by 2025	Bacteria Load Reductions (%)
Magothy River Mainstem	88	0.26
Magothy River/Forked	2	0.11
Magothy River/Tar Cove	31	0.46
Patapsco River Lower North Branch	3	0.10
Patapsco River/Furnace Creek	5	0.07
Patapsco River/Marley Creek	0	0
Patuxent River Upper	5	0.38
Rhode River/Bear Neck Creek	0	0
Rhode River/Cadle Creek	0	0
Severn River Mainstem	100	0.20

TMDL Watershed ID	Number of Septic Systems That Would Be Retired by 2025	Bacteria Load Reductions (%)
Severn River/Mill Creek	21	0.63
Severn River/Whitehall and Meredith Creek	6	0.42
South River/Duvall Creek	0	0
South River Mainstem	31	0.29
South River/Ramsey Lake	0	0
South River/Selby Bay	0	0
W. Chesapeake Bay/Tracy and Rockhold Creeks	0	0
West River Mainstem	0	0
West River/Parish Creek	0	0

In September 2017, the County ranked and prioritized 20 HDPAs for connection to the municipal sanitary sewer system (Anne Arundel County, 2017). 10 of the 20 prioritized HDPAs are located in watersheds with bacteria-associated TMDLs, with six (6) being designated as "high priority" (Table 5). The total number of individual connections in HDPAs within watersheds with bacteria-associated TMDLs is 5,930. Two of the HDPAs (Huntsmore and Laurel Acres) would require the construction of regional sewage pumping stations for connection to the sanitary sewer system.

In February 2017, a Septic Task Force was created, consisting of staff from relevant County departments as well as representatives from the local business and environmental communities. The Septic Task Force's stated goals included developing recommendations that will inform decision making, and identifying short term strategies and long term approaches to reducing septic system loads. Key questions discussed by the group include where and how residents could connect to public sewer systems, how will septic conversion projects be financed, and what policies are required to develop a successful conversion program. The task force met monthly from February to July in 2017, with a close-out meeting held in March 2018. A Final Report was produced in June 2018. In September 2018 a private consulting firm was hired to serve as a Conversion Program Manager, and in July 2019 the Septic Task Force began meeting again on a bi-weekly basis. In August 2019, a customer survey was distributed to County residents to gauge citizens' attitudes towards water quality and willingness to pay for a septic-to-sewer conversion program. Nearly 1,500 residents responded to the survey. The 2018 Septic Task Force Final Report, as well as Septic Task Force meeting minutes can be found at https://www.aacounty.org/departments/public-works/septic-task-force/minutes/index.html

Table 5. Health Department Priority Areas (HDPAs) within bacteria TMDLs watersheds

HDPA	TMDL Watershed	Priority	Number of Connections
Clearview Village	Magothy Mainstem	High	364
Huntsmore, Pasadena	Magothy Mainstem	High	993
Gingerville Manor	South River Mainstem	High	263
Edgewater Beach (North)	South River Mainstem	High	259
Laurel Acres	Magothy Mainstem	High	183

HDPA	TMDL Watershed	Priority	Number of Connections
Edgewater Beach (South)	South River Mainstem	High	305
Palisades on the Severn/Herald Harbor	Severn Mainstem	Medium	1,730
Chelsea Beach	Magothy Mainstem	Medium	1,236
Amberly	Whitehall & Meredith Creeks	Low	188
Long Point on the Magothy	Tar Cove	Low	409

In 2017, the County also applied for and received a grant to evaluate the feasibility of County take-over of select private minor wastewater treatment facilities to either convey to existing County facilities or to construct new advanced treatment package plants utilizing the same discharge location. Five feasible projects were identified, two of which are located in watersheds with bacteria-related TMDLs (South River Mainstem and Patapsco River Lower North Branch). The study, which assessed cost-benefit aspects and policy outcome impacts of the individual projects, was completed in March 2018. More detailed investigations of the potential projects are planned for the future. No privately facility owners have been approached as of yet.

1.4 TIER B STRATEGIES

Tier B strategies are those that address non-human sources of bacteria, such as pet waste, wildlife waste, and livestock waste. The progress of implementation of Tier B strategies is described below.

1.4.1 Implementing New Stormwater Management Projects and Retrofitting Pre-2002 Stormwater Management Facilities to Meet Current MDE Criteria

Restoration Plan Goal

The County is underway with the restoration of 20 percent of currently unmanaged impervious areas though implementing new stormwater management projects and retrofitting existing stormwater management facilities to meet current MDE requirements

Progress

109 projects have been completed within the watersheds with bacteria impairment between 2015 and 2019, with 21 of those projects being completed between 2018 and 2019. Projects included Step Pool Storm Conveyance (SPSC), stream restoration, wet ponds, and retention ponds. Furthermore, the County refined data for the impervious area to be treated on previously retrofitted stormwater management facilities. New projects, project status, and updated data are shown in Appendix A. This information was entered into the proposed conditions in the WTM to estimate the bacteria load reductions that would be attained from implementing this strategy. The load reductions were further adjusted based on the assumptions that:

- The proposed practices would capture 90 percent of the rainfall depth they are designed for,
- The County requires location-based and performance-enhancing standards for design of

stormwater features that will result in high pollutant-removal efficiencies, and
- Regular maintenance of the practices will be enforced and conducted by the County.

In addition to including the updated drainage area and treated impervious area of the stormwater management projects listed in Table 4-5 of the Restoration Plan, Appendix A also includes new stormwater management projects planned by the County in the bacteria impaired watersheds. Table 6 shows a breakdown of proposed urban stormwater projects by bacteria TMDL watershed.

Table 6. Proposed Urban Stormwater Projects in Bacteria TMDL Watersheds

TMDL Watershed ID	Number of Urban Retrofit Projects Proposed	Drainage Area Proposed to Be Treated (acres)	Impervious Area Proposed to Be Treated (acres)	Bacteria Load Reductions (%)
Magothy River Mainstem	44	1,000.2	306.67	12.47
Magothy River/Forked	1	65.1	5.1	8.84
Magothy River/Tar Cove	0	0	0	0
Patapsco River Lower North Branch	30	884.5	435.7	7.84
Patapsco River/Furnace Creek	17	309.7	126.0	5.76
Patapsco River/Marley Creek	11	208.9	74.5	1.47
Patuxent River Upper	0	0	0	0
Rhode River/Bear Neck Creek	5	18.9	5.3	0.63
Rhode River/Cadle Creek	0	0	0	0
Severn River Mainstem	28	1,199.9	266.2	2.59
Severn River/Mill Creek	6	116.6	14.4	5.51
Severn River/Whitehall and Meredith Creek	2	45.4	8.3	0.99
South River/Duvall Creek	3	12.7	3.8	3.08
South River Mainstem	32	643.7	335.0	10.27
South River/Ramsey Lake	0	0	0	0
South River/Selby Bay	0	0	0	0
W. Chesapeake Bay/Tracy and Rockhold Creeks	0	0	0	0
West River Mainstem	1	1.4	0.9	0.08
West River/Parish Creek	0	0	0	0

1.4.2 Riparian Buffer Education

Restoration Plan Goal

The Restoration Plan recommends that a riparian buffer education program be implemented in areas where the buffer is reduced, altered, or where private property abuts the waterway.

Progress

Anne Arundel County and the Maryland Department of Natural Resources (DNR) continue to provide support to the Anne Arundel County Watershed Stewards Academy (WSA). WSA trains and certifies Master Watershed Stewards to engage in educational outreach and implement water quality improvement projects throughout their community. One such program WSA manages is the Backyard Buffers program which accounted for the planting of 873 native trees in Anne Arundel County in FY 2019.

1.4.3 Expanded Pet Waste Education Program

Restoration Plan Goal

The Restoration Plan recommends pet waste education programs such as increasing pet waste stations, increasing signage, developing public service announcements, improving management of pet waste at public parks and providing grants to communities to install pet waste stations.

Progress

Master Watershed Stewards trained through the WSA are given the knowledge and resources needed to teach their communities about the importance of cleaning up pet waste and provide pet waste stations where needed.

In 2018 WPRP purchased three pet waste stations which it will make available to communities that express interest. The community of Avalon Shores in Shady Side (within the West River Mainstem Bacteria TMDL watershed) accepted one of these pet waste stations, which was installed in May 2019. The community of Millrace in Millersville (Marley Creek Bacteria TMDL watershed) has also agreed to install a pet waste station in spring 2020. While pet waste stations are installed in all County parks that have specific dog park areas, there are several local County parks that do not have pet waste stations installed. More research on new potential pet waste station installations will continue into 2020.

1.4.4 Live Stock Fencing (Two TMDL Watersheds Only)

Restoration Plan Goal

The Restoration Plan recommends installation of livestock fencing along streams in pasture areas in Patuxent River Upper and West River Mainstem watersheds.

Two Year Progress

Livestock fencing was identified as a low priority restoration strategy as it has limited applicability in only two of the watersheds. No additional exclusion fencing was installed in Anne Arundel County in FY 2019 (J. Czajkowski, pers. Communication October 10, 2018). A total of 54,520

linear feet of livestock exclusion fencing has been installed in the West River and Patuxent River watersheds combined since 2002.

1.4.5 Canada Goose Management (Site-Specific)

Restoration Plan Goal

The Restoration Plan recommends adoption of various techniques for the management of Canada goose population including implementation of exclusion methods, habitat alteration and bird dispersal method.

Progress

Although this strategy was given a low priority at the time of the previous annual update, the County has begun to research methods of goose management and possible locations where management would be applicable. The County has also begun discussions with the Maryland Aviation Administration to begin evaluating nuisance bird presence at County-owned stormwater facilities within four miles of BWI Airport.

1.4.6 No Discharge Zone

Although the Restoration Plan did not identify the creation of a "No Discharge Zone" as a strategy, the County - in conjunction with the City of Annapolis and the Severn River Association – pursued the establishment of a No Discharge Zone. In 2018 a resolution supporting a No Discharge Zone for all waters in Anne Arundel County was introduced to the Anne Arundel County Council. The resolution, which was passed by both the Anne Arundel County Council as well as the City of Annapolis Council in fall 2018, would prohibit the discharge of marine vessel sewage into waters of the County, whether treated or not. The resolution, which is currently awaiting state and federal approval, would require marine vessel sewage to be disposed at designated pump-out stations if approved. Violations would be punishable by civil penalties not to exceed $10,000 per violation. Three meetings were held during August 2019 to solicit public feedback prior to submitting the application for the No Discharge Zone to the Maryland Department of Natural Resources and Maryland Department of the Environment for review in October 2019.

1.4.7 Additional Outreach Opportunities

Restoration Plan Goal

The Restoration Plan recommends additional outreach programs for homeless population, stray animals and expanded outreach programs for marinas.

Progress

Outreach programs for homeless population and stray animals are currently identified as low priority strategies for the County to meet the bacteria TMDL goals; however the County continued to perform outreach via social media targeting boaters as a follow-up to informational brochures covering proper boat sewage disposal practices and pumpout locations produced during the last reporting period. In FY19, Arundel Rivers Federation expanded their pump-out boat service -

originally operating only in the West and Rhode Rivers – to include the South River. The pump-out boat operates Fridays through Mondays from 9 AM to 5 PM and can be hailed by boaters via phone, text, or VHS radio.

The Maryland Clean Marinas program recognizes marinas that meet standards of pollution prevention established by Maryland Department of Natural Resources and the Maryland Clean Marina Committee, including standards of sewage handling, waste containment and disposal, and stormwater management. Certified Clean Marinas are re-inspected every three years to ensure continued compliance. One new certification was issued to a marina in Anne Arundel County in FY 2019, while two marinas did not renew their certification. Currently, 49 of the estimated 165 marinas in Anne Arundel County are certified Clean Marinas (Maryland DNR, 2019).

1.5 POLLUTANT LOAD REDUCTIONS

Bacteria load reductions that would be achieved from the implementation of the proposed restoration strategies were quantified using the Center for Watershed Protection's spreadsheet based Watershed Treatment Model and existing literature review.

All Tier A strategies and two Tier B strategies (Implementing New Stormwater Management Projects and Retrofitting Pre-2002 Stormwater Management Facilities to Meet Current MDE Criteria, Riparian Buffer Education Program) were modeled using CWP's Watershed Treatment Model to estimate the potential bacteria load reductions from them.

Potential bacteria load reductions from remaining Tier B strategies (Expanded Pet Waste Education Program, Canada Goose Management and Livestock Fencing) were estimated using existing literature review.

Based on the FY 2019 County information, the following restoration strategies were modeled using CWP's Watershed Treatment Model to update the bacteria load reductions. Data sources for the FY 2019 model include:

- Restoration of 20 percent of the untreated impervious area through urban stormwater management retrofits based on 2019 updated County data
- Elimination of household connections based on 2,259 sampled outfalls under the Illicit Discharge Detection and Elimination program from 2005 to 2019.
- Abatement of sanitary sewer overflows (SSOs) based on the new sewage pump station projects identified by the Department of Public Works
- Retirement of OSDSs and subsequent connection to the County's sanitary sewer system.

Table 7 provides a comparison of estimated bacteria load reductions quantified for the four above mentioned strategies in each bacteria TMDL watershed as modelled between reporting years 2018 and 2019.

Implementation of urban stormwater management retrofits slightly reduced the percent bacteria load reductions in Severn River/Whitehall and Meredith Creek watersheds because the drainage area and impervious cover treated data for BMP projects was updated in the FY 2019 dataset compared to the FY 2018 data. No stormwater management projects were proposed in Magothy River/Tar Cove, Patuxent River Upper, Rhode River/Cadle Creek, South River/Ramsey Lake, South River/Selby Bay, W. Chesapeake Bay/Tracy and Rockhold Creeks, and West River/Parish watersheds. The percent bacteria load reductions remained the same for Rhode River/Bear Creek and West River Mainstem watersheds, as no new projects were implemented in these watersheds. The percent bacteria load reductions increased for all of the remaining watersheds because of updated impervious cover treated, designed rainfall treatment depth, and the addition of new stormwater projects in FY 2019.

The increase in the IDDE rate resulted in a slight increase in percent bacteria load reductions across all watersheds. The Severn River Mainstem watershed showed the greatest change with a 0.26 percent increase in bacteria load reductions. The South River/Ramsey Lake and W. Chesapeake Bay/Tracy and Rockhold Creeks watersheds showed no increase in bacteria load reductions.

No new pump station upgrades were implemented in FY 2019. Therefore no change in bacteria load reductions for abatement of SSOs was observed for any watersheds compared to the FY 2018 modeling results.

There were no changes or updates to the data related to the retirement of County septic systems; therefore, the percent bacteria load reductions from this Tier A strategy is unchanged.

Monitoring in the pet waste outreach focus areas would be needed to evaluate the progress and quantify the bacteria load reductions from of this strategy. The County has not initiated the low priority strategies of Canada Goose Management and Livestock Fencing, therefore the progress from these strategies are not quantified as well.

Overall, a slight increase in percent bacteria load reductions was observed in most watersheds compared to the FY 2018 annual progress modeling results. Significant increase in bacteria load reductions were observed in Magothy River Mainstem, Patapsco River/Furnace Creek, Severn River/Mill Creek, South River Mainstem due to the implementation of new and retrofit urban stormwater projects in FY 2019. The Severn River/Whitehall and Meredith Creek watershed experienced a 0.08 percent reduction in overall percent bacteria load reductions. Bacteria load reductions in the Rhode River/Bear Neck Creek, W. Chesapeake Bay/Tracy and Rockhold Creeks, and South River/Ramsey Lake watersheds all remained the same compared with the FY 2018

results. A comparison of percent bacteria load reductions modeled in FY 2019 to the percent bacteria load reductions modeled in FY 2018 for the Bacteria TMDL Restoration Plan is provided in Table 7.

Table 7. Estimated Load Reductions for Proposed Strategies in Bacteria TMDL Watershed FY2018-FY2019.

Watershed	Restoration of 20% Untreated Impervious Area through Urban Stormwater Management Retrofits (%)		Eliminate Illicit Household Connections (%)		Abatement of SSOs (%)		Retirement of OSDS (%)		Total Cumulative Reduction (%)	
	FY2018	FY2019	FY2018	FY2019	FY2018	FY2019	FY2018	FY2019	FY2015-FY2018	FY2015-FY2019
Magothy River Mainstem	1.41	12.47	10.62	10.81	1.84	1.82	0.26	0.26	14.13	25.36
Magothy River/Forked Creek	8.85	8.84	1.37	1.39	6.20	6.20	0.11	0.11	16.53	16.54
Magothy River/Tar Cove	0	0	0.80	0.83	N/A	0	0.46	0.46	1.26	1.29
Patapsco River Lower North Branch	4.45	5.11	13.69	13.92	2.56	2.54	0.10	0.10	20.89	21.67
Patapsco River/Furnace Creek	1.01	7.63	10.11	10.29	2.30	2.29	0.07	0.07	13.49	20.28
Patapsco River/Marley Creek	1.23	1.42	13.08	13.28	2.95	2.93	0	0	17.26	17.63
Patuxent River Upper	0	0	1.36	1.40	N/A	0	0.38	0.38	1.74	1.78
Rhode River/Bear Neck Creek	0.63	0.63	0.64	0.65	4.61	4.60	0	0	5.88	5.88
Rhode River/Cadle Creek	0	0	0.31	0.33	17.04	17.04	0	0	17.35	17.37
Severn River Mainstem	0.84	2.94	22.10	22.36	1.13	1.11	0.20	0.20	24.27	26.61

Watershed	Restoration of 20% Untreated Impervious Area through Urban Stormwater Management Retrofits (%)		Eliminate Illicit Household Connections (%)		Abatement of SSOs (%)		Retirement of OSDS (%)		Total Cumulative Reduction (%)	
	FY2018	FY2019	FY2018	FY2019	FY2018	FY2019	FY2018	FY2019	FY2015-FY2018	FY2015-FY2019
Severn River/Mill Creek	(0.05)	6.84	1.86	1.9	0	0	0.63	0.63	2.44	9.37
Severn River/Whitehall and Meredith Creek	1.13	1.03	1.15	1.17	0	0	0.42	0.42	2.70	2.62
South River/Duvall Creek	1.15	3.08	13.30	0.81	6.40	6.40	0	0	9.54	10.29
South River Mainstem	2.35	10.27	0.79	13.50	0.40	0.40	0.29	0.29	15.14	24.46
South River/Ramsey Lake	0	0	0.14	0.14	0	0	0	0	0.14	0.14
South River/Selby Bay	0	0	0.19	0.20	0	0	0	0	0.19	0.20
W. Chesapeake Bay/Tracy and Rockhold Creeks	0	0	0.30	0.30	0.22	0.22	0	0	0.52	0.52
West River Mainstem	0.08	0.08	1.68	1.71	2.00	2.00	0	0	3.76	3.79
West River/Parish Creek	0	0	0.23	0.24	12.90	12.90	0	0	13.13	13.14

SECTION TWO MONITORING

As noted in the Restoration Plan, there are six different monitoring programs operating in the County including the County's ongoing NPDES MS4 Assessment of Controls monitoring of the Parole Plaza outfall and Church Creek; MDE's shellfish harvesting area monitoring; the County Department of Health's bacteria monitoring of public bathing beaches; the community-sponsored Operation Clearwater, which is (as of summer 2019) monitoring water quality at select locations along the Magothy River, Rock Creek and Severn River; the County's Stream Restoration Project Monitoring; and bacteria trend monitoring in the Marley and Furnace Creek watersheds, all of which monitor bacteria concentration.

2.1 ASSESSMENT OF CONTROLS MONITORING

In compliance with County NPDES MS4 permit requirements, the County samples stormwater runoff in the Church Creek watershed. A variety of parameters are measured, including bacteria (*E. coli*). Church Creek is located in Annapolis, MD within the South River Mainstem subwatershed, which is listed as impaired for Fecal Coliform. Church Creek MS4 stormwater sampling is conducted by private consultant at two different monitoring stations – the upstream Parole Plaza station and the downstream Church Creek station. During summer 2015, significant discrepancies were observed in *E.coli* counts between samples taken at the upstream Parole Plaza monitoring station and the downstream Church Creek monitoring station on the same date throughout the hydrograph.

Upon County review of these data and in response to these discrepancies, the County began conducting synoptic bacteria sampling at the two MS4 monitoring stations as well as four other locations along Church Creek. Limited data collection occurred in 2016, and in 2017 a more robust growing season synoptic sampling program was developed, entailing collection of samples at the two MS4 monitoring stations as well as four other locations along Church Creek. Synoptic studies allow for detailed investigations of the geographic distribution of particular water quality characteristics at a given time, as all samples are synchronized to be taken at the same time. The County continued to conduct synoptic sampling at Church Creek during summer 2018. At this time there are no plans to continue further monitoring.

The impetus behind the synoptic study was to determine what, if any, unidentified source of bacteria is contributing to the disparity in results observed between the Church Creek and Parole Plaza monitoring stations. The average median *E. coli* concentrations for sites along the tributary branch originating at Parole Plaza were 242.9 in 2017 and 221.7 in 2018. E. coli concentrations for sites along the tributary originating north of Harbour Center were 519.8 in 2017 and 201.7 in 2018. Potential sources of *E.coli* identified during this study include sediments mobilized during the retrofit of the stormwater pond at Harbour center and wildlife. Additionally, IDDE efforts during 2019 revealed an illicit discharge associated with power washing at a parking garage directly across the street from the Parole Plaza monitoring station, which may have contributed to bacteria inputs. A full report on the synoptic study will be included in the FY2020 Annual Bacteria TMDL Assessment.

2.2 BACTERIA TREND MONITORING

In July 2019, the County began trend monitoring for bacteria (enterococcus) in the Furnace Creek and Marley Creek bacteria TMDL watersheds. The County identified 12 monitoring stations – six in each TMDL watershed – to be monitored monthly for surface water bacteria (Figure 3). Results from the first 12 months of monitoring (July 2019 – July 2020) will be included in the 2020 Annual TMDL Assessment Report. The County's Bacteria Sampling Plan and QA/QC Protocols document can be found in Appendix B of this report.

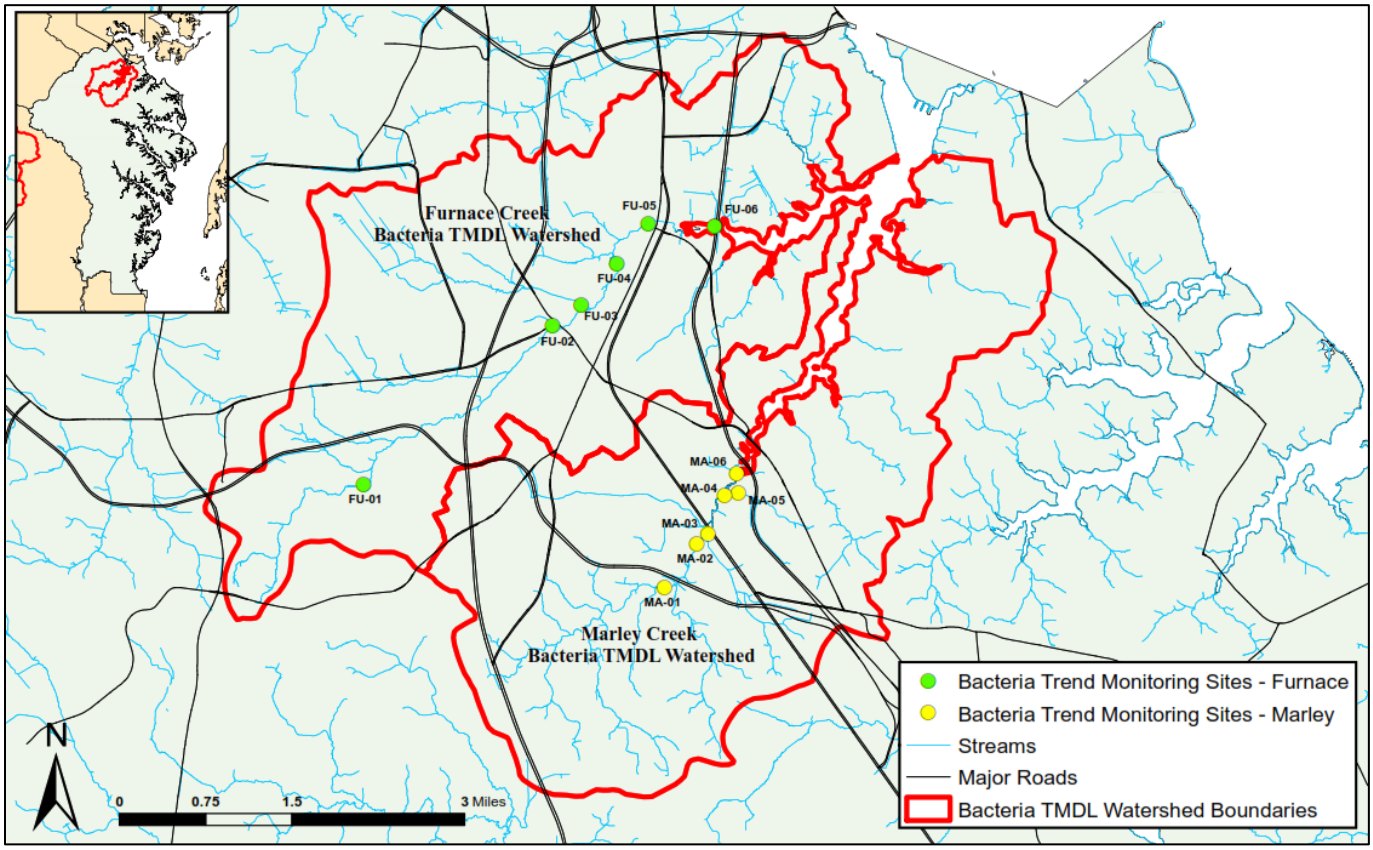

Figure 3. Bacteria trend monitoring sampling locations in the Furnace and Marley Creek TMDL watersheds.

2.3 SHELLFISH HARVESTING MONITORING STATIONS

MDE uses the monitoring data from the shellfish harvesting area monitoring stations to prepare the Integrated Report for Surface Water Quality which includes a surface water quality assessment of the State waters, and for the development of TMDLs. In order to demonstrate support of the shellfish harvesting designated use, the measured level of fecal coliform in water (expressed as MPN/100 ml) must have a median of less than the MDE criterion level of 14 and a 90th percentile of less than 49, calculated from a minimum of 30 samples taken over a three year period.

Annual (fiscal year) median bacteria concentrations based on historical monitoring data for 41 monitoring stations in 15 applicable Bacteria TMDL watersheds (as presented in Appendix C of the Restoration Plan) can be found in Appendix C of this Annual Assessment. A comparison of MDE's monitoring data for FY18 and FY19 is provided in Table 8.

Annual median bacteria concentrations for FY19 were below the MDE criterion level at 36 monitoring stations and above the MDE criterion level at 5 stations. Median bacteria concentrations decreased at 10 stations from FY18 to FY19 and increased at 21 stations from FY18 to FY19; median bacteria concentrations remained the same at 10 stations. Analysis of the historical data shows an overall downward trend in yearly median bacteria concentrations at 31 of the 42 monitoring stations.

The County will continue to review the monitoring data as well as the Integrated Report for Surface Water Quality Assessment to assess whether the bacteria TMDLs are meeting the MDE's water quality criterion for bacteria.

Table 8. Comparison of MDE Shellfish Harvesting Area Monitoring Data

Bacteria TMDL Watershed	Monitoring Data Source	Monitoring Station	Median (MPN/100ml)[1]	
			FY18	FY19
Magothy Mainstem	MDE	0301001	1.0	9.1
Magothy Mainstem	MDE	0301001A	3.6	3.6
Magothy Mainstem	MDE	0301001C	1.0	1.0
Magothy Mainstem	MDE	0301800	1.0	3.6
Magothy River/Forked Creek	MDE	0301011	43.0	9.1
Magothy River/Tar Cove	MDE	0301005C	1.0	3.6
Magothy River/Tar Cove	MDE	0301006B	1.0	12.1
Magothy River/Tar Cove	MDE	0301801	1.0	1.0
Magothy River/Tar Cove	MDE	0301802	1.0	1.0
Rhode River/Bear Neck Creek	MDE	0307120A	4.0	23.0
Rhode River/Cadle Creek	MDE	0307019	4.0	23.0
Severn River Mainstem	MDE	0304152	23.0	43.0
Severn River Mainstem	MDE	0304150	7.3	3.6
Severn River Mainstem	MDE	0304002A	7.3	1.0
Severn River Mainstem	MDE	0304005	1.0	2.3
Severn River Mainstem	MDE	0304008	3.0	2.3
Severn River Mainstem	MDE	0304011	1.0	3.3
Severn River Mainstem	MDE	0304016	1.0	3.6
Severn River Mainstem	MDE	0304020	1.0	3.6

Bacteria TMDL Watershed	Monitoring Data Source	Monitoring Station	Median (MPN/100ml)[1]	
			FY18	FY19
Severn River Mainstem	MDE	0304028	3.6	2.3
Severn River Mainstem	MDE	0304029	1.0	3.6
Severn River Mainstem	MDE	0303200	1.0	1.0
Severn River Mainstem	MDE	0303202	1.0	1.0
Severn River Mainstem	MDE	0303204	1.0	3.3
Severn River/Mill Creek	MDE	0303006	9.1	12.1
Severn River/Whitehall and Meredith Creek	MDE	0303005	3.6	3.6
Severn River/Whitehall and Meredith Creek	MDE	0303005A	9.1	16.1
South River/Duvall Creek	MDE	0306104	3.6	9.3
South River/Duvall Creek	MDE	0306013A	3.6	4.2
South River Mainstem	MDE	0306110	3.6	3.6
South River Mainstem	MDE	0306211	3.6	3.6
South River Mainstem	MDE	0306002	3.6	2.3
South River Mainstem	MDE	0306205	3.6	1.0
South River Mainstem	MDE	0306111	3.6	2.3
South River Mainstem	MDE	0306208A	3.6	3.6
South River/Ramsey Lake	MDE	0306115A	9.1	3.6
South River/Selby Bay	MDE	0306801	9.1	6.4
South River/Selby Bay	MDE	0306115	1.0	3.6
W. Chesapeake Bay/Tracy and Rockhold Creeks	MDE	0501004	19.0	19.0
West River Mainstem	MDE	0307205	3.6	3.6
West River/Parish Creek	MDE	0307011	1.0	9.1

[1] The MDE Criterion for Median Sample (MPN/100ml) is 14
[2] The MDE Criterion for 90th Percentile Sample (MPN/100ml) is 43.

2.4 HEALTH DEPT. MONITORING OF BATHING BEACHES

The Anne Arundel County Department of Health, under State of Maryland regulations, conducts water quality sampling at 81 community bathing beach sites along area creeks and rivers from Memorial Day to Labor Day either weekly or biweekly. The water bodies are tested for levels of enterococci bacteria. If enterococci counts exceed the acceptable level or when a sewage spill impacts a waterway the Department of Health will issue an advisory against swimming and other direct water contact activities. The advisory remains in effect until test results show enterococci counts are within acceptable levels. The acceptable level for bodies of water sampled is 104 MPN (Most Probable Number) of colonies of organisms per 100 milliliters of water.

Recreational water quality reports are available from the County's Department of Health website at https://www.aahealth.org/recreational-water-quality-report/

2.5 OPERATION CLEARWATER AND NGO MONITORING

Several NGOs also conduct water quality monitoring for bacteria within the County's TMDL watersheds. Operation Clearwater has provided regular bacteria monitoring at waterfront recreational areas for 43 years. In 2019, Operation Clearwater conducted weekly monitoring of microbial (Enterococci) water quality at 67 sites throughout the County - 51 of which were located within bacteria TMDL watersheds - from Memorial Day through Labor Day. Further information about Operation Clearwater, including monitoring data, can be found online at https://sites.google.com/view/aaccecoperationclearwater and http://ola2.aacc.edu/tldomanski/

Arundel Rivers Federation also conducted weekly water quality monitoring for Enterococci bacteria from Memorial Day through Labor Day in 2019 at 11 sites in the West River Mainstem, Bear Neck Creek, and Cadle Creek bacteria TMDL watersheds. Additionally, Arundel Rivers Federation has collaborated with the Smithsonian Environmental Research Center (SERC) in DNA source tracking analysis to determine the source of chronic bacteria pollution in areas of high concern. Further information about Arundel Rivers Federation's bacteria monitoring program, including monitoring data, can be found online at http://www.arundelrivers.org/water-quality-monitoring/programs/bacteria-monitoring/

Partners at the Anne Arundel Community College monitored enterococci weekly at six locations along the Rhode River and its tributaries from May through August 2017 as part of an effort to characterize water quality in the Rhode River prior to the conversion of the Mayo Water Reclamation Facility from a treatment plant to a pumping station (Domanski, 2017). The conversion was completed in October 2017 and the first full season of post-conversion monitoring was accomplished from May through August 2018. A second year of monitoring was accomplished from May-August 2019. Full reports on this monitoring effort can be found in Appendices D and E of this annual report.

2.5.1 Special Investigation

Following a sanitary sewer overflow in April 2019 at sewer manhole 11218 located near 609 Park Place in Deale, Anne Arundel County DPW requested Arundel Rivers Federation (via Operation Clearwater) to sample multiple sites along Rockhold Creek to characterize bacteria levels in the waterway (Figure 3). While overall bacteria levels in Rockhold Creek showed normal to low levels of bacteria, bacteria counts at site RC2 (nearest to manhole 11218) were higher throughout the summer (Table 9). While the levels and the corresponding adjacent samples did not appear to be influenced by an active sanitary sewer overflow, which would exhibit consistent and uniform results, they did suggest an unknown source is elevating readings at sample location RC-2.

On July 8, 2019 DPW visually inspected manhole 11218 during a rain event and found no evidence of surfacing or surcharging. DPW also smoke-tested the sewer collection system between manholes 11227 to 11228 and found no evidence of leaks within the network. On July 10, the County dispatched an IDDE crew to sample storm outfall Q34O002 in order to gather information

helpful to identifying the source of elevated bacteria levels nearby. The crew found no flowing water at the outfall, but did test standing water found at storm inlet Q341006 for a suite of water quality parameters. Test results indicated that none of the constituent concentrations were at or above the corresponding action level, as specified by the County's IDDE Standard Operating Procedures. The crew noted that the water had no detectable color or odor and, based on test results, did not document conclusive evidence to support an inference that the stormwater runoff through the network connected to outfall Q34O002 had been conveying sewage with its discharge. A map of the area of concern, including sewer and stormwater infrastructure, can be seen in Figure 4.

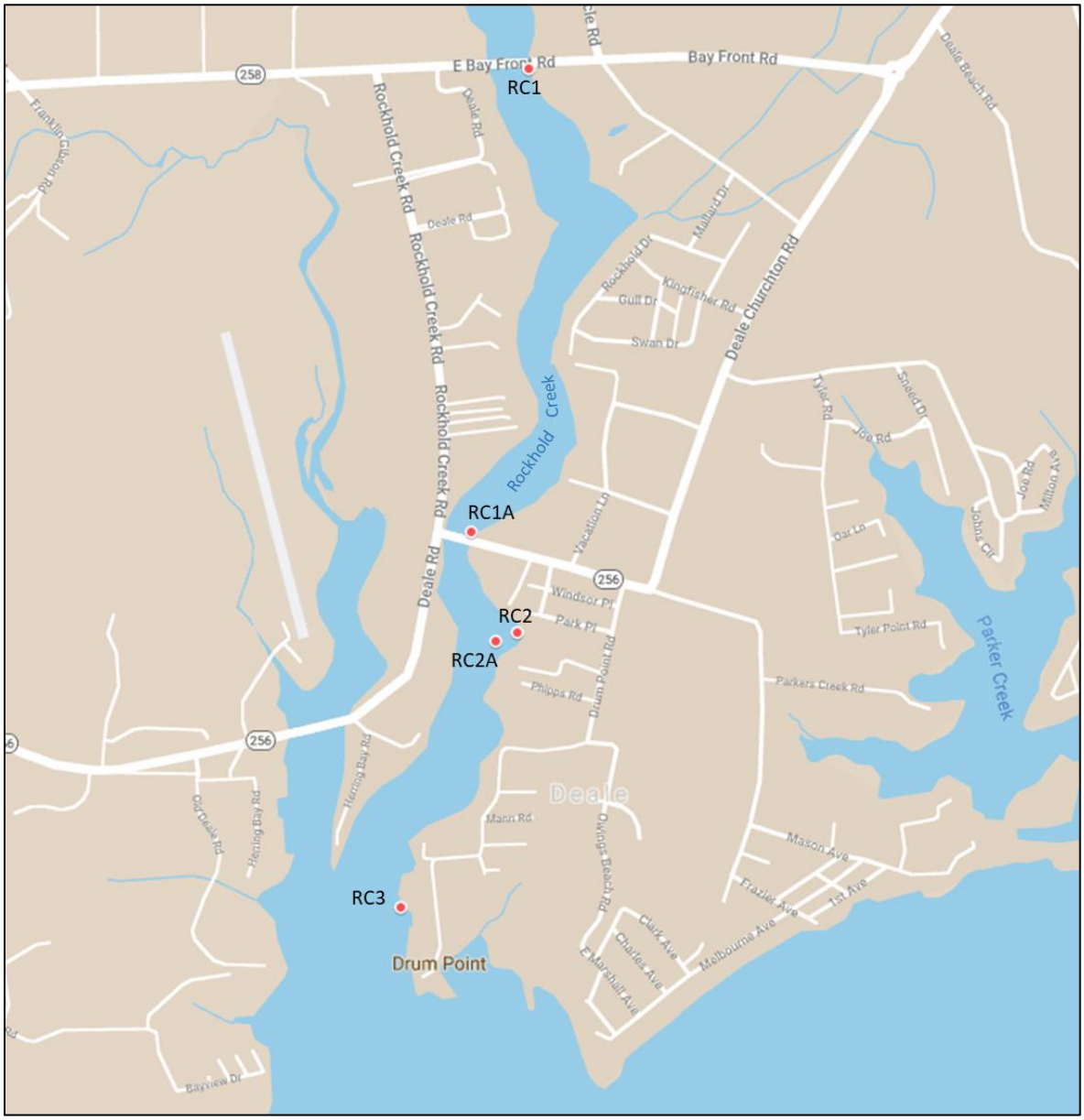

Figure 4. Bacteria (enterococci) sampling sites along Rockhold Creek.

Table 9. Bacteria (enterococci) sampling results from Rockhold Creek, summer 2019.

Date	Station	Depth (ft)	Rain within previous 48 hours (in)	Enterococci count (CFU/100 ml)
6/5/2019	RC1	0.1	0	56
6/5/2019	RC2	0.1	0	**150**
6/5/2019	RC3	0.1	0	10
6/5/2019	RC3 (QA)	0.1	0	20
6/12/2019	RC1	0.1	0.4	48
6/12/2019	RC2	0.1	0.4	**250**
6/12/2019	RC3	0.1	0.4	10
6/12/2019	RC1A	0.1	0.4	50
6/19/2019	RC1	0.1	1.4	**1660**
6/19/2019	RC2	0.1	1.4	**1680**
6/19/2019	RC3	0.1	1.4	**332**
6/19/2019	RC1A	0.1	1.4	**1288**
6/26/2019	RC1	0.1	0	16
6/26/2019	RC2	0.1	0	**688**
6/26/2019	RC3	0.1	0	2
6/26/2019	RC1A	0.1	0	**240**
7/2/2019	RC1	0.1	0	**132**
7/2/2019	RC2	0.1	0	**2130**
7/2/2019	RC3	0.1	0	72
7/2/2019	RC1A	0.1	0	60
7/10/2019	RC1	0.1	0.7	60
7/10/2019	RC2	0.1	0.7	**450**
7/10/2019	RC3	0.1	0.7	32
7/10/2019	RC1A	0.1	0.7	100
7/17/2019	RC1	0.1	0	28
7/17/2019	RC2	0.1	0	**3400**
7/17/2019	RC3	0.1	0	8
7/17/2019	RC1A	0.1	0	44
7/24/2019	RC1	0.1	0	38
7/24/2019	RC2	0.1	0	**2540**
7/24/2019	RC3	0.1	0	4
7/24/2019	RC1A	0.1	0	16
7/24/2019	RC2A	0.1	0	**386**
7/31/2019	RC1	0.1	0	**116**
7/31/2019	RC2	0.1	0	**300**
7/31/2019	RC3	0.1	0	38
7/31/2019	RC1A	0.1	0	30
7/31/2019	RC2A	0.1	0	30

Figures in bold indicate enterococci counts exceeding the EPA acceptable level for recreational waters of 104 CFU/100 ml

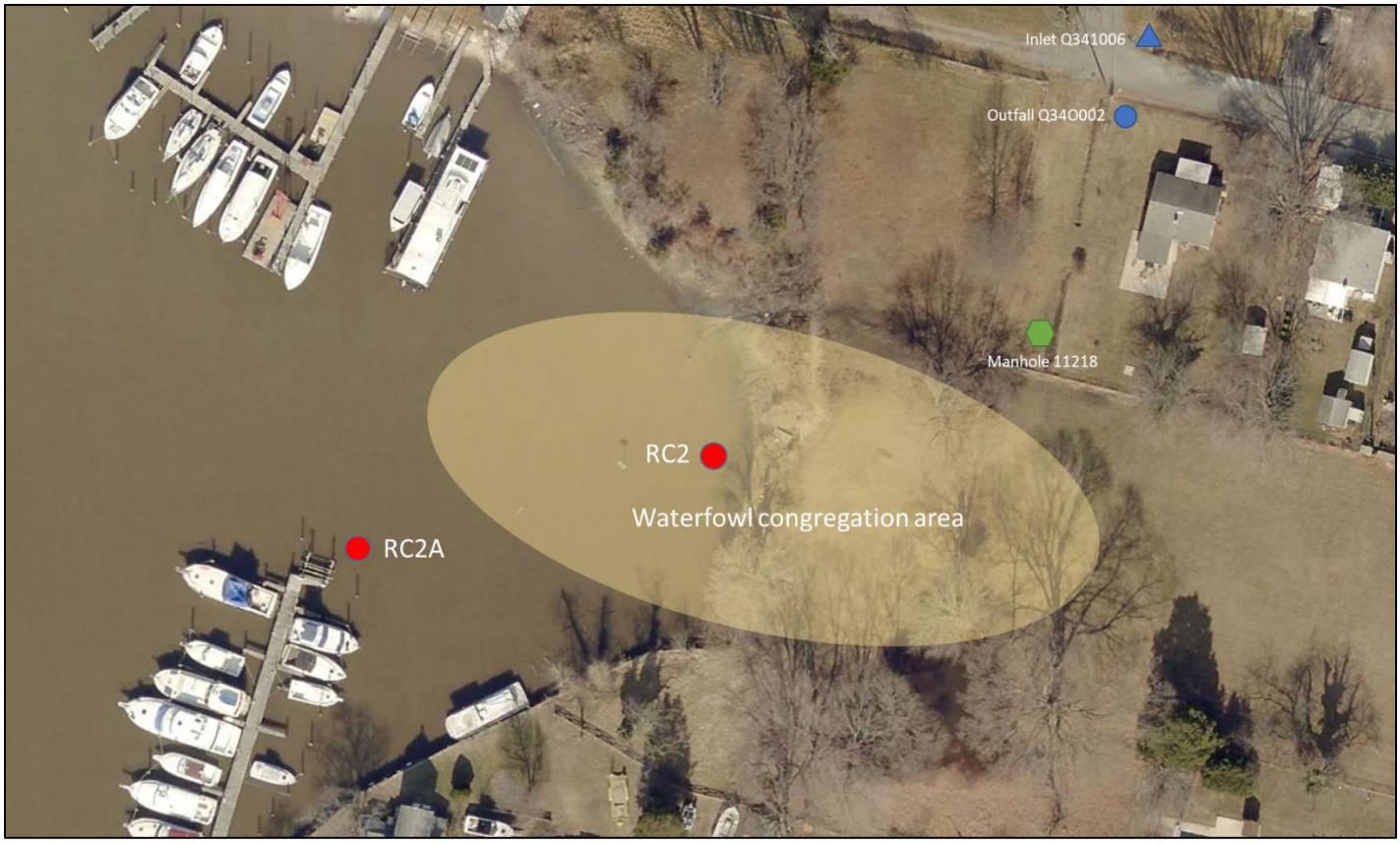

Figure 5. Storm and sewer infrastructure and bacteria sampling sites in Rockhold Creek special investigation area of concern.

The team investigated the conditions in the vicinity of the outfall and along the drainage path from the outfall to the waterway, Rockhold Creek. The IDDE crew did not observe any signs of solid waste or damage to the sanitary sewer network near the outfall. The ditch that conveyed the outfall drainage toward the creek discharged to an open parcel directly behind the lot on the southeast side of the intersection of Deale Place and Park Place. The crew documented that the discharge extent broadens when it reaches a larger and flatter floodplain downstream of the south end of the ditch. It is here that the team documented the presence of approximately 45 geese and the tracks of many geese in the mud associated with the discharge path.

On July 19, 2019 County WPRP staff visited the site location and confirmed the presence of waterfowl in the open parcel, shoreline, and in the water of the cove where sampling site RC-2 is located. The staff installed a wildlife camera in hopes of capturing further evidence showing the extent of waterfowl usage of the area. Photographs taken over the next seven days confirmed that a large amount of waterfowl frequently inhabit the riparian area of the cove near sampling site RC-2. This information, combined with results from water quality monitoring of Rockhold Creek, resulted in the conclusion that the resident wildlife - primarily waterfowl - were the pollutant source.

2.6 CIP RESTORATION PROJECT MONITORING

In August 2018, the County broke ground on a stream restoration project at Furnace Branch located in Glen Burnie. The project includes the removal of an existing concrete floodway and restoring a natural stream channel and floodplain. Furnace Branch lies within the highly impaired Furnace Branch subwatershed, which is listed as impaired for Enterococci. As part of this project, a water quality monitoring program has been established to determine what water quality benefits occur due to restoration activity. During the pre-restoration monitoring work occasional elevated bacteria (*E. coli*) counts and observation of an overflowing sewer manhole (subsequently repaired), prompted a more thorough investigation of conditions along the channelized portion of the stream, upstream of the monitoring station, between Kent Rd and 7th Avenue. In summer 2017, the County began collecting additional bacteria samples under baseflow conditions from locations along the main stem that bracket known sewer crossings, as well as from storm drain outfalls discharging to the reach of interest. Bacteria sampling was discontinued with the initiation of construction in August and will resume after construction is completed in 2020.

2.7 COUNTYWIDE BIOMONITORING

The County has performed biological monitoring in accordance with Maryland Biological Stream Sampling protocols at 13 targeted CIP sites within bacteria TMDL watersheds since 2015, with benthic sampling occurring annually and fish sampling occurring triennially. Of these sites, three (including a reference site) are within the Severn Mainstem watershed, eight are within the Magothy Mainstem watershed, and two are within the Furnace Branch watershed. Table 10 shows the Benthic Index of Biotic Integrity (BIBI) scores for each of these sites for years 2016 through 2019. Biological monitoring has also been performed as a component of a separate study at 15 sites along Sawmill Creek and its tributaries within the Furnace Creek bacteria TMDL watershed since 2017, and is expected to continue at least until 2021.

Table 10. Benthic Index of Biotic Integrity (BIBI) scores at Targeted CIP Sites in Bacteria TMDL Watersheds, 2016-2019

Site ID	Bacteria TMDL Watershed	BIBI Score 2016	BIBI Score 2017	BIBI Score 2018	BIBI Score 2019
FB-01	Furnace Creek	1.86 (Very Poor)	2.14 (Poor)	1.00 (Very Poor)	n/a[1]
FB-02	Furnace Creek	1.86 (Very Poor)	1.57 (Very Poor)	1.57 (Very Poor)	n/a[1]
CY-01	Magothy Mainstem	1.86 (Very Poor)	1.86 (Very Poor)	1.57 (Very Poor)	2.43 (Poor)
CY-02	Magothy Mainstem	1.57 (Very Poor)	2.43 (Poor)	2.43 (Poor)	2.14 (Poor)
DC-01	Magothy Mainstem	2.14 (Poor)	2.14 (Poor)	2.43 (Poor)	1.00 (Very Poor)
DC-02	Magothy Mainstem	1.86 (Very Poor)	1.86 (Very Poor)	1.49 (Very Poor)	2.43 (Poor)
MC-01	Magothy Mainstem	2.71 (Poor)	2.71 (Poor)	2.71 (Poor)	2.43 (Poor)
MC-02	Magothy Mainstem	1.57 (Very Poor)	3.00 (Fair)	1.00 (Very Poor)	2.14 (Poor)

Site ID	Bacteria TMDL Watershed	BIBI Score 2016	BIBI Score 2017	BIBI Score 2018	BIBI Score 2019
MC-03	Magothy Mainstem	2.71 (Poor)	2.71 (Poor)	1.00 (Very Poor)	2.14 (Poor)
MC-04	Magothy Mainstem	2.71 (Poor)	2.71 (Poor)	3.00 (Fair)	2.71 (Poor)
HB-01	Severn Mainstem	3.00 (Fair)	3.29 (Fair)	2.43 (Poor)	2.71 (Poor)
HB-02	Severn Mainstem	3.29 (Fair)	1.00 (Very Poor)	2.14 (Poor)	1.86 (Very Poor)
SR-01	Severn Mainstem	3.86 (Fair)	3.86 (Fair)	3.29 (Fair)	3.57 (Fair)

[1] Not sampled in 2019 due to ongoing restoration project construction.

SECTION THREE CONCLUSION

In Section 7 (Implementation Schedule and Milestone) of the TMDL Restoration Plan, the following programmatic criteria were identified to be achieved by the end of the 2019 milestone year by the County towards meeting the TMDL goals. Table 11 provides the County's progress towards achieving the implementation milestones.

Implementation of a multi-media expanded pet waste outreach program was identified as a strategy that would provide the highest bacteria load reductions among 9 of the 19 TMDL watersheds. The County has continued the development of a robust pet waste outreach program, with a pilot program to be launched in the future in the Rhode River/Cadle Creek and Magothy. The results of the pilot program, which will include yard signage and survey of select community organizations and HOAs, will inform the County on the most effective outreach strategy (or strategies) to use for a County-wide outreach effort. Methodology for evaluating the effectiveness and quantifying the bacteria load reductions for the adopted pet waste outreach program is still needed.

In July 2019, the County began long-term bacteria trend monitoring at twelve (12) sites within the Marley and Furnace Creek bacteria TMDL watersheds. The first year of data from this effort will be available in the FY2020 Bacteria Annual Assessment Report.

There are some restoration strategies such as Canada Goose Management, Livestock Fencing and outreach opportunities for management of homeless population and stray animals which currently have not been initiated by the County as these were given a low priority. Evaluation of their effectiveness needs to be conducted if these strategies are to be implemented.

Continual monitoring of the effectiveness of implemented strategies is recommended. This is because most restoration techniques require time to produce quantifiable benefits at the watershed level from their implementation time. Data collected by MDE from shellfish harvesting monitoring stations, as well as the Integrated Report for Surface Water Quality, will continue to be reviewed to determine the effectiveness of the implemented restoration strategies as well as to determine if any of the bacteria TMDL water bodies become eligible for removal from the TMDL list through the achievement of water quality standards for bacteria.

Table 11. 2019 (end of NPDES MS4 permit cycle) Milestone Programmatic Criteria

Programmatic Criteria	Progress
20% of impervious area managed with SPSC or other high-performing BMP (meet NPDES MS4 Permit/WIP goal).	The County continues to make progress towards completing new and retrofit stormwater management facilities projects in accordance with County goals. For the amount of impervious acres managed within bacteria TMDL watersheds, refer to the geodatabase submitted as part of the County's FY2019 NPDES MS4 Annual Report.
Continued triennial inspection and maintenance of constructed BMPs.	During 2019 the County continued triennial inspection and maintenance of constructed BMPs to verify functionality.
50% of planned septic systems connected to sewers, if funding allows.	The County successfully secured Chesapeake Bay Trust Funding to advance the County's efforts to connect septic systems to public sewer. This funding enabled the County to prioritize watersheds for septic conversion. The County has developed conceptual layouts and cost estimates for approximately 140 separate projects. Individual tasks have been completed through the use of consultants. The Septic Task Force produced a Final Report in June 2018 and continued to meet on a bi-weekly basis beginning in July 2019. In September 2018, a private consulting firm was hired to serve as a Conversion Program Manager. In August 2019, a customer survey was distributed to County residents to gauge citizens' attitudes towards water quality and willingness to pay for a conversion program. The County received a grant to evaluate the feasibility of County take-over of select private minor wastewater treatment facilities to either convey to existing County facilities or to construct new advanced treatment package plants utilizing the same discharge location. Five feasible projects were identified, two of which are located in bacteria TMDL watersheds with bacteria TMDLs. More detailed investigations of the potential projects are planned for the future.
Pet waste education program continues; implement additional television PSAs, videos, social media, etc. as funds allow.	Throughout 2019 the County highlighted proper pet waste management practices through its social media outlets, and at community events and presentations. Results of a 2017 survey are being utilized to inform outreach strategies, including pilot projects in two communities in the future. In 2018 WPRP purchased three pet waste stations to be made available for interested communities; one station was installed in May 2019 and another will be installed in Spring 2020. WPRP will further investigate the number and locations of pet waste stations at County parks.
Streamside livestock fencing completed.	No livestock fencing projects were implemented in the Bacteria TMDL watersheds during 2019. Department of Agriculture does not foresee any additional exclusion fencing being installed in the County.

SECTION FOUR REFERENCES

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Appendix A

County CIP Urban Stormwater Retrofit Projects Proposed in the Bacteria TMDL Watersheds, 2015 - 2019

Restoration Id	TMDL Watershed	Project Description	Existing Project Type	Proposed Project Type	Drainage Area (acres)	Impervious Area (acres)	Rainfall Depth (inches)	Projected Year of Completion	Year of Completion
AA14RST000098	Magothy River Mainstem	Longfellow Drive Pond Retrofit	Extended Detention Structure, Dry	Retention Pond	17.62	4.39	0.39	2014	2014
AA14RST000099	Magothy River Mainstem	Copperwood Ct Pond Retrofit #2	-	Step Pool Conveyance System	7.58[2]	2.89[2]	0.04	2014	2014
AA14RST000100	Magothy River Mainstem	Copperwood Ct Pond Retrofit	Retention Pond	Retention Pond	7.58	2.89	0.36	2014	2014
AA14RST000101	Magothy River Mainstem	Sylvan Ave Pond Retrofit	Extended Detention Structure, Dry	Retention Pond	10.36	4.65	0.43[2]	2014	2014
AA14RST000102	Magothy River Mainstem	Lahinch Dr SWM Pond Retrofit	Extended Detention Structure, Dry	Retention Pond	35.03	7.66	0.48[2]	2014	2014
AA14RST000103	Magothy River Mainstem	Tarks Lane Pond Retrofit	Wet Pond – Wetland	Retention Pond	25.93	5.51	0.59	2014	2014
AA14RST000104	Magothy River Mainstem	Sylvan Ave Pond Retrofit #2	-	Step Pool Conveyance System	-	-	-[2]	-[2]	-[2]
AA14RST000105	Magothy River Mainstem	Collington Court Pond Retrofit	Detention Structure Dry (Dry Pond)	Retention Pond	37.41	6.82	0.34	2014	2014
AA14RST000106	Magothy River Mainstem	Mayfield Rd and Gladnor Rd Pond Retrofit	Detention Structure Dry (Dry Pond)	Retention Pond	6.18	2.66	1.2	2014	2014
AA14RST000107	Magothy River Mainstem	Amesbury Ct. Pond Retrofit	Wet Pond – Wetland	Retention Pond	35.55	4.88	0.53	2014	2014
AA14RST000108	Magothy River Mainstem	Longfellow Drive Pond Retrofit #2	-	Step Pool Conveyance System	17.62[2]	4.39[2]	0.03	2014	2014
AA15RST000085	Magothy River Mainstem	Earleigh Heights Rd at B&A Trail Pond Retrofit	Extended Detention Structure, Wet	Retention Pond	12.89	3.69	2.6	2015	2015
AA15RST000086	Magothy River Mainstem	Evon Ct Pond Retrofit	Detention Structure Dry (Dry Pond)	Retention Pond	8.92	2.85	2.6	2015	2015
AA15RST000087	Magothy River Mainstem	Colleen Garden/Severndale GST Pond Retrofit	Infiltration Trench	Retention Pond	21.09	5.55	0.15	2015	2015
AA15RST000088	Magothy River Mainstem	Colleen Garden Ln Pond Retrofit	Detention Structure Dry (Dry Pond)	Retention Pond	3.03	1.1	0.55	2015	2015
AA15RST000089	Magothy River Mainstem	Waycross Way Pond Retrofit	Wet Pond – Wetland	Retention Pond	45.54	12.82	0.48	2015	2015
AA15RST000091	Magothy River Mainstem	244 Kennedy Drive Pond Retrofit	Infiltration Basin	Retention Pond	2.28	0.89	1.33	2016[2]	2016[2]
AA15RST000094	Magothy River Mainstem	109 Chelsea Grove Ct Pond Retrofit	Detention Structure Dry (Dry Pond)	Retention Pond	13.12	2.84	0.39	2016[2]	2016[2]
AA15RST000096	Magothy River Mainstem	Finnegan Dr Pond Retrofit	Infiltration Basin	Retention Pond	7.16	2.23	1.52	2015	2015
AA16RST000017	Magothy River Mainstem	8013 Tick Neck Road Pond Retrofit	Extended Detention Structure, Dry	Retention Pond	52.71	23.14	0.13	2016[2]	2016
AA16RST000018	Magothy River Mainstem	603 Deering Road Pond Retrofit	Extended Detention Structure, Wet	Retention Pond	50.12	23.14	0.51	2016[2]	2016
AA16RST000027	Magothy River Mainstem	725 Bridge Drive Pond Retrofit	Extended Detention Structure, Dry	Retention Pond	3.89	1.07	1.46	2016	2016
AA16RST000031	Magothy River Mainstem	Dividing Creek AACC Pond Retrofit #1	Extended Detention Structure, Dry	Retention Pond	15.11	12.84	1	2016	2016
AA16RST000032	Magothy River Mainstem	Dividing Creek AACC Pond Retrofit #2	Infiltration Trench	Bioretention	7.72	6.55	0.39	2016	2016
AA16RST000033	Magothy River Mainstem	Grosvenor Lane Bioretention	-	Bioretention	4.08	0.55	0.32	2016[2]	2016
AA16RST000048[4]	Magothy River Mainstem	227TH Street Pond Retrofit[1]	Extended Detention Structure, Wet	ED – Wetland	11.46	4.25	1.57	2018	2018
AA16RST000085	Magothy River Mainstem	Will O Brooke Drive Outfall Stabilization	-	Step Pool Conveyance System	4.68	1.49	2.6	2017	2017[2]
AA16RST000086	Magothy River Mainstem	Pinewood Road Storm Drain SPSC	-	Step Pool Conveyance System	26.72	7.79	1.42	2017[2]	2017
AA17RST000004	Magothy River Mainstem	Old Mill RD Outfall Stabilization	-	Step Pool Conveyance System	15.09	1.8	0.79	2021[2]	-
AA17RST000015	Magothy River Mainstem	Randell Road Bioretention (Round Bay Community)	-	Rain Gardens	1.5	0.38	0.49	2014[2]	2014[2]

Restoration Id	TMDL Watershed	Project Description	Existing Project Type	Proposed Project Type	Drainage Area (acres)	Impervious Area (acres)	Rainfall Depth (inches)	Projected Year of Completion	Year of Completion
AA17RST000024	Magothy River Mainstem	Upper Mill Creek Stream Restoration BMP 824	Detention Structure Dry (Dry Pond)	Step Pool Conveyance System	22.6	4.5	0.56	2023[2]	-
AA17RST000033	Magothy River Mainstem	Cypress Creek Recreation Bioretention	-	Bioretention	0.76	0.45	1.08	2012	2012[2]
AA17RST000034	Magothy River Mainstem	Cypress Creek Park and Ride Bioretention	-	Bioretention	6.46	3.8	0.99	2012	2012[2]
AA17RST000049	Magothy River Mainstem	Dunkeld Manor SWM Retrofit	Infiltration Basin	Step Pool Conveyance System	18.26	7.6	0.5	2013[2]	2013[2]
AA18RST000020	Magothy River Mainstem	Twin Harbors HOA Bioretention[1]	-	Bioretention	3.64	1.03	0.93	2018	2018
AA18RST000035	Magothy River Mainstem	Wee Lad and Lassie Bioretention	-	Bioretention	1.2	0.25	1.26	2017[2]	2017[2]
AA18RST000042	Magothy River Mainstem	Berrywood Community Bioretention and Swale	-	Bio-Swale	3.54	0.96	2.07	2019	2019
AA18RST000047	Magothy River Mainstem	Harting Farm Pond 1 Retrofit	Retention Pond	Extended Detention Structure, Wet	58.95	18.59	0.59	2023	-
AA18RST000048	Magothy River Mainstem	Harting Farm Pond 2 Retrofit	Retention Pond	Extended Detention Structure, Wet	81.95	22.53	2.6	2023	-
AA18RST000049	Magothy River Mainstem	Harting Farm Pond 3 Retrofit	Retention Pond	Extended Detention Structure, Wet	1.85	0.19	2.6	2023	-
AA19RST000002	Magothy River Mainstem	Barrensdale Outfall Restoration - SPSC[1]	Detention Structure Dry (Dry Pond)	Step Pool Conveyance System	22.5	7.9	2.6	2019	2019
AA19RST000013	Magothy River Mainstem	Farmington Village at Schramms Crossing Pond Retrofit[1]	Extended Detention Structure, Wet	Extended Detention Structure, Wet	59.1	19.58	2.53	2020	-
AA19RST000014	Magothy River Mainstem	North Star Drive Pond Retrofit[1]	Extended Detention Structure, Wet	Extended Detention Structure, Wet	192.31	43.42	1.76	2020	-
AA19RST000015	Magothy River Mainstem	Walmart Pond Retrofit - Ritchie Hwy[1]	Detention Structure Dry (Dry Pond)	Extended Detention Structure, Wet	19.11	14.16	2.14	2020	-
AA18RST000023	Magothy River/Forked Creek	Forked Creek Outfall Retrofit - U15O002	-	Step Pool Conveyance System	65.09	5.08	2.09	2020[2]	-
AA16RST000011	Patapsco River Lower North Branch	Jerome Avenue Pond Retrofit	Extended Detention Structure, Dry	Infiltration Basin	4.63	1.54	1.56	2016[2]	2016
AA16RST000020	Patapsco River Lower North Branch	Musical Way Pond Retrofit	Extended Detention Structure, Wet	Infiltration Basin	16.82	3.77	0.6	2016[2]	2016
AA16RST000024	Patapsco River Lower North Branch	Severn Road / Carriage Drive Pond Retrofit	Extended Detention Structure, Dry	Retention Pond	11.2	4.81	0.76	2016[2]	2016
AA16RST000030	Patapsco River Lower North Branch	806 Central Ave (Linthicum) Pond Retrofit	Extended Detention Structure, Wet	Retention Pond	1.53	1.01	0.38	2017[2]	2017[2]
AA16RST000047	Patapsco River Lower North Branch	Groveland Road Pond Retrofit	Detention Structure Dry (Dry Pond)	Infiltration Basin	12.38	3.79	0.63	2019	-
AA16RST000060	Patapsco River Lower North Branch	Gesna Dr Retrofit	Detention Structure Dry (Dry Pond)	Shallow Marsh	30.47	11.81	0.76	2019	-
AA16RST000061	Patapsco River Lower North Branch	Tuckerman Dr Retrofit	Detention Structure Dry (Dry Pond)	ED – Wetland	92.56	22.23	1.79	2019	-
AA16RST000062	Patapsco River Lower North Branch	Fairbanks Dr Retrofit	Detention Structure Dry (Dry Pond)	Shallow Marsh	14.4	6.35	0.71	2019	-
AA16RST000064	Patapsco River Lower North Branch	Green Moss Glen Retrofit	Detention Structure Dry (Dry Pond)	Sand Filter[3]	23.38	7.23	0.66[2]	2021	-
AA16RST000066	Patapsco River Lower North Branch	Ridge Commons Blvd Retrofit	Extended Detention Structure, Dry	Extended Detention Structure, Wet	24.08	10.59	2.6	2019	-
AA16RST000075	Patapsco River Lower North Branch	Northrup Grumman Bioswale 1	-	Bio-Swale	0.55	0.55	0.69	2016[2]	2016[2]
AA16RST000076	Patapsco River Lower North Branch	Northrup Grumman Grass Swale 2	-	Grass Swale	-	-[2]	-[2]	-	-
AA16RST000077	Patapsco River Lower North Branch	Northrup Grumman Bioretention Area 1	-	Micro-Bioretention	-	-[2]	-[2]	-	-

Restoration Id	TMDL Watershed	Project Description	Existing Project Type	Proposed Project Type	Drainage Area (acres)	Impervious Area (acres)	Rainfall Depth (inches)	Projected Year of Completion	Year of Completion
AA16RST000078	Patapsco River Lower North Branch	Northrup Grumman Pervious Pavement 1	-	Permeable Pavements	0.97	0.75	1.36	2016[2]	2016[2]
AA16RST000079	Patapsco River Lower North Branch	Northrup Grumman Pervious Pavement 3A-2	-	Permeable Pavements	1.51	1.2	1.2	2016[2]	2016[2]
AA16RST000080	Patapsco River Lower North Branch	Northrup Grumman Pervious Pavement 3B	-	Permeable Pavements	1.26	1.23	1.5	2016[2]	2016[2]
AA16RST000081	Patapsco River Lower North Branch	Northrup Grumman Pervious Pavement 2	-	Permeable Pavements	0.53	0.5	0.65	2016[2]	2016[2]
AA17RST000001	Patapsco River Lower North Branch	Riverside Park Stormwater Management Retrofit	-	Step Pool Conveyance System	8.72[2]	4.75[2]	1	2020[2]	-
AA17RST000002	Patapsco River Lower North Branch	Chesapeake Arts Center Stormwater Management Retro	-	Infiltration Trench	4.09	2.64	1	2020[2]	-
AA17RST000003	Patapsco River Lower North Branch	Brooklyn Park Stormwater Management Retrofit	-	Infiltration Trench	7.02[2]	2.73[2]	1	2020[2]	-
AA17RST000022	Patapsco River Lower North Branch	Maritime Institute (Maritime Blvd) Pond Retrofit	Detention Structure Dry (Dry Pond)	Step Pool Conveyance System	17.49[2]	9.22[2]	0.85	2021	-
AA17RST000030	Patapsco River Lower North Branch	Northrop Grumman ESD Pervious Pavement 3A-1	-	Permeable Pavements	1.51	1.2	2.07	2016	2016[2]
AA17RST000031	Patapsco River Lower North Branch	Northrop Grumman ESD Raingarden	-	Rain Gardens	0.03	0.03	2.53	2016	2016[2]
AA17RST000035	Patapsco River Lower North Branch	Peach Orchard SWM Retrofit	Extended Detention Structure, Wet	Retention Pond	43.7	10.92	1	2013[2]	2013[2]
AA18RST000005	Patapsco River Lower North Branch	Walmart Arundel Mills Pond Opti Retrofit	Retention Pond	Retention Pond	33.76	26.8[2]	2.1[2]	2018[2]	2018
AA18RST000010	Patapsco River Lower North Branch	Arundel Mills Limited Partnership CMAC Pond Retrofit	Retention Pond	Retention Pond	198.93[2]	137.39[2]	1.6[2]	2018	2018
AA18RST000017	Patapsco River Lower North Branch	Hock Business Park (Corporate Blvd) Pond Retrofit	Detention Structure Dry (Dry Pond)	Sand Filter	89.16	52.57	1.41	2021	-
AA18RST000018	Patapsco River Lower North Branch	International Drive Pond Retrofit	Detention Structure Dry (Dry Pond)	Wet Pond – Wetland	137.35	74.28	0.19	2021	-
AA18RST000022	Patapsco River Lower North Branch	Concorde Circle Dry Pond Retrofit	Detention Structure Dry (Dry Pond)	Step Pool Conveyance System	63.29	15.05	2.22	2021	-
AA19RST000011	Patapsco River Lower North Branch	601-611 Hammonds Ferry Road North Pond Retrofit[1]	Detention Structure Dry (Dry Pond)	Sand Filter	43.17	20.73	1.09	2021	2022
AA16RST000014	Patapsco River/Furnace Creek	Lochaber Court Pond Retrofit	Extended Detention Structure, Dry	Retention Pond	14.64	3.43	0.85	2016[2]	2016
AA16RST000025	Patapsco River/Furnace Creek	McNeil Court Pond Retrofit	Extended Detention Structure, Dry	Retention Pond	8.15	3.13	1.15	2016[2]	2016
AA16RST000041	Patapsco River/Furnace Creek	Chalmers Ave Pond Retrofit	Detention Structure Dry (Dry Pond)	Infiltration Basin	18.99	5.31	1	2017	2017
AA16RST000044	Patapsco River/Furnace Creek	Towering Oaks Court Pond Retrofit	Detention Structure Dry (Dry Pond)	Retention Pond	7.95	3.23	2.6	2018	2018
AA16RST000045	Patapsco River/Furnace Creek	Baby Baer Court Pond Retrofit	Detention Structure Dry (Dry Pond)	Infiltration Basin	11.37	3.24	2.6	2016[2]	2016[2]
AA16RST000072	Patapsco River/Furnace Creek	Juneberry Way Pond Retrofit - SPSC	Detention Structure Dry (Dry Pond)	Step Pool Conveyance System	5.4	3.1	0.96[2]	2016[2]	2016[2]
AA17RST000005	Patapsco River/Furnace Creek	Heritage Hills Back Creek Phase 2 Retrofits	Detention Structure Dry (Dry Pond)	Step Pool Conveyance System	9.51[2]	4.1	1.41[2]	2019	-
AA17RST000006	Patapsco River/Furnace Creek	Heritage Hills Back Creek Phase 2 Retrofits	-	Bioretention	-[2]	-[2]	-[2]	-[2]	-
AA17RST000007	Patapsco River/Furnace Creek	Heritage Hills Back Creek Phase 2 Retrofits	-	Infiltration Berms[3]	4.05	2.4	2.6[2]	2019	-
AA17RST000008	Patapsco River/Furnace Creek	Heritage Hills Back Creek Phase 2 Retrofits	-	Bioretention	-[2]	-[2]	-[2]	-[2]	-

Restoration Id	TMDL Watershed	Project Description	Existing Project Type	Proposed Project Type	Drainage Area (acres)	Impervious Area (acres)	Rainfall Depth (inches)	Projected Year of Completion	Year of Completion
AA17RST000009	Patapsco River/Furnace Creek	Heritage Hills Back Creek Phase 2 Retrofits	-	Bioretention	-[2]	-[2]	-[2]	-[2]	-
AA17RST000023	Patapsco River/Furnace Creek	Sawmill Hollins Ferry RD Pond Retrofit BMP 190	Detention Structure Dry (Dry Pond)	Infiltration Basin	32.1	19.45	2.6	2018	2018
AA18RST000028	Patapsco River/Furnace Creek	Sawmill Creek - Cromwell Elementary School Bioretention #1	-	Bioretention	9.98	3.75	1.02	2019	-
AA18RST000029	Patapsco River/Furnace Creek	Sawmill Creek - Cromwell Elementary School Bioretention #2	-	Bioretention	3.56	1.67	1.01	2019	-
AA18RST000030	Patapsco River/Furnace Creek	Sawmill Creek - Cromwell Elementary School Vortechs Unit #1	-	Other	9.22	3.56	-	2019	-
AA19RST000001	Patapsco River/Furnace Creek	Sawmill Creek Stream Restoration Phase I Muddy Bridge Branch SPSC[1]	-	Step Pool Conveyance System	112.4	37	0.21	2022	-
AA19RST000010	Patapsco River/Furnace Creek	Cromwell Fountain Pond Repair[1]	Extended Detention Structure, Wet	Extended Detention Structure, Wet	62.37	32.61	2.6	2020	-
AA16RST000016	Patapsco River/Marley Creek	Hospital Drive Pond #3 SWM Retrofit SPSC	Extended Detention Structure, Dry	Step Pool Conveyance System	31.7	15.8	0.93	2016[2]	2016
AA16RST000034	Patapsco River/Marley Creek	Sun Valley Condos Pond Retrofit	Extended Detention Structure, Dry	Retention Pond	5.46	1.84	0.42[2]	2017[2]	2017[2]
AA16RST000054	Patapsco River/Marley Creek	Hospital Drive / Foxwell Bend Road Pond Retrofit	Extended Detention Structure, Dry	Extended Detention Structure, Wet	30.09	11.28	1.84	2017	2017[2]
AA16RST000055	Patapsco River/Marley Creek	Fox Cub Court Pond Retrofit	Extended Detention Structure, Wet	Extended Detention Structure, Wet	16.19	6.67	2.38	2017	2017[2]
AA16RST000082	Patapsco River/Marley Creek	Hospital Drive Pond 2 Retrofit SPSC	Extended Detention Structure, Dry	Step Pool Conveyance System	13.04	5.84	0.67[2]	2017[2]	2017[2]
AA17RST000010	Patapsco River/Marley Creek	Mill Race Pond Retrofit	Detention Structure Dry (Dry Pond)	Wet Pond – Wetland	47.79	14.51	2.14	2019[2]	-
AA17RST000012	Patapsco River/Marley Creek	Empowering Believers Church Rain Garden 6	-	Rain Gardens	0.17	0.2	2.17	2016	2016[2]
AA17RST000013	Patapsco River/Marley Creek	Empowering Believers Church Rain Garden 2	-	Rain Gardens	0.54	0.5	1.07	2016	2016[2]
AA17RST000014	Patapsco River/Marley Creek	Empowering Believers Church Rain Garden 1	-	Rain Gardens	0.26	0.3	0.86	2016	20162
AA17RST000050	Patapsco River/Marley Creek	Grays Luck SWMP Retrofit	Detention Structure Dry (Dry Pond)	Step Pool Conveyance System	41.9	8.42	0.5	2017[2]	2017
AA19RST000012	Patapsco River/Marley Creek	Mill Pond Stormwater Management Retrofit[1]	Detention Structure Dry (Dry Pond)	ED – Wetland	21.8	9.1	1.06	2021	-
AA18RST000037	Rhode River/Bear Neck Creek	Holly Hill Harbor Community Park Constructed Wetland A	-	ED – Wetland	1.13	0.39	0.28	2018[2]	2018
AA18RST000038	Rhode River/Bear Neck Creek	Holly Hill Harbor Community Park Constructed Wetland B	-	ED – Wetland	1.13	0.39	0.33	2018[2]	2018
AA18RST000039	Rhode River/Bear Neck Creek	Holly Hill Harbor Community Park Constructed Wetland C	-	ED – Wetland	2.14	0.46	0.52	2018[2]	2018
AA18RST000040	Rhode River/Bear Neck Creek	Holly Hill Harbor Community Park Constructed Wetland D	-	ED – Wetland	7.15	2.02	0.05	2018[2]	2018
AA18RST000041	Rhode River/Bear Neck Creek	Holly Hill Harbor Community Park Constructed Wetland E	-	ED – Wetland	7.32	2.06	0.05	2018[2]	2018
AA15RST000092	Severn River Mainstem	Knollwood Road Outfall	-	Step Pool Conveyance System	9.49	2.55	1.04	2016[2]	2016[2]
AA15RST000093	Severn River Mainstem	Western District Police Station	Detention Structure Dry (Dry Pond)	Retention Pond	2.28	1.34	1.71	2016[2]	2016[2]
AA15RST000097	Severn River Mainstem	Wetherfield Pond SWM Retrofit	Detention Structure Dry (Dry Pond)	Retention Pond	16.5	4.78	1	2014[2]	2014[2]
AA15RST000098	Severn River Mainstem	Denington Lane Outfall	-	Step Pool Conveyance System	122.37	38.24	0.5	2016[2]	2016[2]

Restoration Id	TMDL Watershed	Project Description	Existing Project Type	Proposed Project Type	Drainage Area (acres)	Impervious Area (acres)	Rainfall Depth (inches)	Projected Year of Completion	Year of Completion
AA15RST000101	Severn River Mainstem	Old Bay Ridge Rd/Abandoned RR Embankment Sinkhole	-	Step Pool Conveyance System	126.57	20.06	0.03	2015	2015
AA15RST000102	Severn River Mainstem	Olde Severna Park Outfall Retrofit Birch Court	-	Step Pool Conveyance System	37.83	15.86	0.5	2015	2015
AA16RST000009	Severn River Mainstem	Annapolis Mall Pond Retrofit	Extended Detention Structure, Wet	Retention Pond	-	-	-	-	-
AA16RST000012	Severn River Mainstem	1275 Odenton Road Pond Retrofit	Detention Structure Dry (Dry Pond)	Retention Pond	3.36[2]	1.05[2]	0.88[2]	2016	2016
AA16RST000040	Severn River Mainstem	Valentine Creek SWM Retrofit	Detention Structure Dry (Dry Pond)	ED – Wetland	34.89	3.31	1.65	2017	2017
AA16RST000067	Severn River Mainstem	Pasture Brook Rd Retrofit	Detention Structure Dry (Dry Pond)	ED – Wetland	49.42	13.03	1.01	2017[2]	2017
AA16RST000073	Severn River Mainstem	Maryland Theraputic Riding Center SPSC	-	Step Pool Conveyance System	26.6	2.38	2.49	2015	2015[2]
AA16RST000088	Severn River Mainstem	Buttonwood Trail Outfall Repair SPSC	-	Step Pool Conveyance System	8.54	3.31	0.49	2015	2015[2]
AA16RST000090	Severn River Mainstem	Picture Spring Branch Outfall Restoration	-	Step Pool Conveyance System	24.3	1.73	0.5	2016	2016
AA17RST000011	Severn River Mainstem	Lakeland Road Outfall Stabilization	Dry Swale	Step Pool Conveyance System	44.87	13.06	0.97	2019	-
AA17RST000016	Severn River Mainstem	Coventry Court Dry Channel RSC-Category 2	-	Step Pool Conveyance System	2.4	1.5	0.29	2017	2017
AA17RST000017	Severn River Mainstem	Herald Harbor Bonaparte RD #2 CPO	-	Step Pool Conveyance System	17.59	4.88	0.05	2017	2017
AA17RST000018	Severn River Mainstem	Winchester on the Severn Dry Channel RSC	-	Step Pool Conveyance System	18.75	5.07	0.28	2017	2017[2]
AA17RST000025	Severn River Mainstem	Sappington Hill Pond Retrofit	Extended Detention Structure, Wet	Retention Pond	15.32	3.69	1.83	2016	2016[2]
AA17RST000026	Severn River Mainstem	Fairfield Drive Pond Retrofit	Retention Pond	Extended Detention Structure, Wet[3]	25.31	7.64	0.44	2016	2016[2]
AA17RST000027	Severn River Mainstem	Dellwood Court Outfall Sand Filter	-	Sand Filter	1.33	0.27	1.59	2017	2017
AA17RST000028	Severn River Mainstem	Dellwood Court Outfall Bioretention	-	Bioretention	3.88	0.53	0.45	2016	2016[2]
AA17RST000029	Severn River Mainstem	Dellwood Court Infiltration Trench	-	Infiltration Trench	0.57	0.31	0.7	2017	2017
AA17RST000051	Severn River Mainstem	Windswept Estates Pond Retrofit	Infiltration Basin	Step Pool Conveyance System	15.5	6.05	0.5	2014	2014[2]
AA18RST000001	Severn River Mainstem	Jabez SWM BMP 33 Retrofit	Shallow Marsh	Shallow Marsh	119	12.6	1	2018	2018
AA18RST000019	Severn River Mainstem	Sappington Hill BMP 1280 Pond Retrofit	Extended Detention Structure, Wet	Retention Pond[3]	31.28	2.04	2.6	2019	-
AA18RST000053	Severn River Mainstem	Seven Oaks BMP 341[1]	Extended Detention Structure, Wet	Extended Detention Structure, Wet	437.95	99.55	0.5	2018	2018
AA19RST000018	Severn River Mainstem	Epping Forest Stormwater BMPs - Gravel Wetland 1[1]	-	Submerged Gravel Wetland	0.33	0.33	0.86	2019	-
AA19RST000019	Severn River Mainstem	Epping Forest Stormwater BMPs - Gravel Wetland 2[1]	-	Submerged Gravel Wetland	3.63	1.07	0.67	2019	-
AA16RST000019	Severn River/Mill Creek	Comanche Rd Retrofit	Infiltration Basin	Retention Pond	12.99	2.6	0.64	2017[2]	2017[2]
AA16RST000021	Severn River/Mill Creek	Old Sturbridge Rd Retrofit	Infiltration Basin	Retention Pond	7.74	1.55	0.81	2017[2]	2017[2]
AA16RST000022	Severn River/Mill Creek	Nickerson Way Retrofit	Infiltration Basin	Retention Pond	3.73	0.75	1.1[2]	2017[2]	2017[2]
AA19RST000007	Severn River/Mill Creek	Kingsberry Drive SPSC 1[1]	-	Step Pool Conveyance System	32.07	4.86	0.2	2021	-
AA19RST000008	Severn River/Mill Creek	Kingsberry Drive SPSC 2[1]	-	Step Pool Conveyance System	14.09	0.69	2.6	2021	-
AA19RST000009	Severn River/Mill Creek	Kingsberry Drive Wetlands[1]	-	ED – Wetland	45.98	3.95	0.45	2021	-

Restoration Id	TMDL Watershed	Project Description	Existing Project Type	Proposed Project Type	Drainage Area (acres)	Impervious Area (acres)	Rainfall Depth (inches)	Projected Year of Completion	Year of Completion
AA16RST000058	Severn River/Whitehall and Meredith Creek	Pennington Ln South Retrofit	Extended Detention Structure, Dry	Step Pool Conveyance System	24.21	4.69	0.99	2017[2]	2017[2]
AA18RST000044	Severn River/Whitehall and Meredith Creek	Asbury Broadneck United Methodist Church - SPSC	-	Step Pool Conveyance System	21.17[2]	3.57[2]	0.14	2019	2019
AA15RST000090	South River/Duvall Creek	Old Annapolis Neck Road	Detention Structure Dry (Dry Pond)	Retention Pond	3.04	0.86	2.57	2016[2]	2016[2]
AA16RST000007	South River/Duvall Creek	Hillsmere Beach Road Kayak Area CPO / Bioretention	-	Bioretention	9	2.52	0.23	2015	2015[2]
AA17RST000019	South River/Duvall Creek	St. Anne School of Annapolis Rain Garden	-	Rain Gardens	0.63	0.37	1.51	2017	2017
AA15RST000095	South River Mainstem	Dillon Court Pond Retrofit	Detention Structure Dry (Dry Pond)	Retention Pond	15.21	2.8	1.25	2016[2]	2016[2]
AA16RST000001	South River Mainstem	Preserve at Broad Creek Pond Retrofit - SPSC	Extended Detention Structure, Dry	Step Pool Conveyance System	11.04	4.59	0.74	2015	2015[2]
AA16RST000008	South River Mainstem	Historic London Town Step Pools and Rain Garden	-	Rain Gardens	0.7	0.5	1	2013	2013[2]
AA16RST000013	South River Mainstem	St Andrews Pond Retrofit	Extended Detention Structure, Dry	Multiple Pond System	7.97	2.45	2.6	2017[2]	2017[2]
AA16RST000028	South River Mainstem	Loch Haven Manor Pond	Extended Detention Structure, Dry	Retention Pond	8.26	2.19	1.57	2016[2]	2016
AA16RST000035	South River Mainstem	Wordsworth Dr Retrofit	Retention Pond	Retention Pond	69.67	27.15	2.46	2017	2017
AA16RST000038	South River Mainstem	Sharpsburg Dr Retrofit	Detention Structure Dry (Dry Pond)	Retention Pond	32.96	3.97	1.26	2016[2]	2016[2]
AA16RST000039	South River Mainstem	Annapolis Harbour Center Pond Retrofit	Retention Pond	Extended Detention Structure, Wet	36.3	27.1	1.93	2017	2017[2]
AA16RST000069	South River Mainstem	2662 Riva Rd Retrofit	Detention Structure Dry (Dry Pond)	Step Pool Conveyance System[3]	7.85[2]	4.17[2]	1.52[2]	2020	-
AA16RST000084	South River Mainstem	Stepneys Ln Retrofit	Detention Structure Dry (Dry Pond)	Wet Pond – Wetland	-	-[2]	-[2]	-	-
AA16RST000089	South River Mainstem	Cinnamon Lane Outfall Rehabilitation	-	Step Pool Conveyance System	20.91	4.9[2]	0.5	2016	2016
AA16RST000091	South River Mainstem	Annapolis Corporate Park SPSC #1	-	Step Pool Conveyance System	18.84	8.72[2]	0.05[2]	2015	2015[2]
AA16RST000092	South River Mainstem	Annapolis Corporate Park SPSC #2	-	Step Pool Conveyance System	15.76	4.41	0.5	2015	2015[2]
AA16RST000093	South River Mainstem	Camp Woodlands Pre-Treatment	-	Step Pool Conveyance System	7.8	2.09	0.5	2015	2015[2]
AA16RST000094	South River Mainstem	Annapolis Harbour Center SPSC	-	Step Pool Conveyance System	50.33	31.4[2]	0.25[2]	2016	2016
AA18RST000021	South River Mainstem	Broad Creek Headwaters Phase I Dept of Health SPSC	-	Step Pool Conveyance System	7.01	1.11	0.53	2018	2018
AA18RST000024	South River Mainstem	Killarney House and Neighbors Beards Creek Community BMPs	-	Step Pool Conveyance System	20.56	3.82[2]	2.6[2]	2018	2018
AA18RST000025	South River Mainstem	Sylvan Shores Stormwater Infrastructure Upgrade Bioretention #1	-	Bioretention	0.32	0.18	0.37	2016[2]	2016[2]
AA18RST000026	South River Mainstem	Sylvan Shores Stormwater Infrastructure Upgrade Bioretention #2	-	Bioretention	0.77	0.27	0.47	2016[2]	2016[2]
AA18RST000027	South River Mainstem	Sylvan Shores Stormwater Infrastructure Upgrade Bioretention #3	-	Bioretention	0.77	0.16	0.99	2016[2]	2016[2]
AA18RST000031	South River Mainstem	Edgewater Beach Grass Swale	-	Grass Swale	0.82	0.19	0.44	2017[2]	2017[2]
AA18RST000032	South River Mainstem	Edgewater Beach Bioswale	-	Bio-Swale	0.82	0.19	0.08	2017[2]	2017[2]
AA18RST000033	South River Mainstem	Broad Creek Health Department StormTech BMP	-	Other	1.1	1.1[2]	0.85	2018	2018
AA18RST000036	South River Mainstem	United Church of Christ Pond Retrofit	Extended Detention Structure, Dry	Retention Pond[3]	0.58[2]	0.27[2]	0.99[2]	2018	2018

Restoration Id	TMDL Watershed	Project Description	Existing Project Type	Proposed Project Type	Drainage Area (acres)	Impervious Area (acres)	Rainfall Depth (inches)	Projected Year of Completion	Year of Completion
AA18RST000043	South River Mainstem	Center for Applied Technology South - Bioretention	-	Submerged Gravel Wetland[3]	1.95[2]	0.77[2]	0.2[2]	2018	2018
AA18RST000051	South River Mainstem	32 Wilelinor Drive SPSC[1]	-	Step Pool Conveyance System	1.72	0.6	0.4	2014	2014
AA18RST000052	South River Mainstem	Edgewater Beach Pervious Concrete[1]	-	Permeable Pavements	0.29	0.07	1.36	2017	2017
AA19RST000003	South River Mainstem	Broad Creek Outfall Retrofit - SPSC at Camp Woodlands[1]	-	Step Pool Conveyance System	14.39	1.52	2.6	2020	-
AA19RST000005	South River Mainstem	Broad Creek Headwaters Phase II Dept of Health SPSC[1]	-	Step Pool Conveyance System	6.6	2.7	0.57	2019	-
AA19RST000006	South River Mainstem	Broad Creek Headwaters Phase II Dept of Health Infiltration Trench[1]	-	Infiltration Trench	0.84	0.71	1	2019	-
AA19RST000025	South River Mainstem	Central Services Garage Pond 4098 Opti Upgrade[1]	Extended Detention Structure, Wet	Extended Detention Structure, Wet	13.6	7.3	1.31	2019	-
AA19RST000026	South River Mainstem	South River Colony Pond 4063 Opti Upgrade[1]	Extended Detention Structure, Wet	Extended Detention Structure, Wet	268	187.6	2.6	2019	-
AA17RST000020	West River Mainstem	Avalon Shores Fire Dept Stormwater Wetland	-	Bio-Swale	1.37	0.86	0.71	2016	2016[2]

[1] Indicates new project or a project that has previously not been included in Total Maximum Daily Load Restoration Plan for Bacteria (January 2017) and 2018 Annual TMDL Assessment Report (January 2019)

[2] Data has been updated since being listed in Appendix A of the 2018 Annual TMDL Assessment Report (January 2019).

[3] The type of proposed project has been updated since being listed in Appendix A of the 2018 Annual TMDL Assessment Report (January 2019)

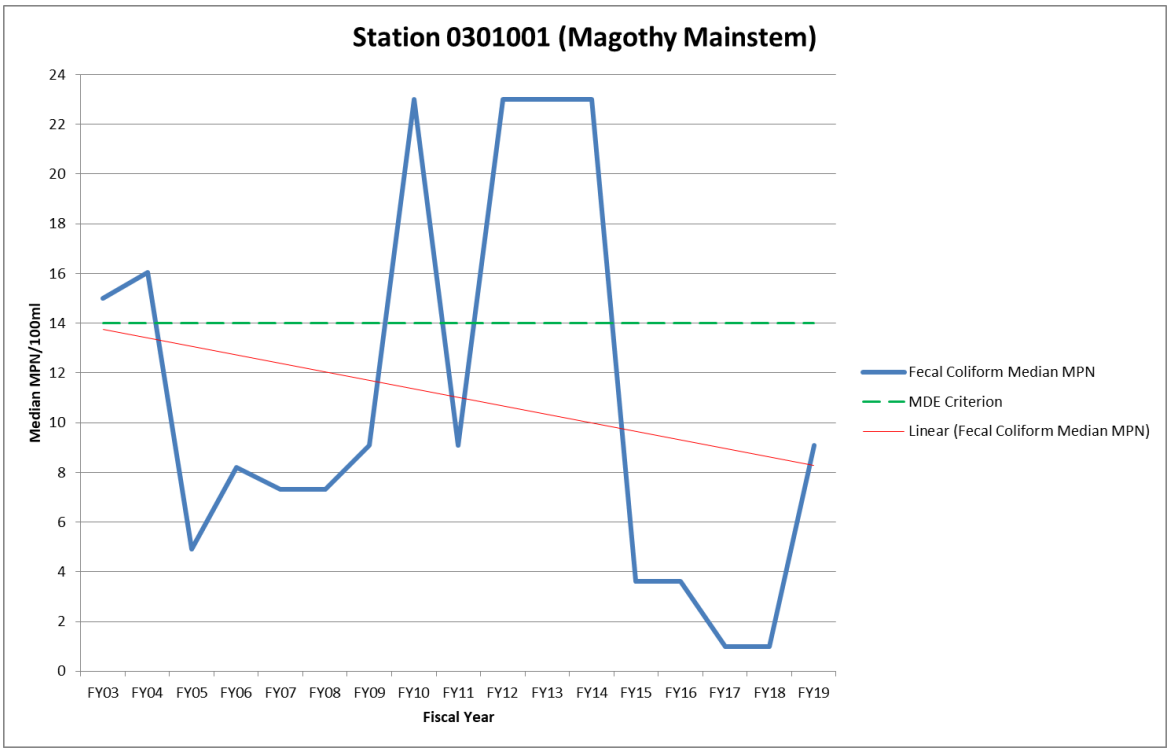
[4] This project is included in the Magothy River Mainstem Watershed in this Plan even though it is listed under Baltimore Harbor Watershed in the County GIS data. This is due to a discrepancy in the watershed boundaries between the County and the MDE GIS data

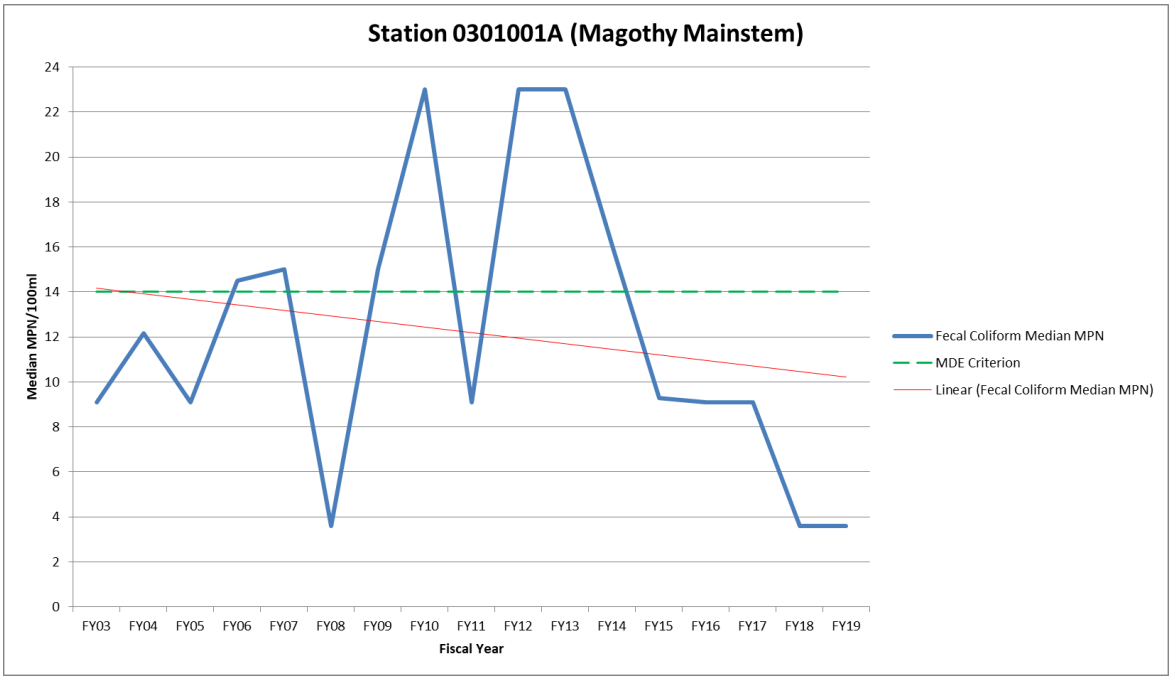
Appendix B

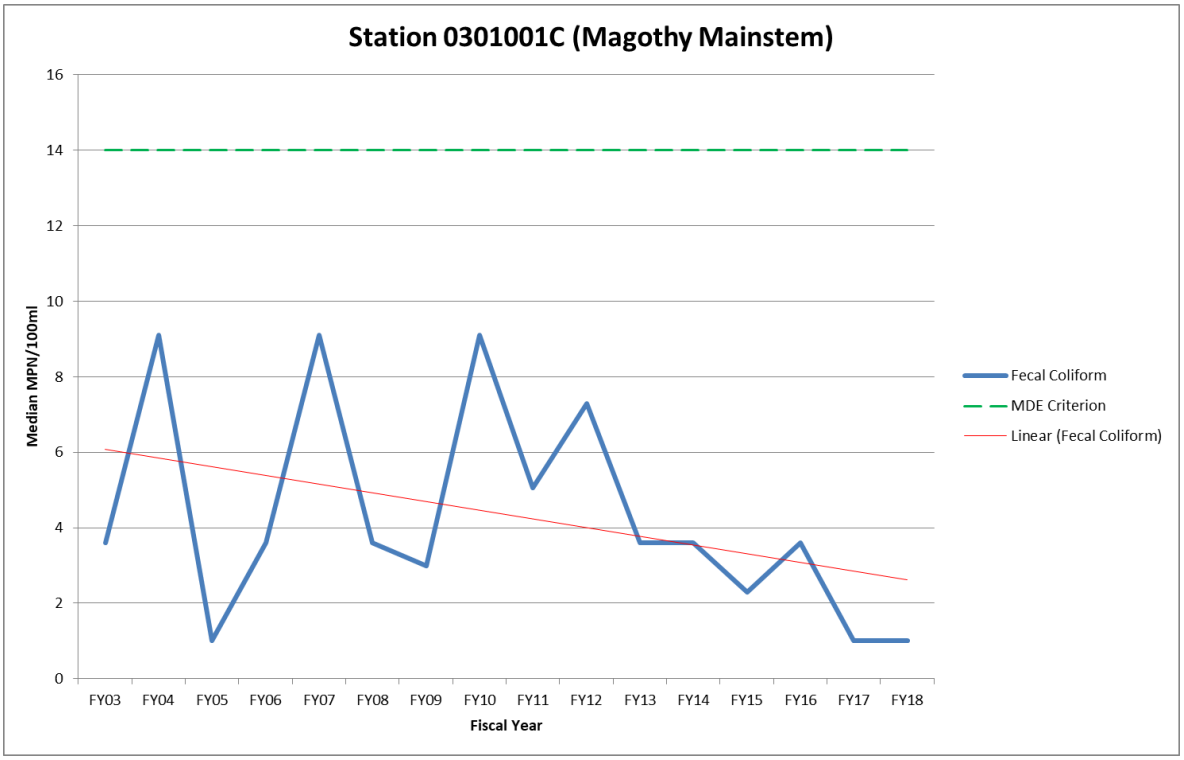
Bacteria Trend Monitoring Sampling Plan and Quality Assurance/Quality Control Protocols

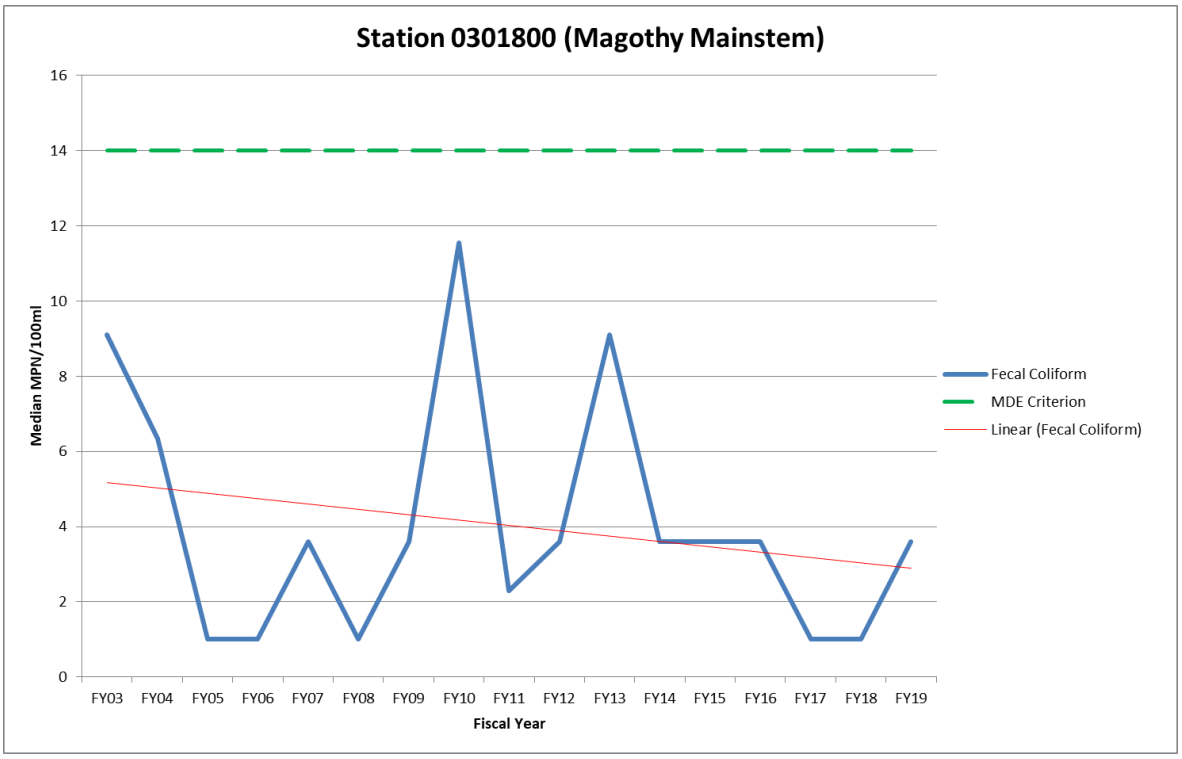
Appendix C

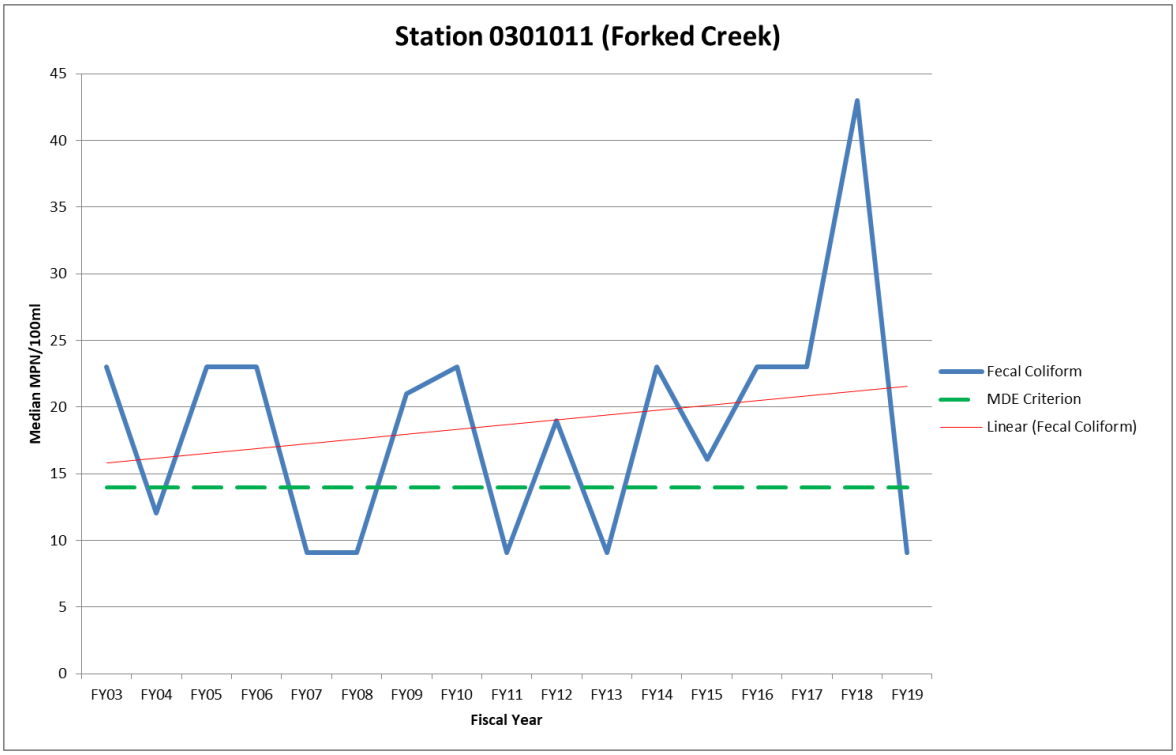
Annual Median Bacteria Concentrations at MDE Shellfish Harvesting Monitoring Stations within TMDL Watersheds

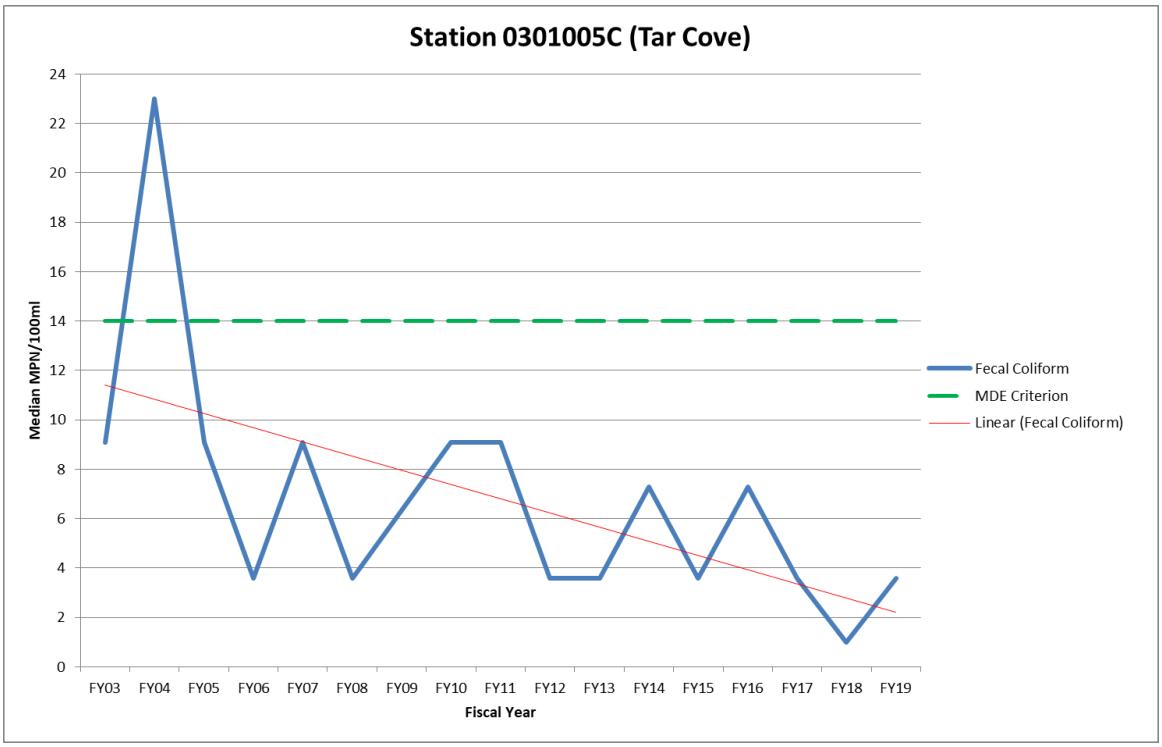

Station 0301001 (Magothy Mainstem)
Median MPN/100ml
24
22
20
18
16
14
12
10
8
6
4
2
0
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform Median MPN
MDE Criterion
Linear (Fecal Coliform Median MPN)

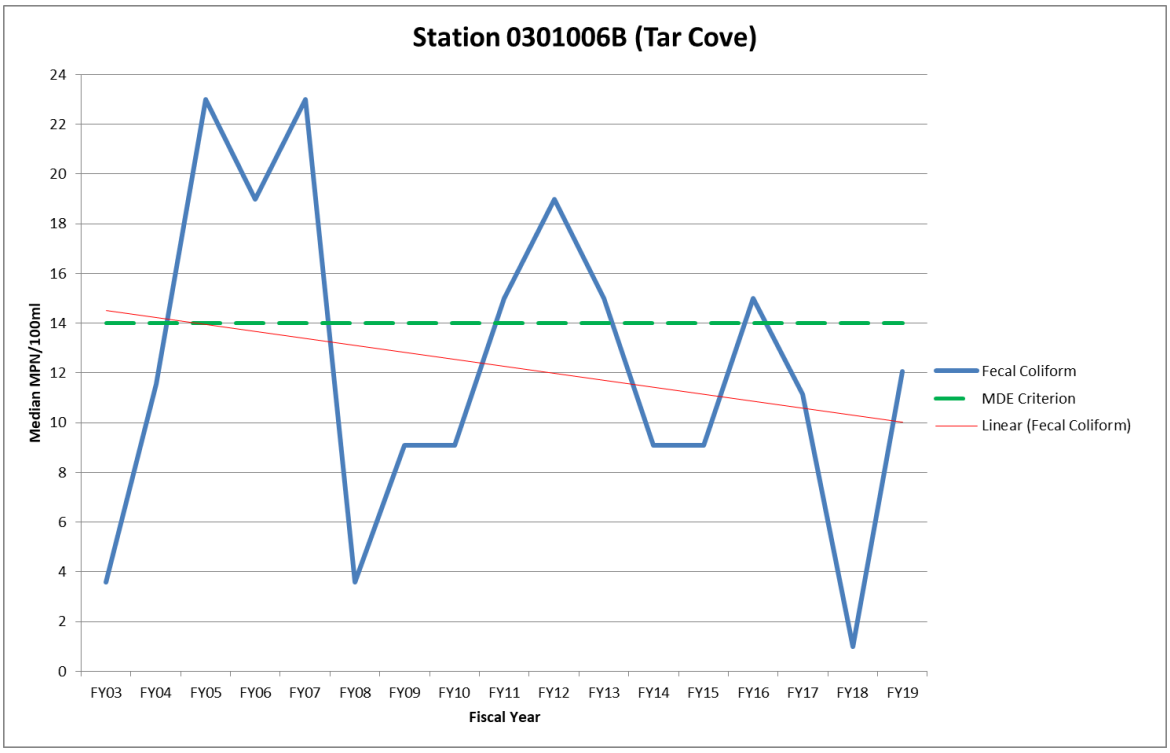

Station 0301001A (Magothy Mainstem)
Median MPN/100ml
24
22
20
18
16
14
12
10
8
6
4
2
0
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform Median MPN
MDE Criterion
Linear (Fecal Coliform Median MPN)

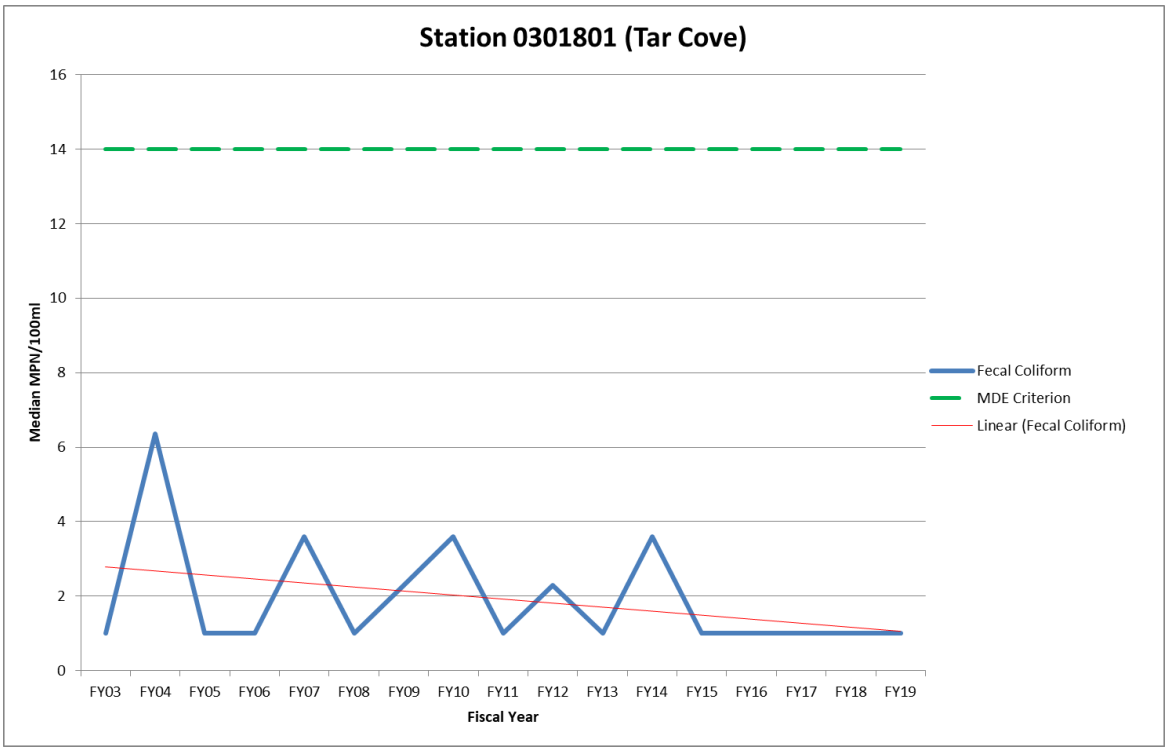

Station 0301001C (Magothy Mainstem)
Median MPN/100ml
16
14
12
10
8
6
4
2
0
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

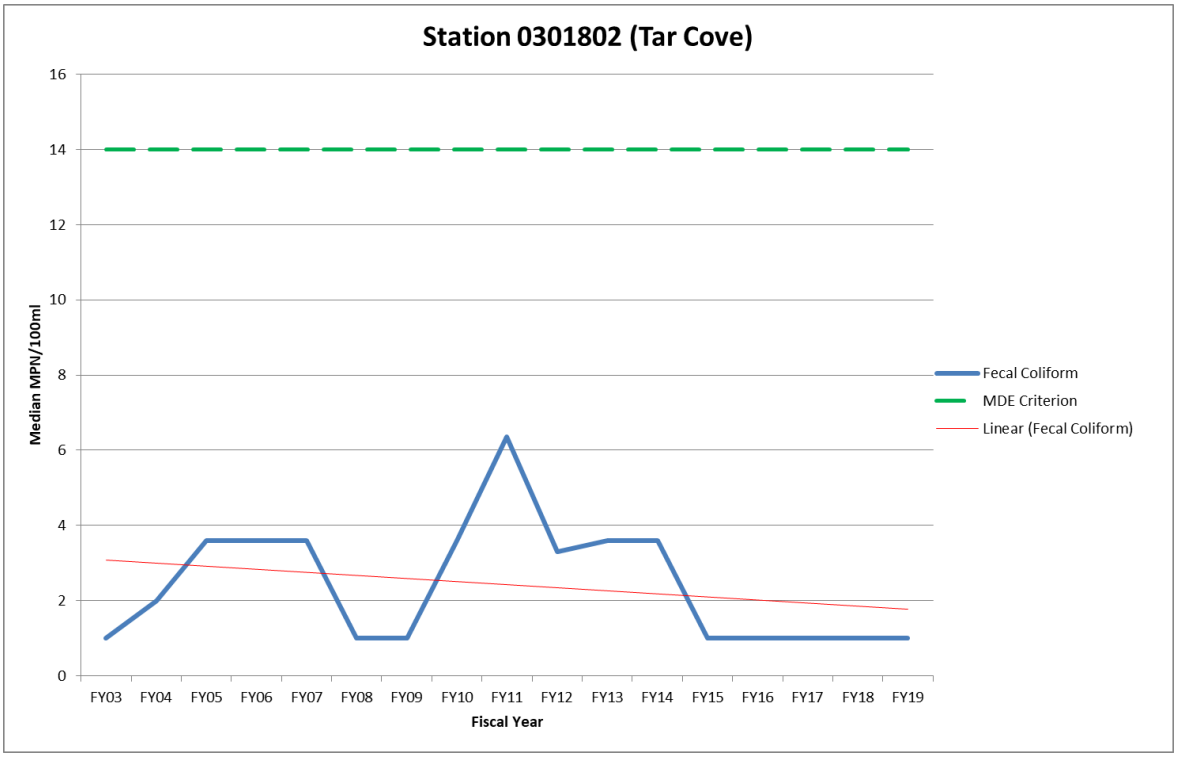

Station 0301800 (Magothy Mainstem)
Median MPN/100ml
16
14
12
10
8
6
4
2
0
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

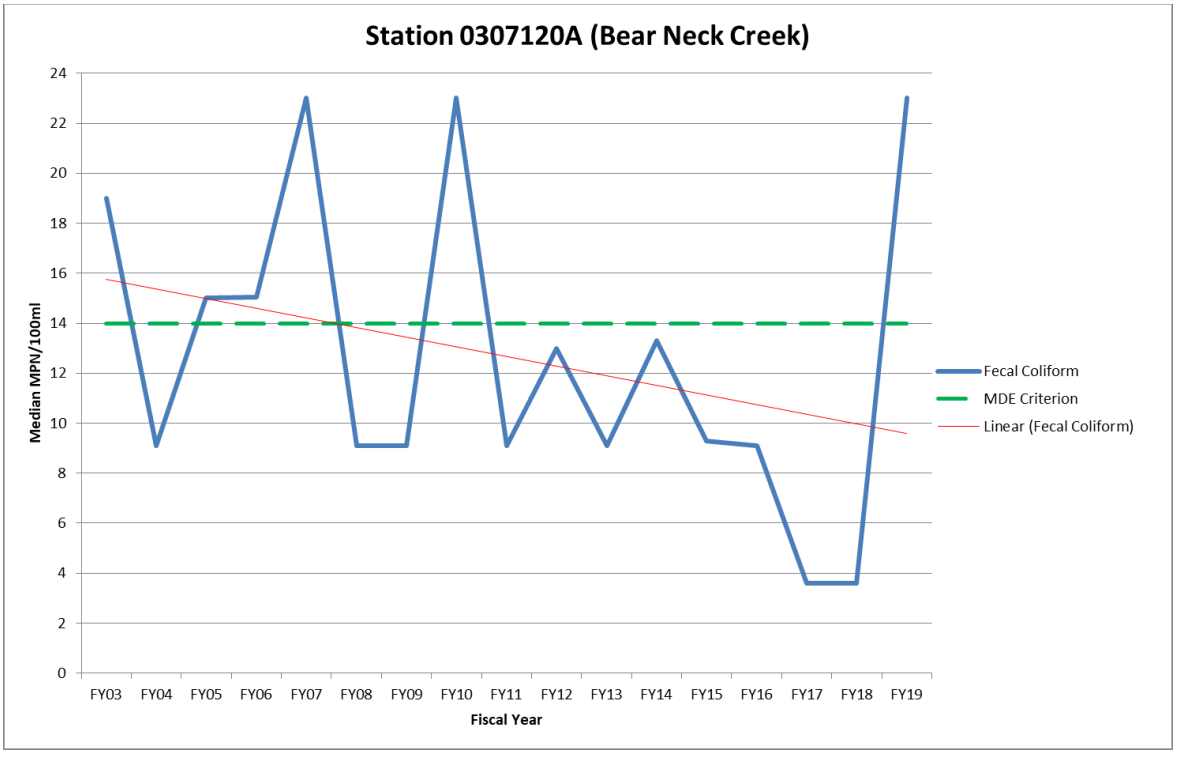

Station 0301011 (Forked Creek)
Median MPN/100ml
45
40
35
30
25
20
15
10
5
0
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

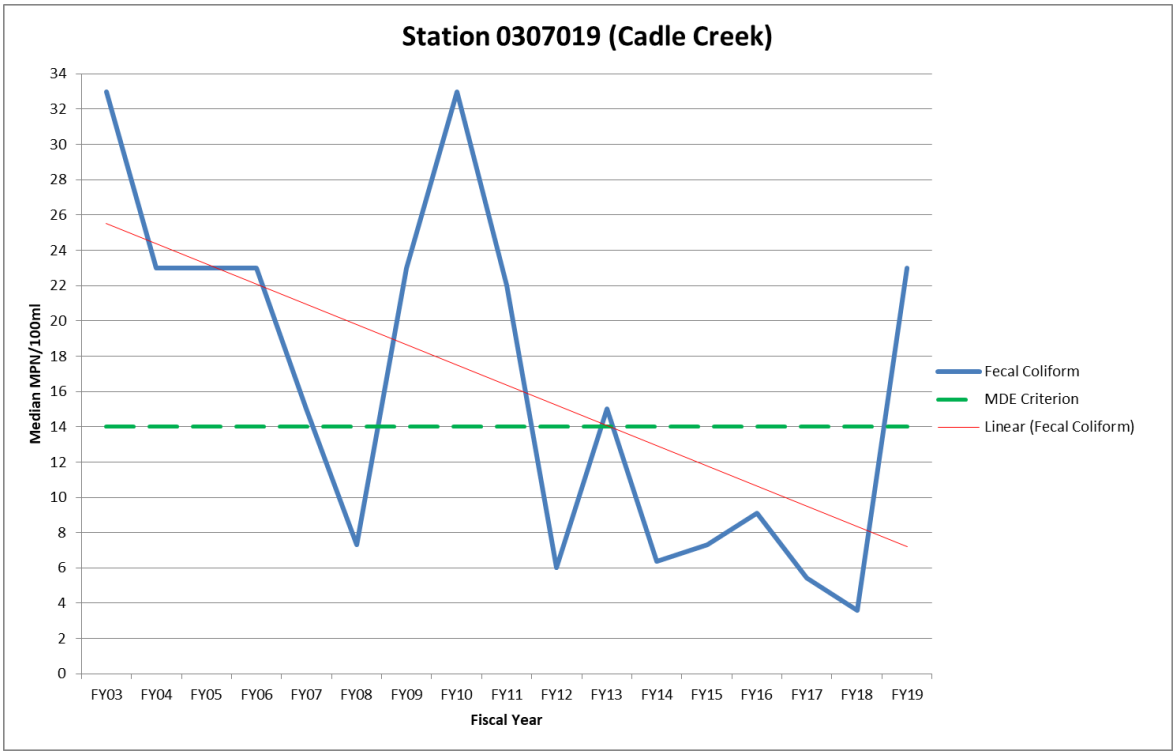

Station 0301005C (Tar Cove)
Median MPN/100ml
24
22
20
18
16
14
12
10
8
6
4
2
0
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

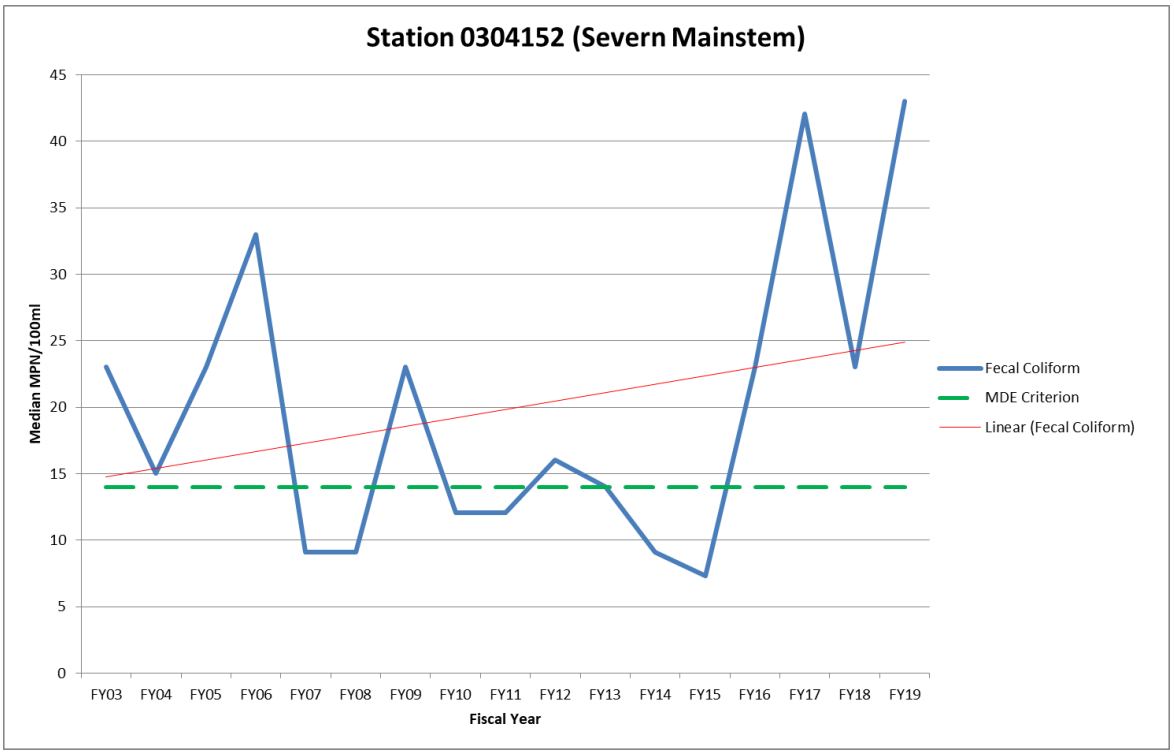

Station 0301006B (Tar Cove)
Median MPN/100ml
24
22
20
18
16
14
12
10
8
6
4
2
0
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

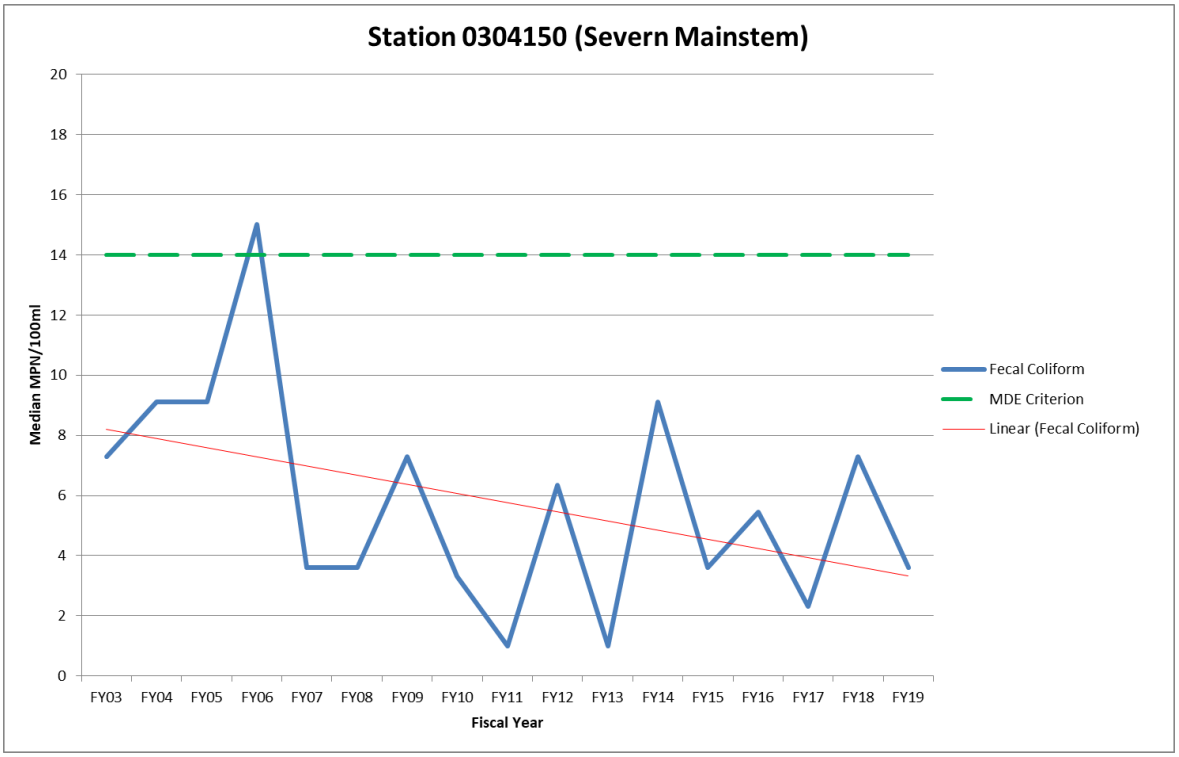

Station 0301801 (Tar Cove)
Median MPN/100ml
16
14
12
10
8
6
4
2
0
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

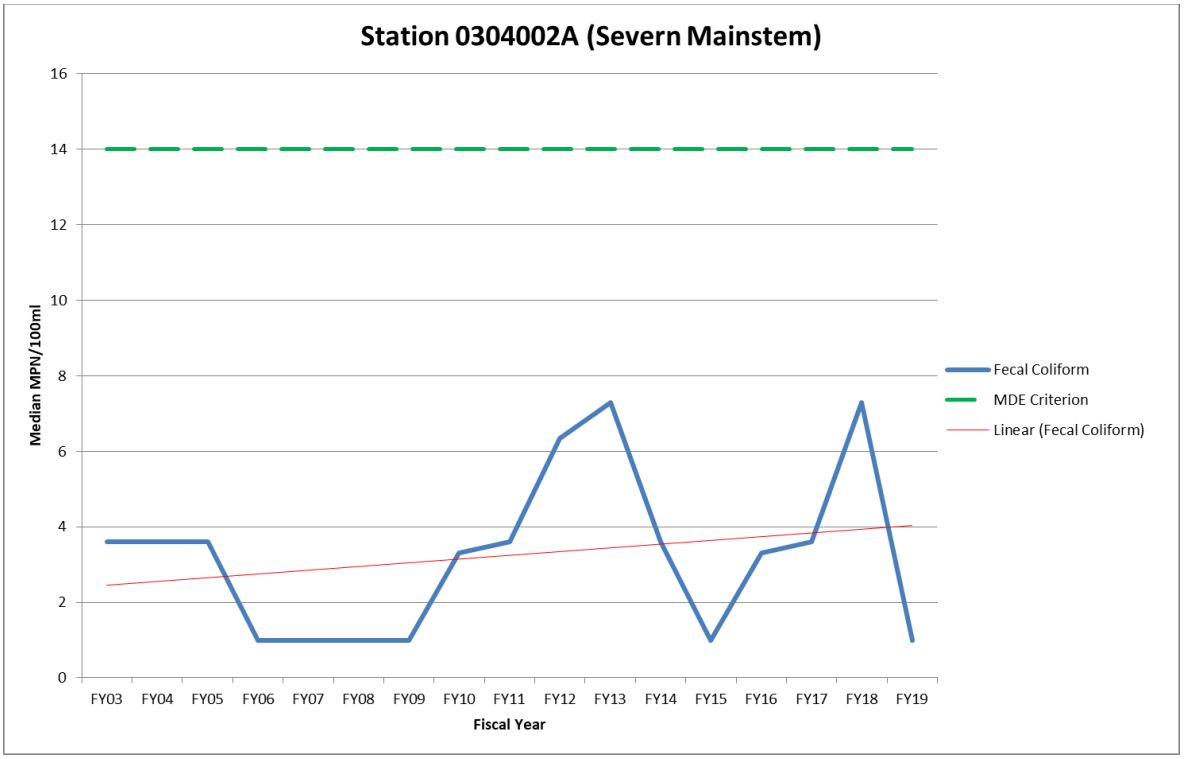

Station 0301802 (Tar Cove)
Median MPN/100ml
16
14
12
10
8
6
4
2
0
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

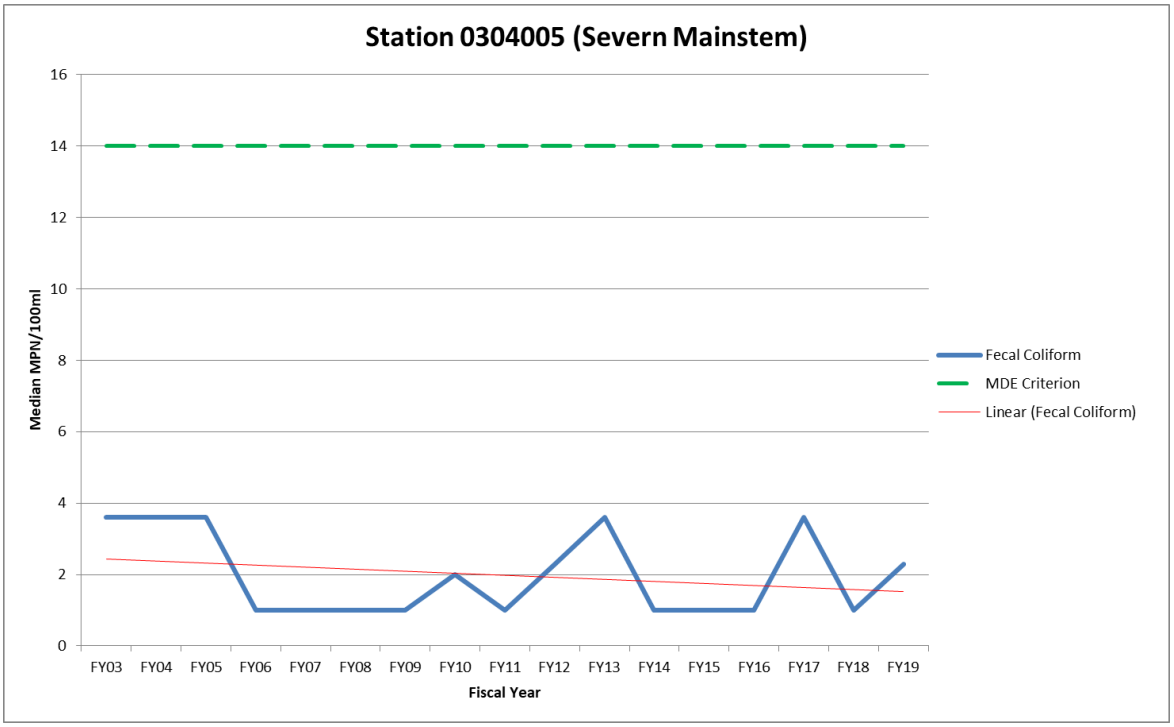

Station 0307120A (Bear Neck Creek)
Median MPN/100ml
24
22
20
18
16
14
12
10
8
6
4
2
0
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

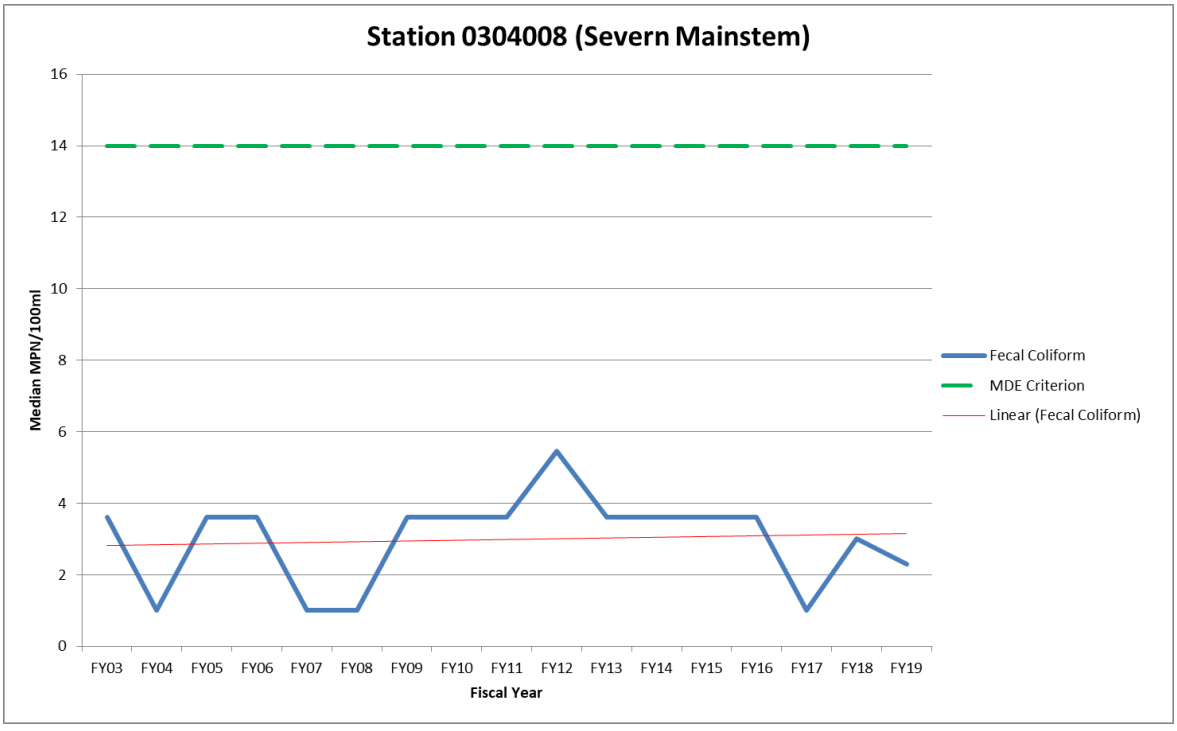

Station 0307019 (Cadle Creek)
Median MPN/100ml
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

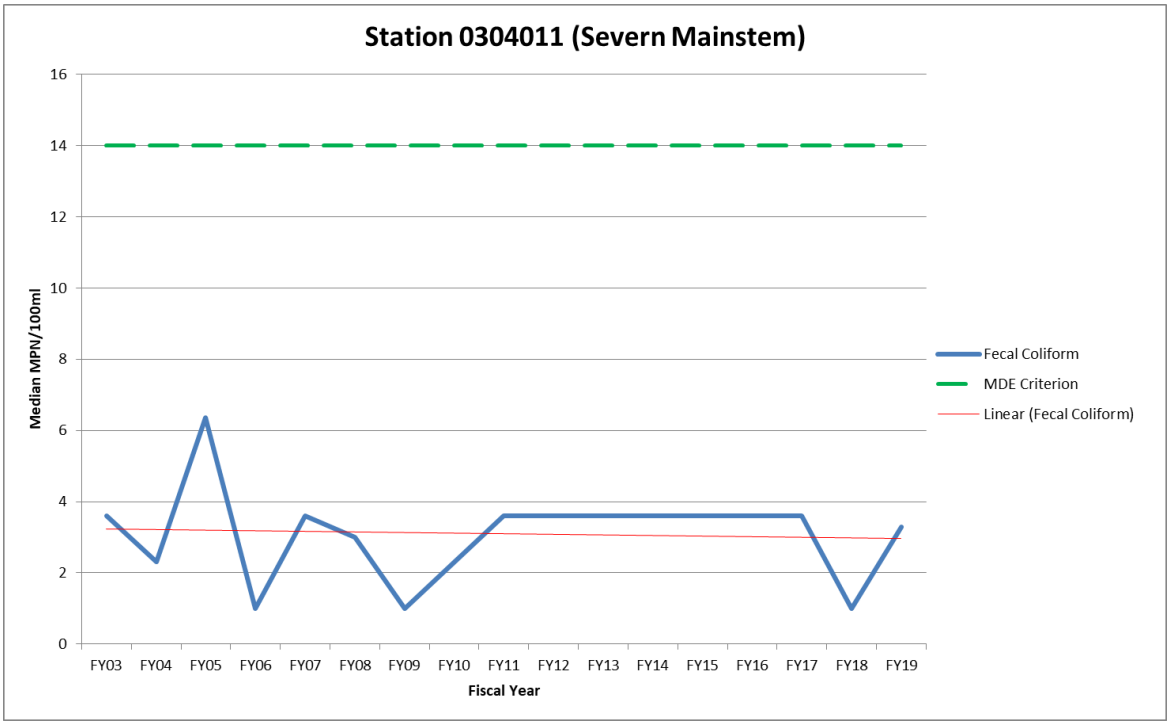

Station 0304152 (Severn Mainstem)
Median MPN/100ml
0
5
10
15
20
25
30
35
40
45
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

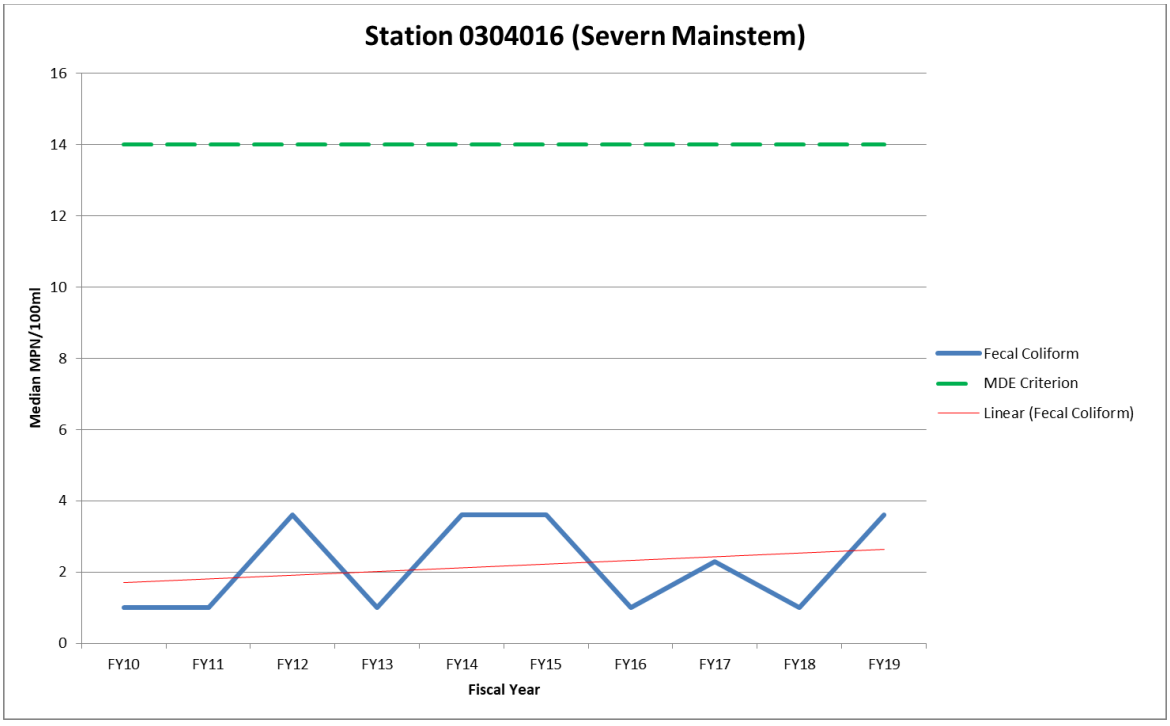

Station 0304150 (Severn Mainstem)
Median MPN/100ml
20
18
16
14
12
10
8
6
4
2
0
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

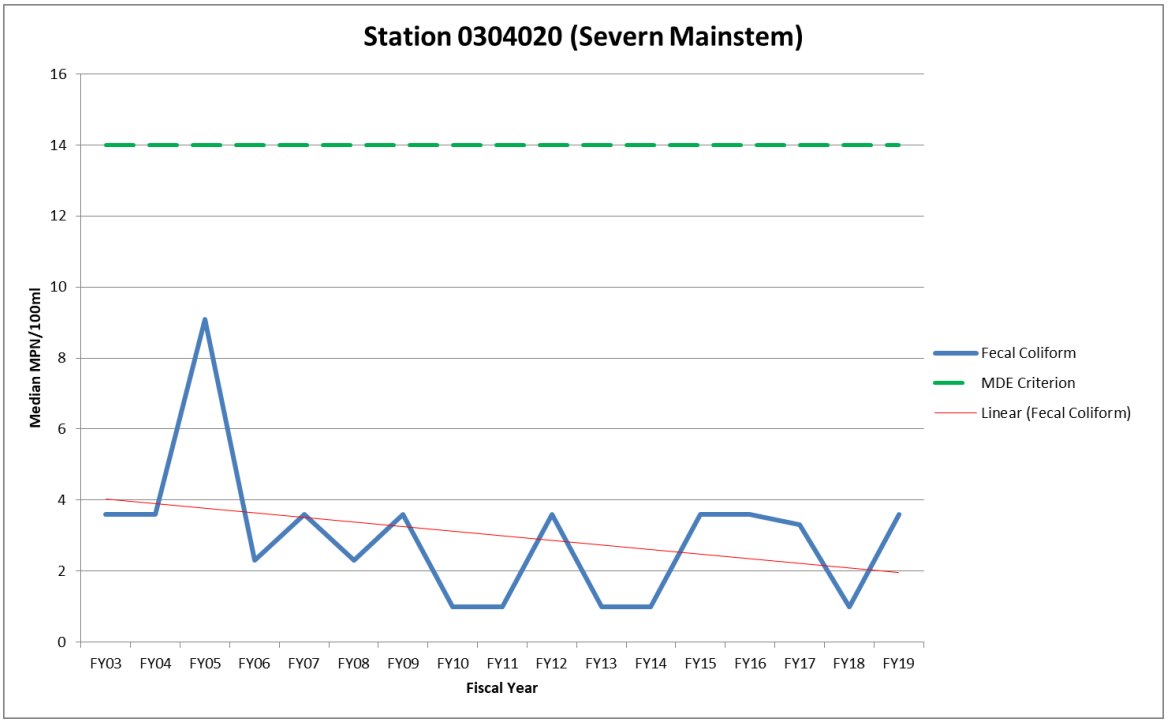

Station 0304002A (Severn Mainstem)
Median MPN/100ml
16
14
12
10
8
6
4
2
0
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

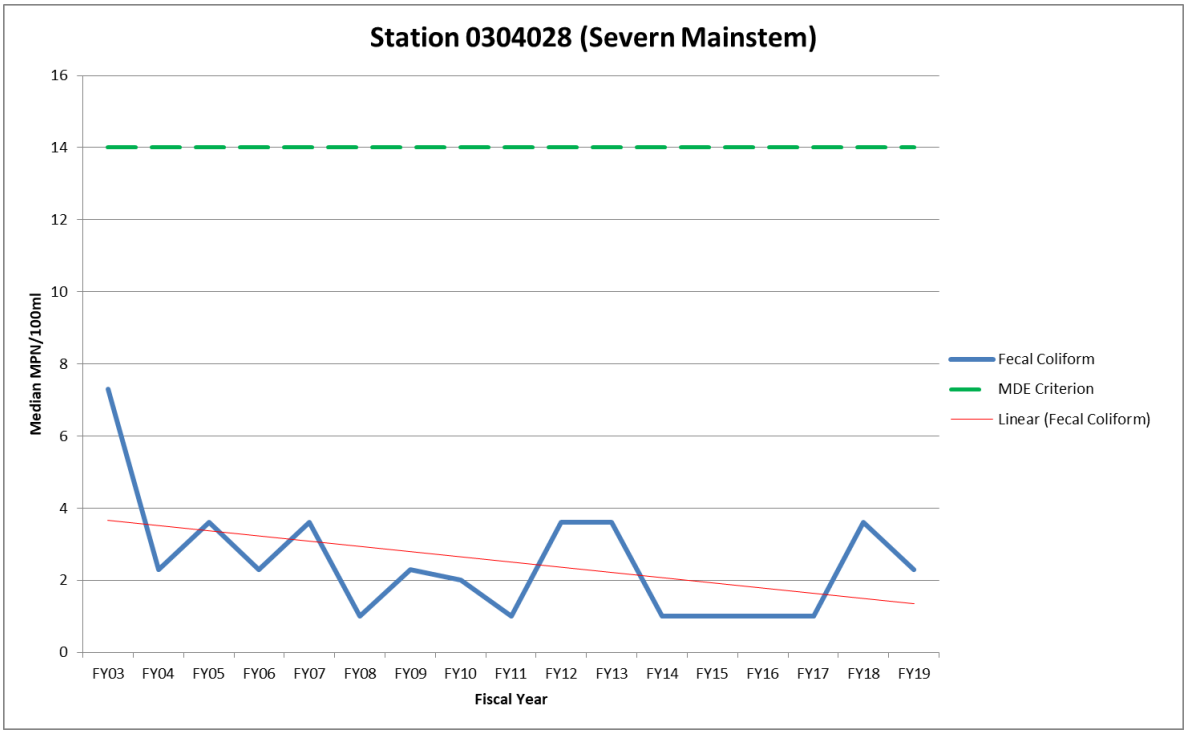

Station 0304005 (Severn Mainstem)
Median MPN/100ml
16
14
12
10
8
6
4
2
0
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

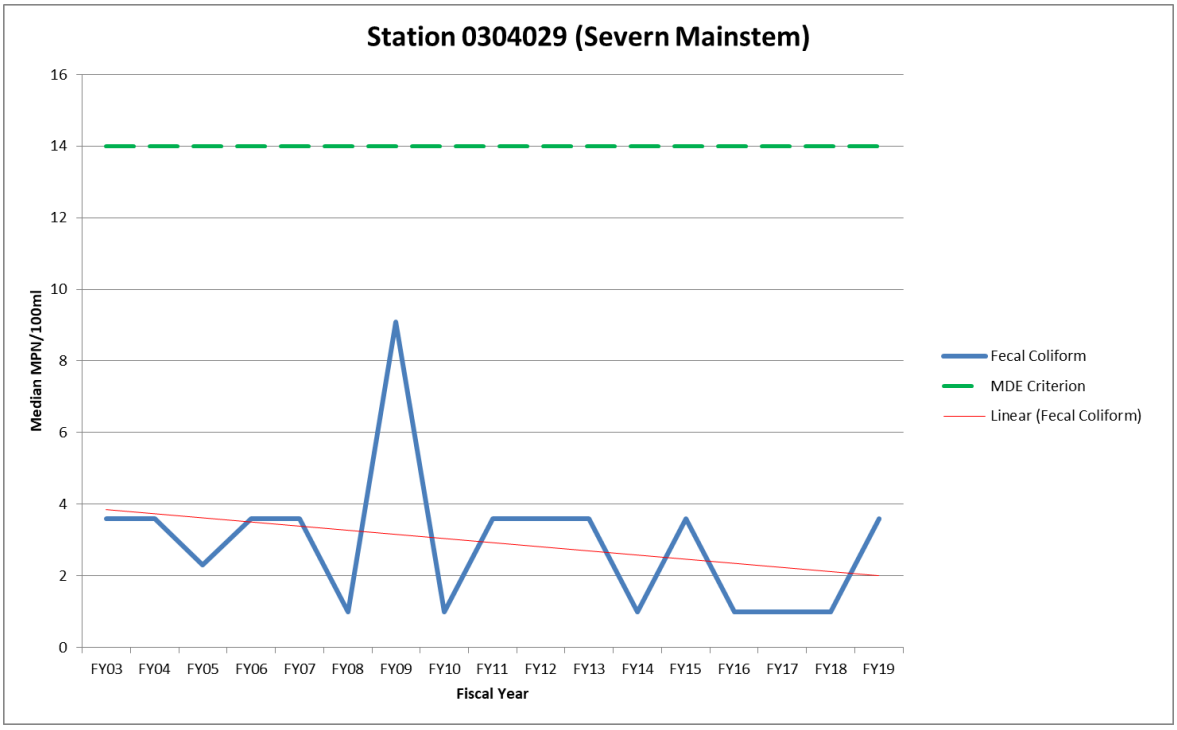

Station 0304008 (Severn Mainstem)
Median MPN/100ml
16
14
12
10
8
6
4
2
0
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

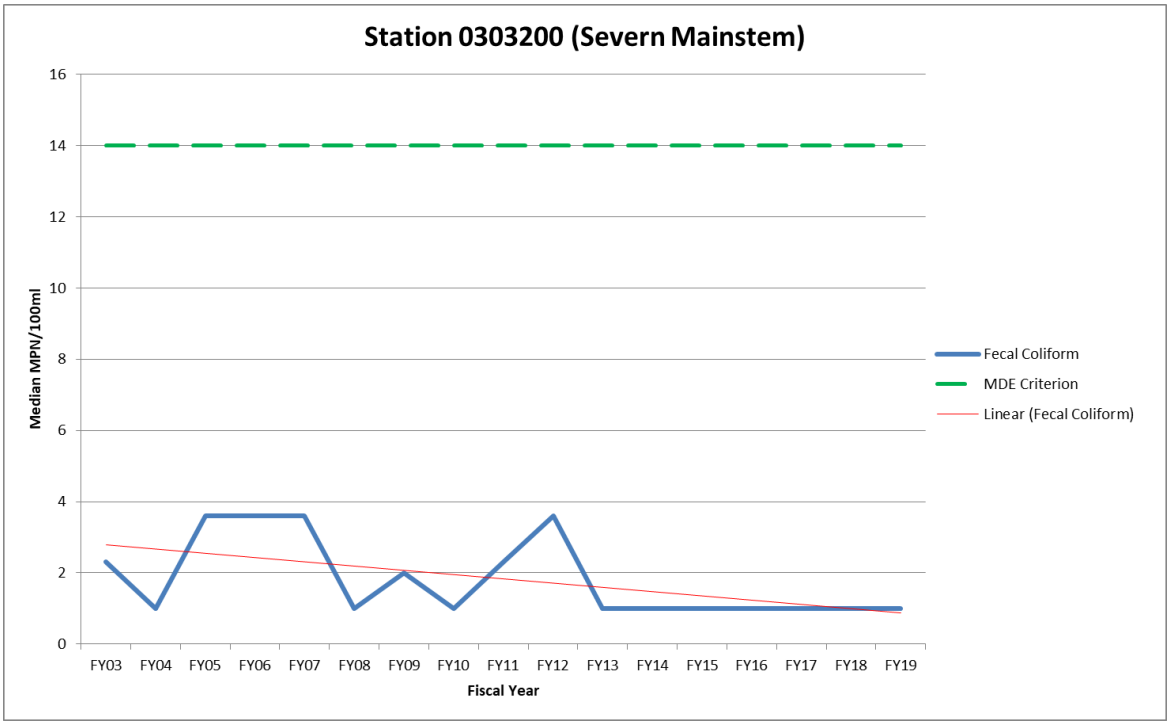

Station 0304011 (Severn Mainstem)
Median MPN/100ml
16
14
12
10
8
6
4
2
0
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

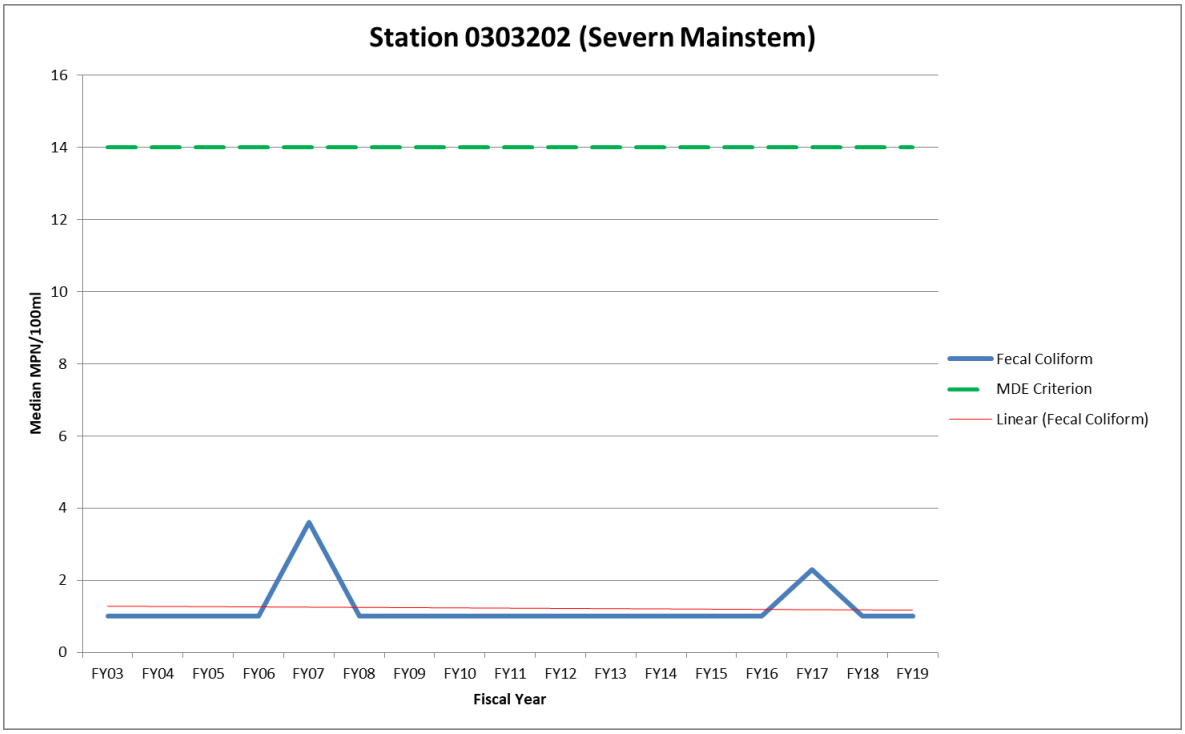

Station 0304016 (Severn Mainstem)
Median MPN/100ml
16
14
12
10
8
6
4
2
0
FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

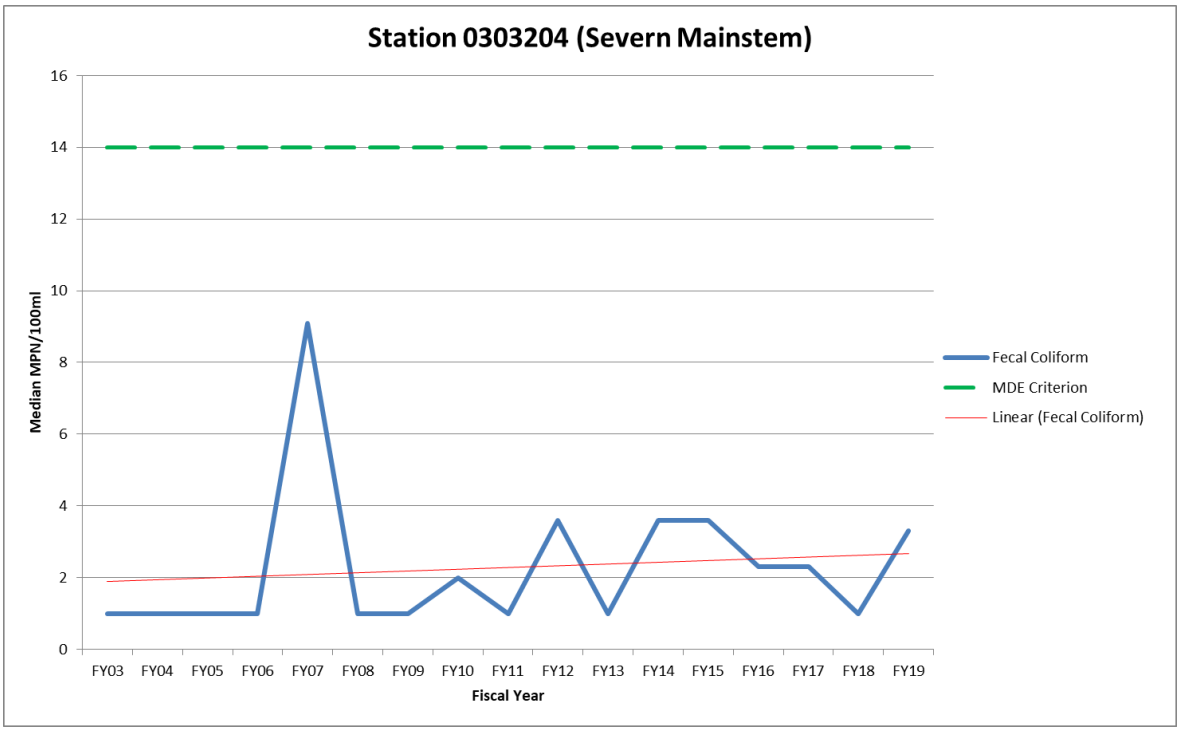

Station 0304020 (Severn Mainstem)
Median MPN/100ml
16
14
12
10
8
6
4
2
0
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

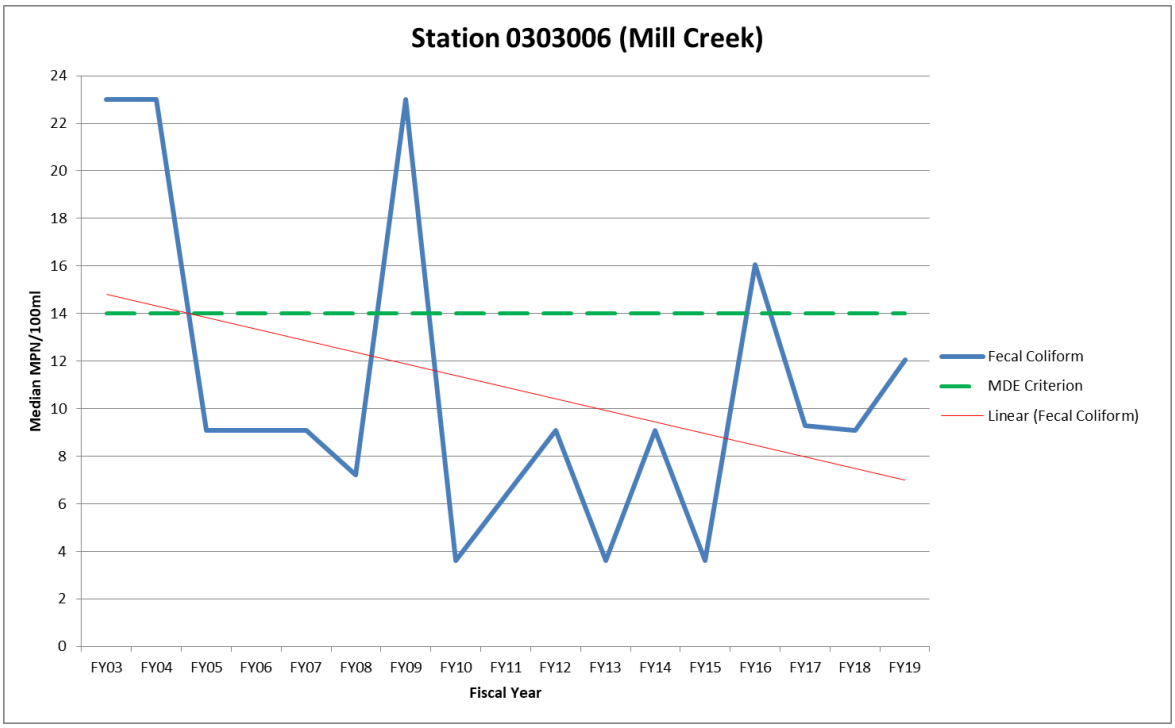

Station 0304028 (Severn Mainstem)
Median MPN/100ml
16
14
12
10
8
6
4
2
0
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

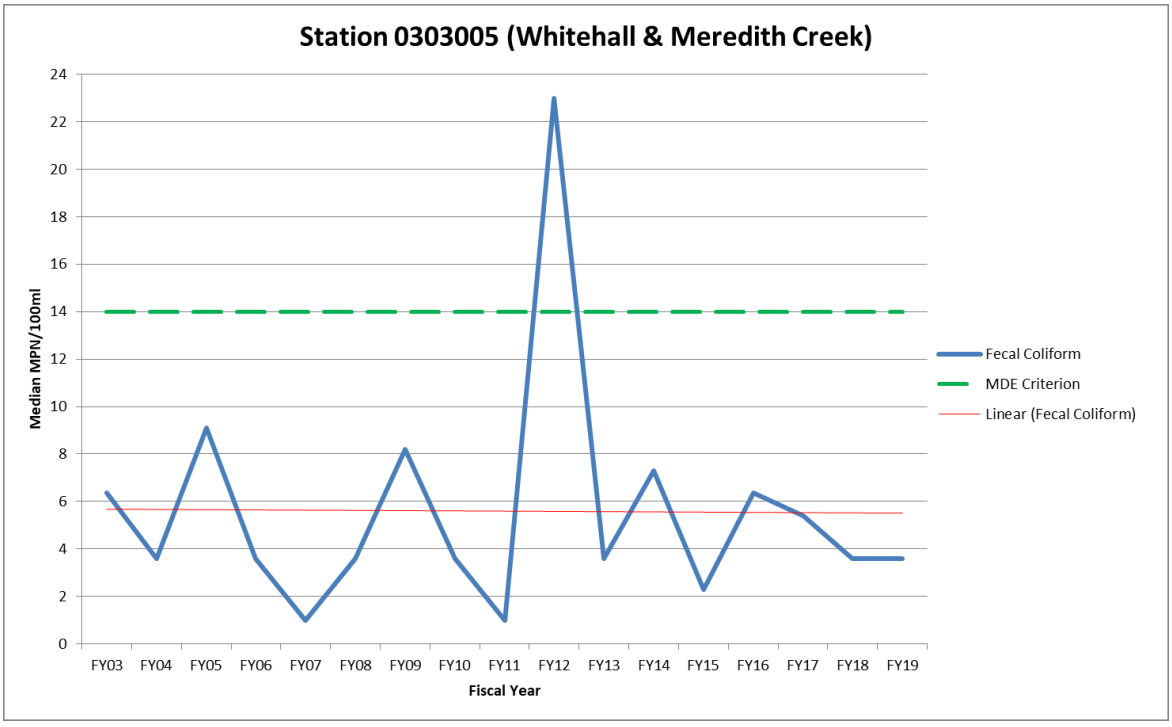

Station 0304029 (Severn Mainstem)
Median MPN/100ml
16
14
12
10
8
6
4
2
0
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

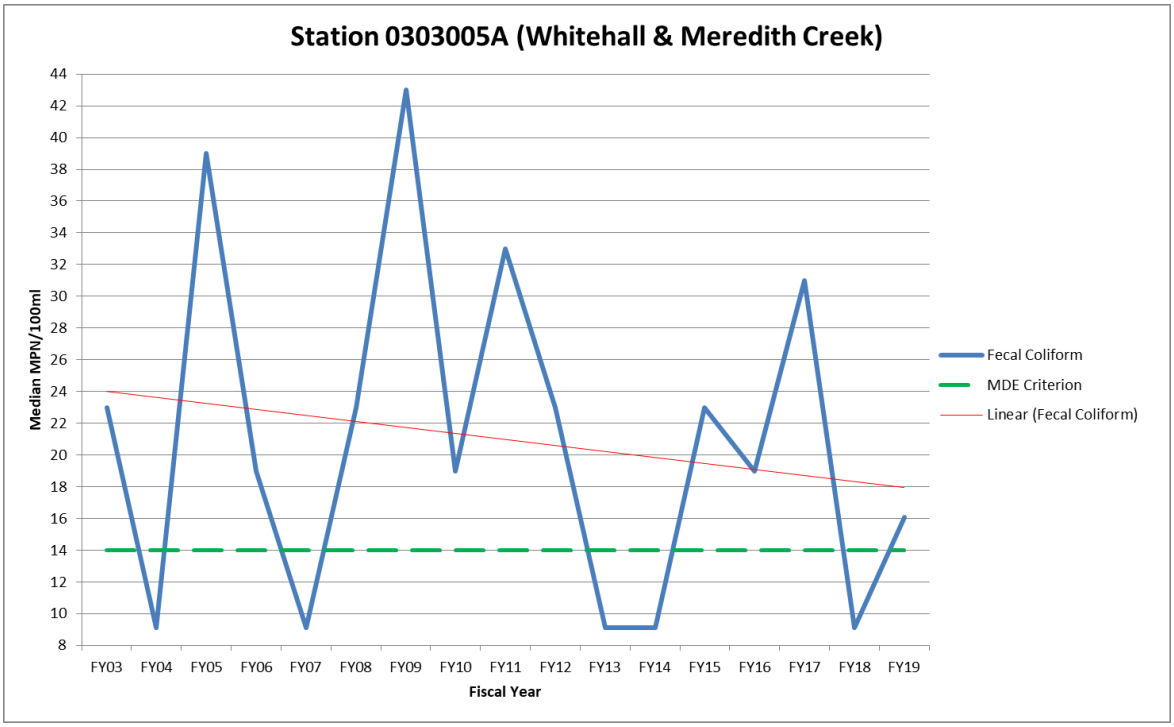

Station 0303200 (Severn Mainstem)
Median MPN/100ml
16
14
12
10
8
6
4
2
0
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

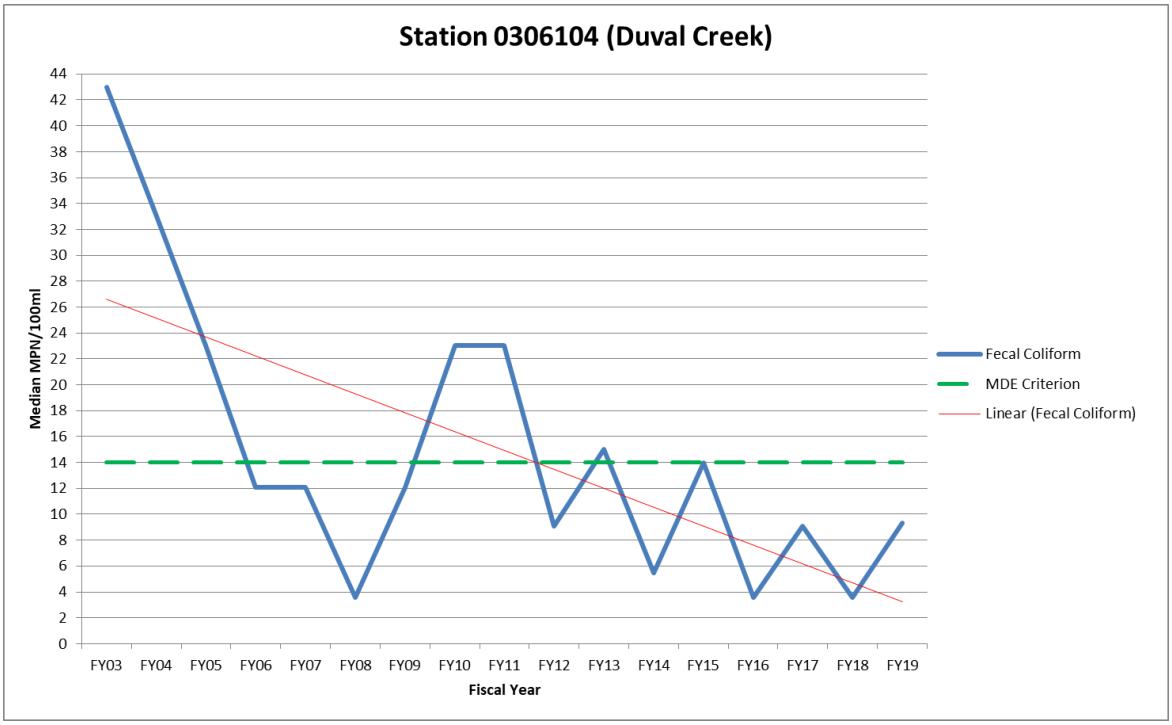

Station 0303202 (Severn Mainstem)
Median MPN/100ml
16
14
12
10
8
6
4
2
0
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

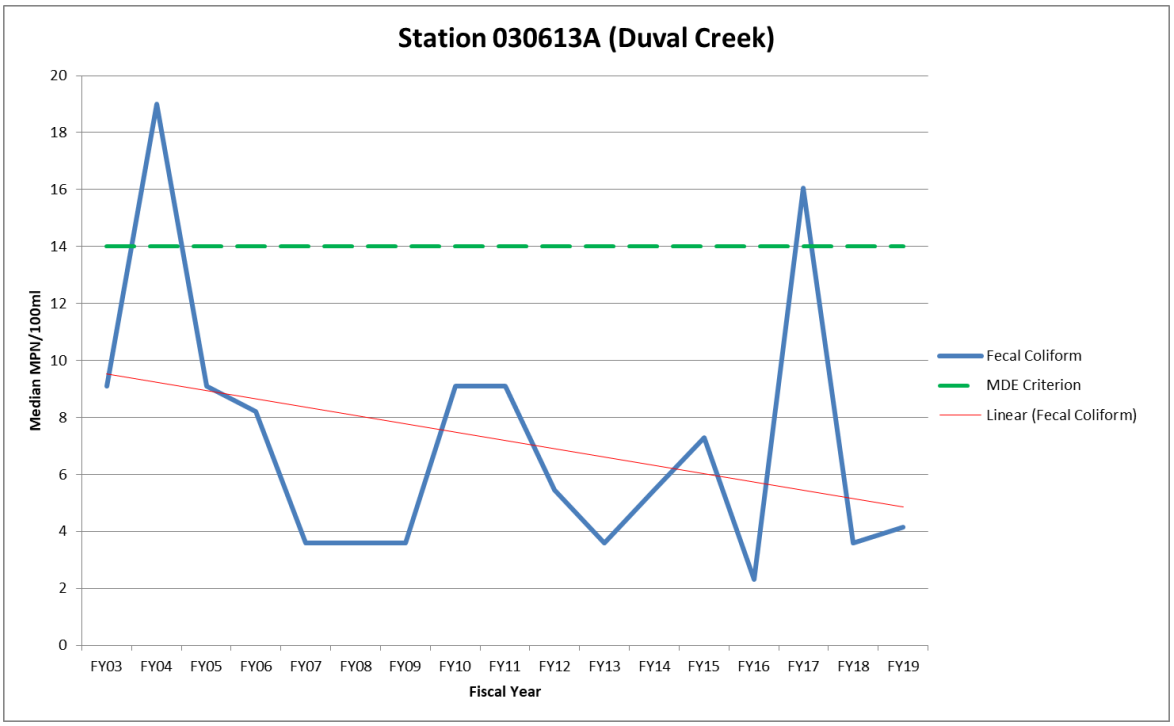

Station 0303204 (Severn Mainstem)
Median MPN/100ml
16
14
12
10
8
6
4
2
0
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

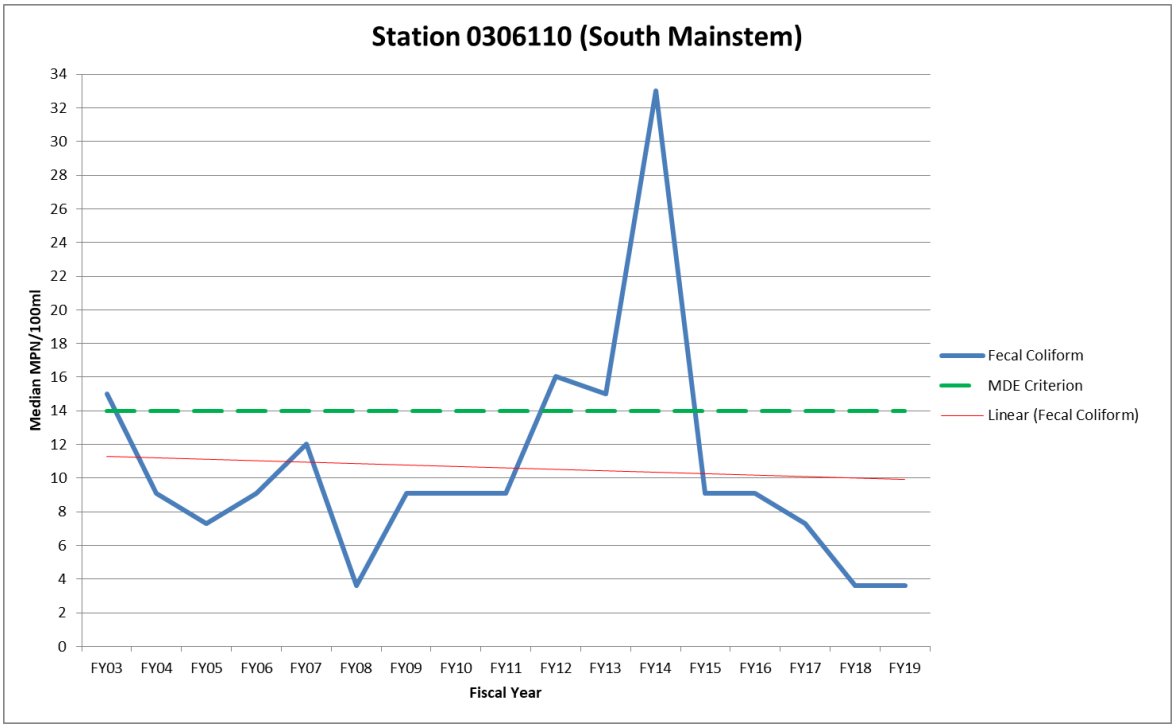

Station 0303006 (Mill Creek)
Median MPN/100ml
0
2
4
6
8
10
12
14
16
18
20
22
24
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

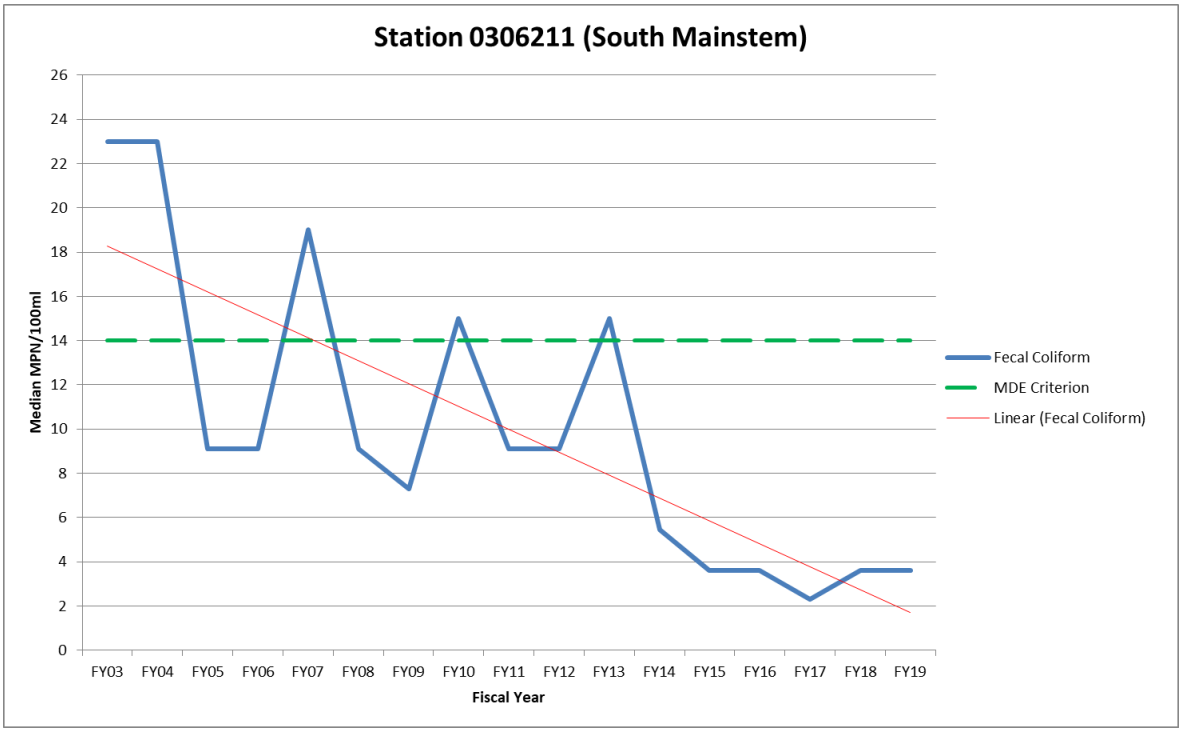

Station 0303005 (Whitehall & Meredith Creek)
Median MPN/100ml
0
2
4
6
8
10
12
14
16
18
20
22
24
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

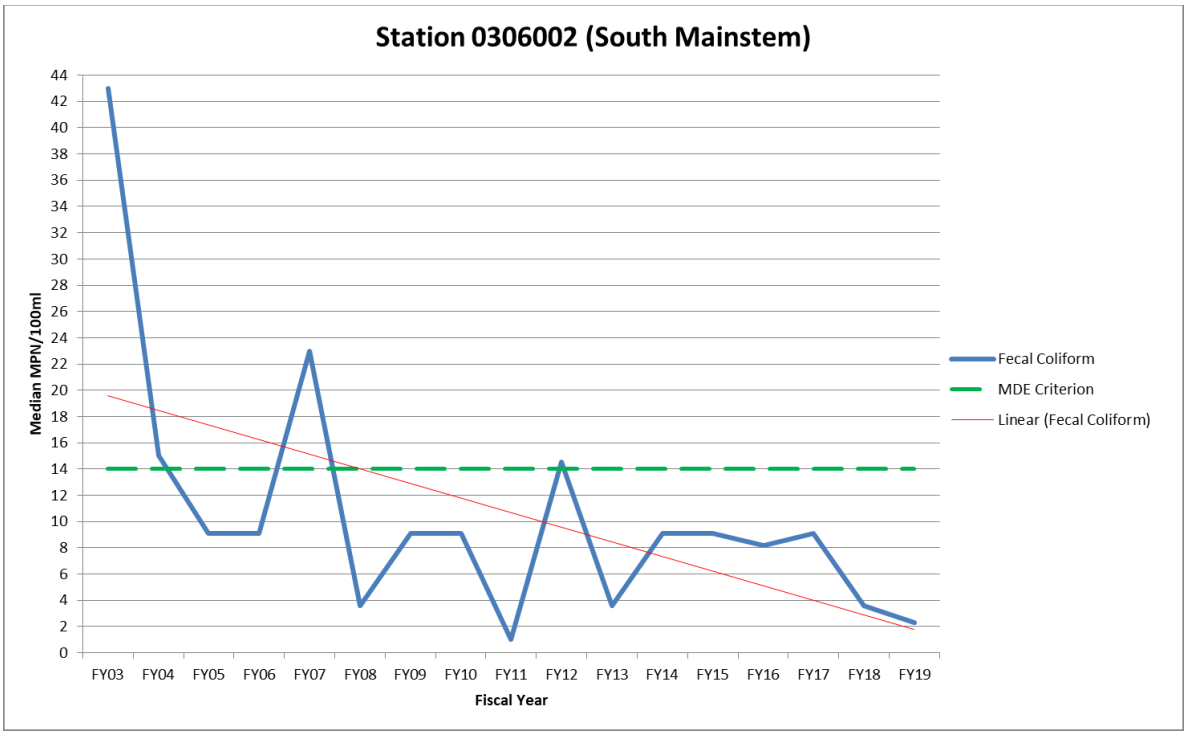

Station 0303005A (Whitehall & Meredith Creek)
Median MPN/100ml
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

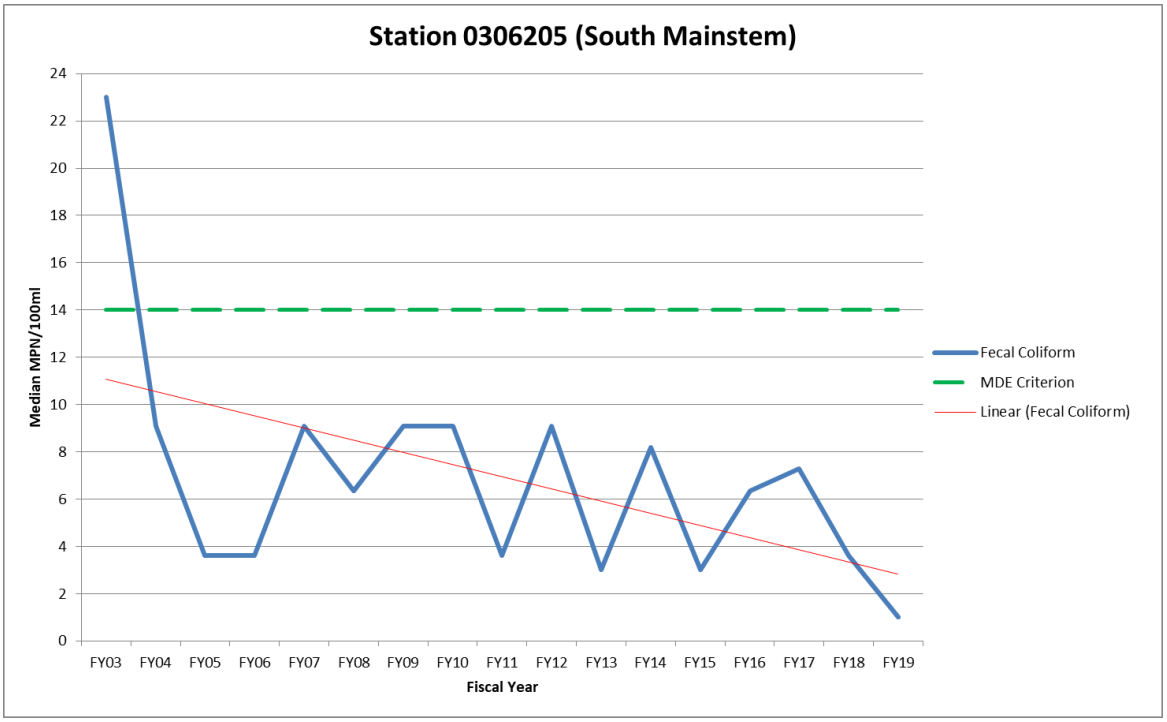

Station 0306104 (Duval Creek)
Median MPN/100ml
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

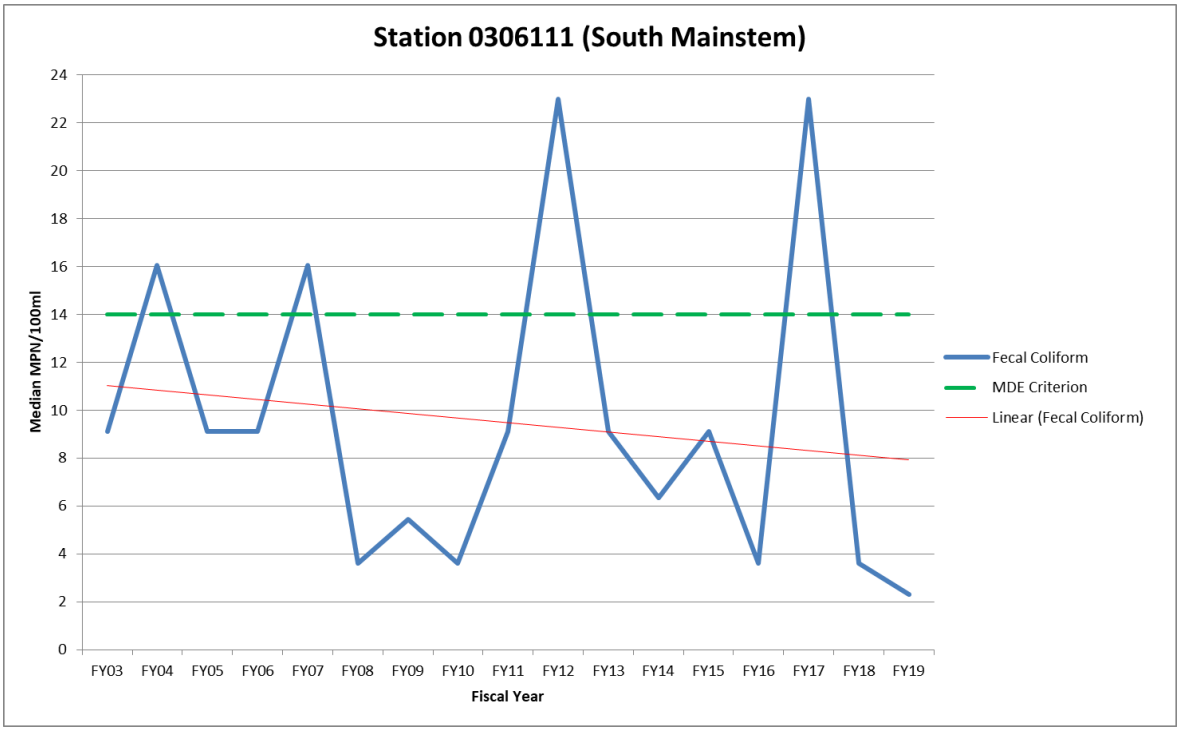

Station 030613A (Duval Creek)
Median MPN/100ml
0
2
4
6
8
10
12
14
16
18
20
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

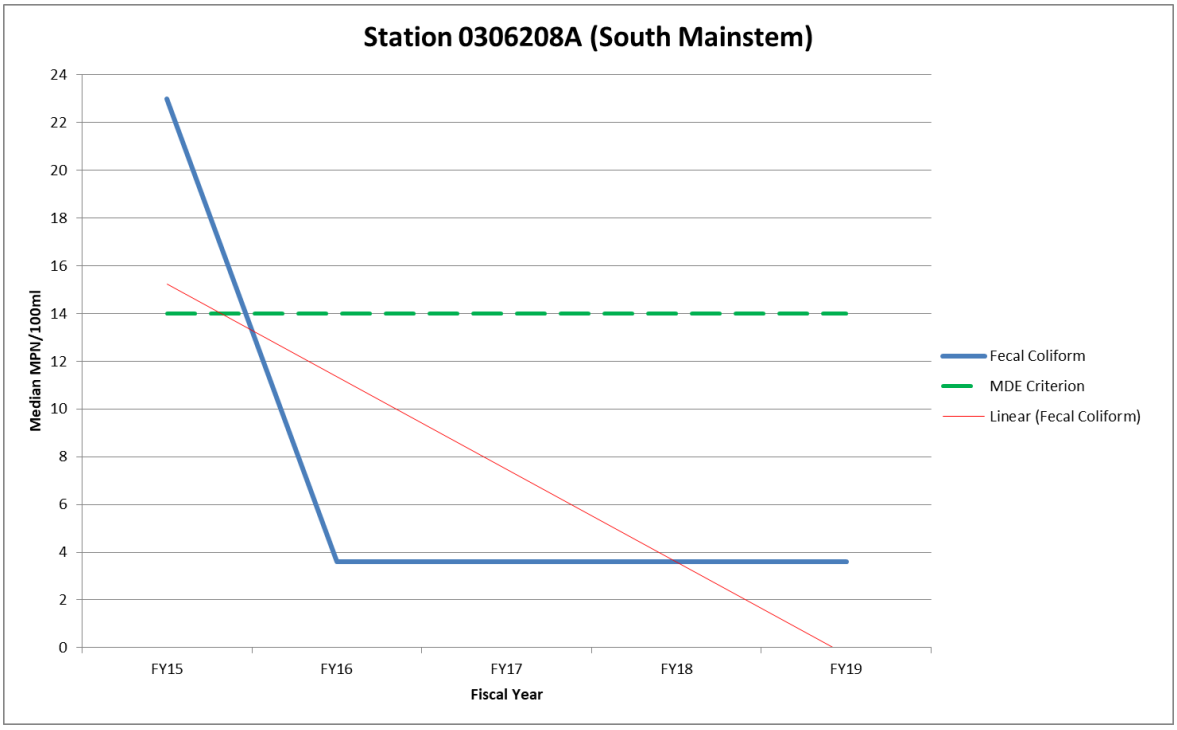

Station 0306110 (South Mainstem)
Median MPN/100ml
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

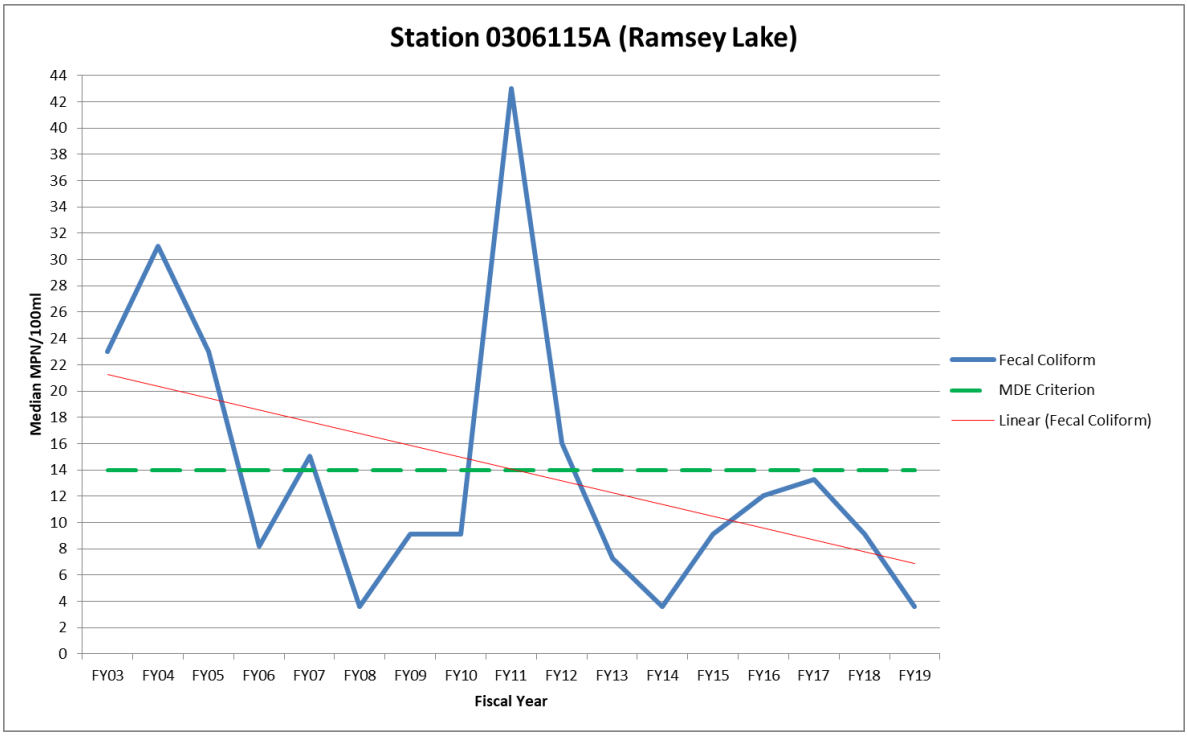

Station 0306211 (South Mainstem)
Median MPN/100ml
26
24
22
20
18
16
14
12
10
8
6
4
2
0
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

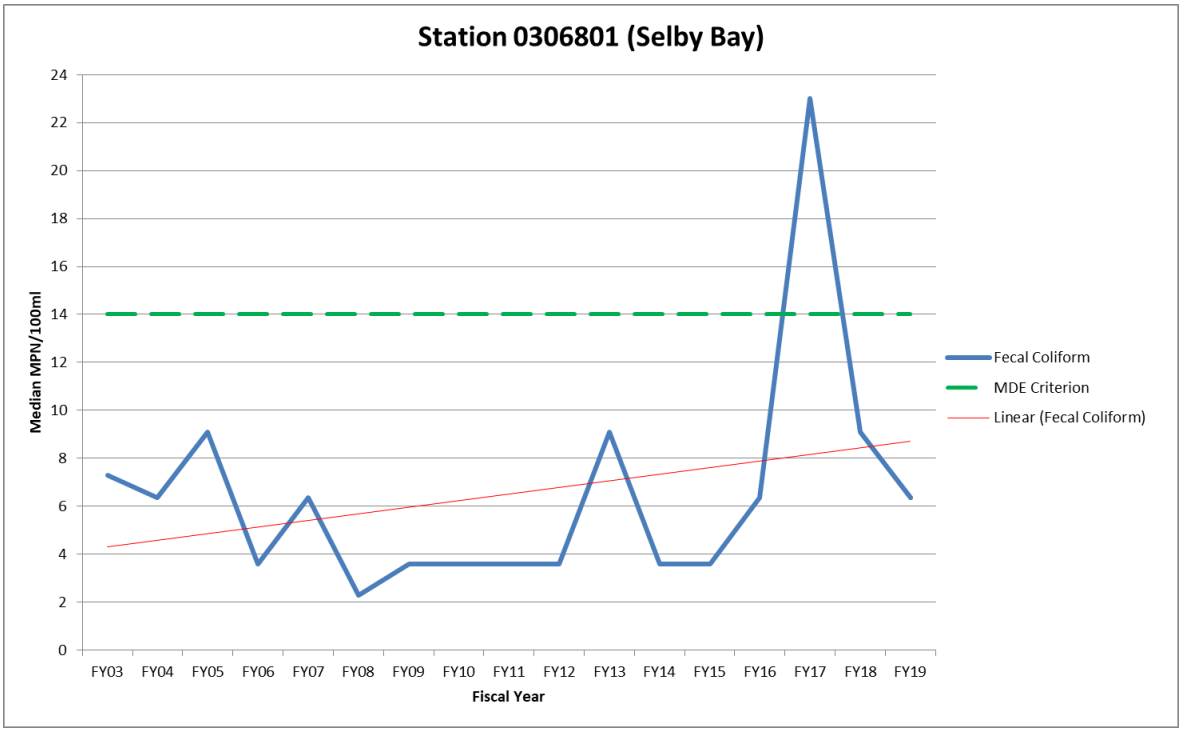

Station 0306002 (South Mainstem)
Median MPN/100ml
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

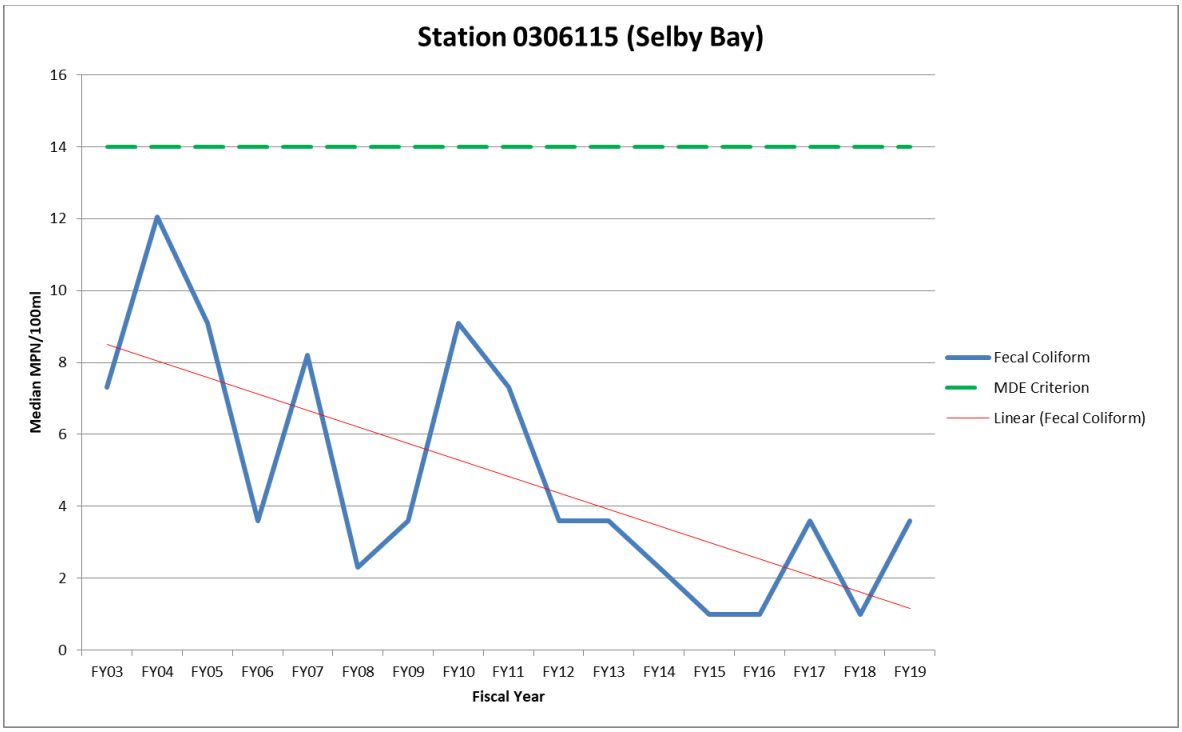

Station 0306205 (South Mainstem)
Median MPN/100ml
24
22
20
18
16
14
12
10
8
6
4
2
0
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

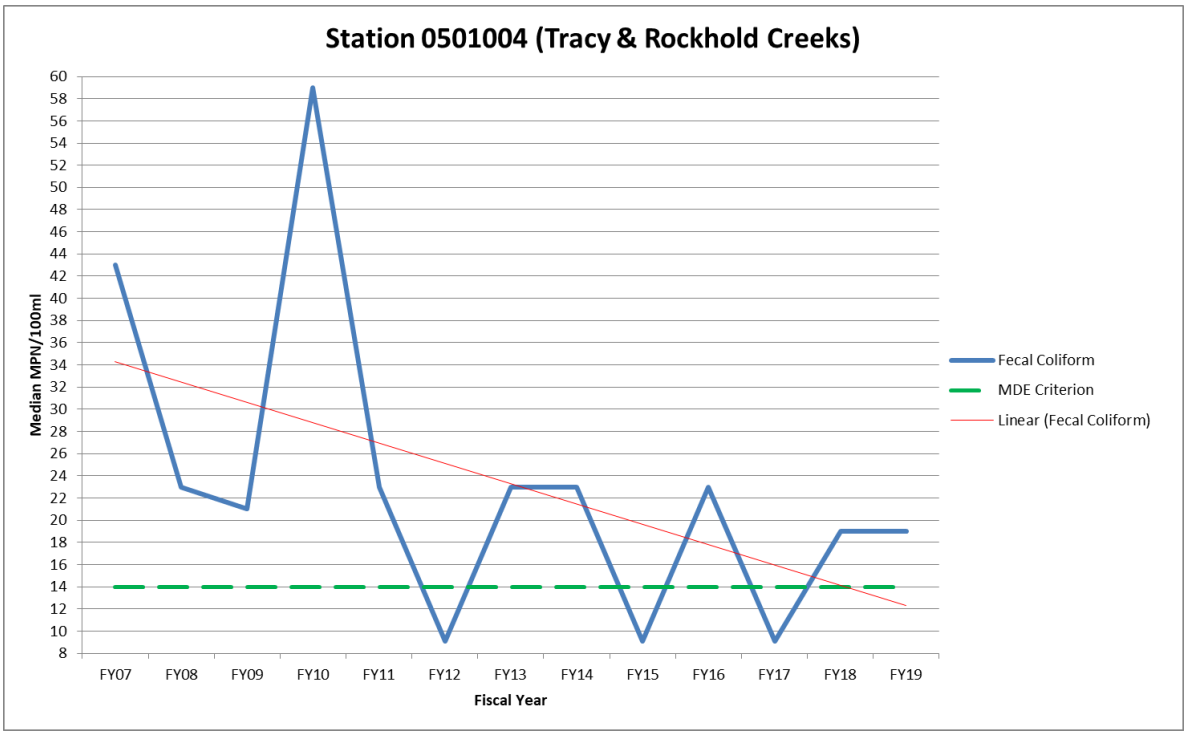

Station 0306111 (South Mainstem)
Median MPN/100ml
24
22
20
18
16
14
12
10
8
6
4
2
0
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

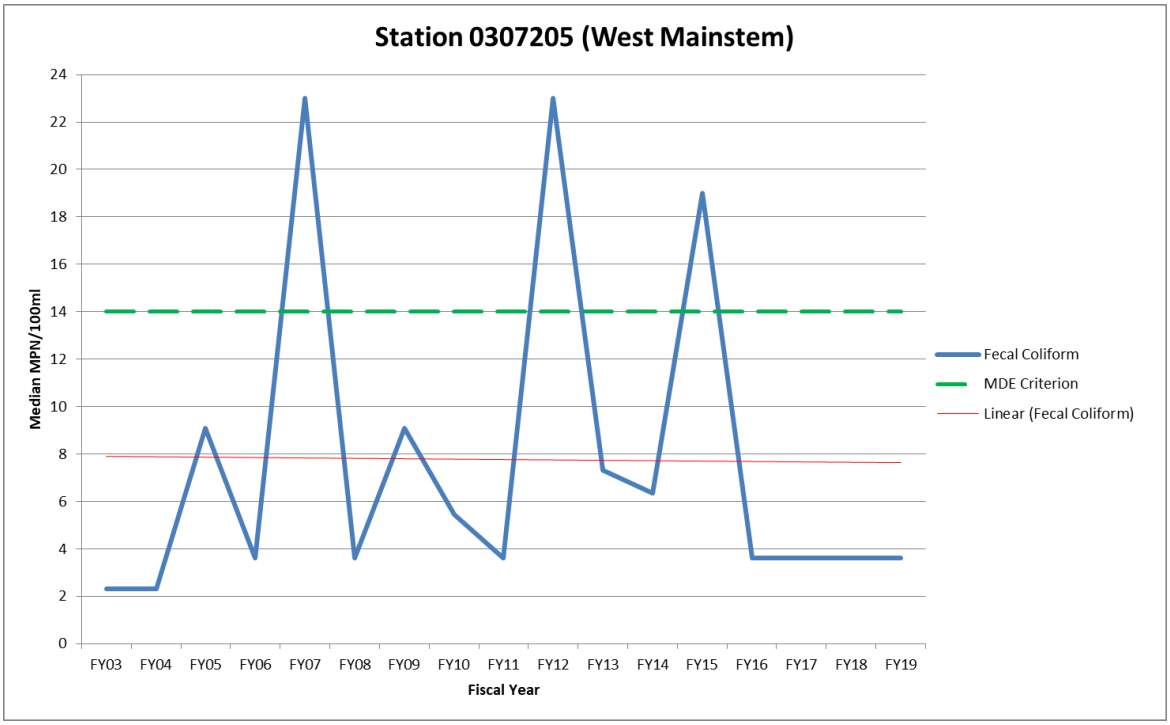

Station 0306208A (South Mainstem)
Median MPN/100ml
24
22
20
18
16
14
12
10
8
6
4
2
0
FY15
FY16
FY17
FY18
FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

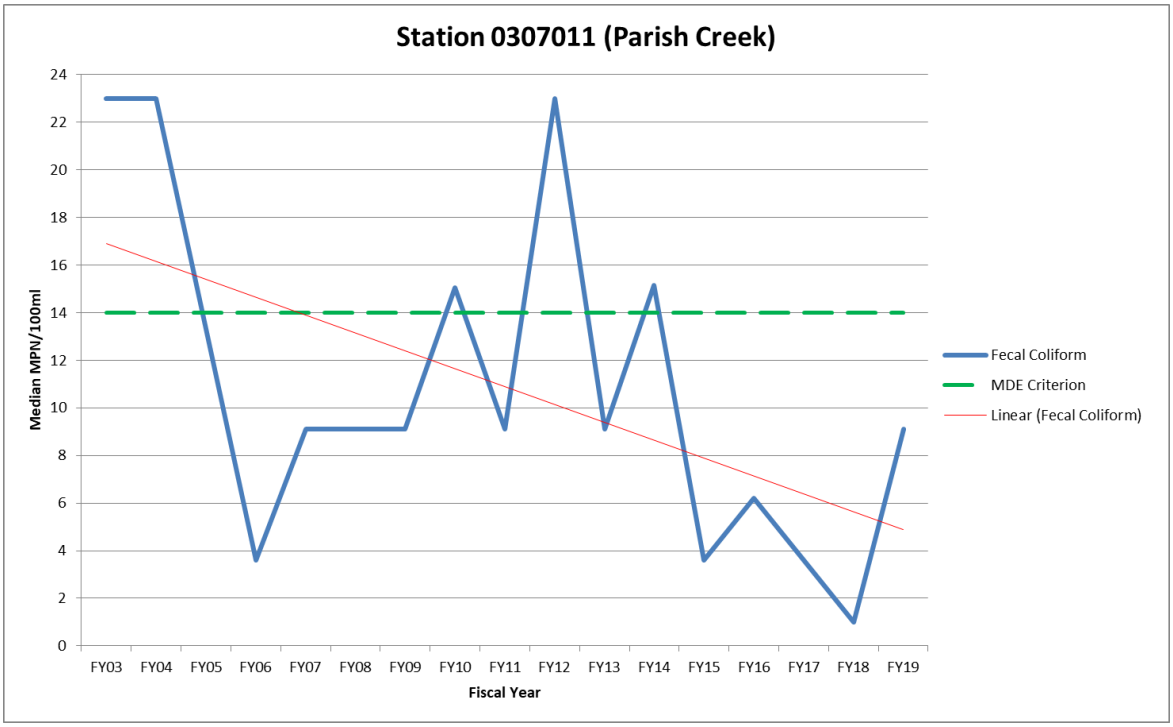

Station 0306115A (Ramsey Lake)
Median MPN/100ml
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
FY03
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
FY18
FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)


Station 0306801 (Selby Bay)
Median MPN/100ml
24
22
20
18
16
14
12
10
8
6
4
2
0
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)


Station 0306115 (Selby Bay)
Median MPN/100ml
16
14
12
10
8
6
4
2
0
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17 FY18 FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)


Station 0501004 (Tracy & Rockhold Creeks)
Median MPN/100ml
60
58
56
54
52
50
48
46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
FY18
FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)


Station 0307205 (West Mainstem)
Median MPN/100ml
24
22
20
18
16
14
12
10
8
6
4
2
0
FY03
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
FY18
FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)


Station 0307011 (Parish Creek)
Median MPN/100ml
24
22
20
18
16
14
12
10
8
6
4
2
0
FY03
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
FY18
FY19
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

Appendix D

Rhode River Water Quality Monitoring – 2018 Summary

Appendix E

Rhode River Water Quality Monitoring – 2019 Summary

Appendix F

MDE Observations on FY2018 Annual Bacteria TMDL Assessment Report and County Response

MDE did not provide comments to the County on the 2018 FY2018 Annual Bacteria TMDL Assessment Report.