Total Maximum Daily Load Restoration Plan for Bacteria

2017 Annual TMDL Assessment Report

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With support from:

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List of Tables

List of Figures

List of Appendices

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) 17, July 1, 2016 – June 30, 2017, by the County towards achieving the bacteria TMDL goals after one year of the development of the TMDL Restoration Plan. 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

During the 2017 reporting period, the County conducted targeted outfall sampling in Parole, Glen Burnie, Pasadena, and Southgate, which are located within the Furnace Creek, Marley Creek, and South River Mainstem watersheds. In 2017, the County evaluated 159 outfalls and confirmed that 5 outfalls had illicit connections. At the time of this progress assessment, final results of the 2017 evaluations are pending. From 2005 to 2017, 45 illicit connections were detected out of 1,954 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 2.3 percent, up from 2 percent as identified in the plan.

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 September 26, 2017) and are listed in Table 1. In addition to including the updated status and budget of the SPS projects listed in Table 4-2 of the Restoration Plan, Table 1 also includes new sanitary system improvement projects as identified by DPW. As shown in Table 1, from 2016 to 2017, the following pump stations were built or improved: Jennifer Road and Marley. The Mayo Collection System upgrade is ongoing, four projects are complete, and all other projects remain active.

In FY17, there were eight (8) sanitary sewer overflows (SSOs) reported in the County's TMDL watersheds, down from 17 in FY16. The net volume of spilled material in TMDL watersheds in FY17 was 3,770 gallons, down from 18,853 gallons in FY16. In 16 years of available data, both the lowest number of SSOs and the lowest net volume of spills across all TMDL watersheds were reported in FY17. Figure 1 shows the number of SSOs per year within all Anne Arundel County watersheds with bacteria-related TMDLs from FY02 through FY17.

Table 1. List of Discrete Sewage Pumping Station Upgrade Projects in the TMDL Watersheds (2015–2017)

Project	Project Title	Current Status	Description	TMDL Watershed	Qty. of Pump Stations Being Upgraded	Total Budgeted Costs[3]	Expended and/or Encumbered as of 9/26/2017
S804700	Mill Creek SPS Upgrade[2]	**Complete**	Various upgrades to the Mill Creek sewage pumping station	Magothy River Mainstem	1	$11,377,000	$11,343,025
S805400	Marley SPS Upgrade[2]	Active	Construction of various upgrades to Marley Sewage Pumping Station to improve operation and reliability	Patapsco River/Marley Creek	1	$4,329,000	$4,101,883
S804900	Parole SPS Upgrade[2]	**Complete**	Construction of miscellaneous improvements to the Parole Sewage Pumping Station to increase operation and reliability	South River Mainstem	1	$491,702	$486,177
S799200	Mayo Collection Sys Upgrade[2]	Ongoing	Expansion of Mayo Wastewater Collection and Conveyance System to accommodate planned growth within Mayo Sewer service area	Rhode River/Cadle Creek	18	$7,222,829	$5,226,336
S804000	Sylvan Shores PS Upgrade	**Complete**	Construction of improvements to Sylvan Shore Sewage Pumping Station to improve reliability and efficiency of system	South River Mainstem	1	$3,718,000	$3,717,286

S806200	SPS Fac Gen Replacement	Active	Generator replacement (Phase 5 contract)	Magothy River Mainstem, Patapsco River LNB, South River/Duvall Creek	6	$25,434,000[4]	$12,194,809
S806200	SPS Fac Gen Replacement	Active	Generator replacement (Design 1 and Phase 6 contracts)	Patapsco River LNB, Baltimore Harbor, Stony Creek, Rock Creek	8	$25,434,000[4]	$5,826,661
S806200	SPS Fac Gen Replace	Active	Generator replacement (Design 2 and Phase 7 contracts)	Unknown	multiple	$25,434,000[4]	$3,325,716
S806200	SPS Fac Gen Replace	Active	Generator replacement/CMI services at all sites	Multiple	multiple	$25,434,000[4]	$455,214
S805300	Cinder Cove SPS Mods[2]	Active	Pump station reliability improvements necessary to minimize risks of sanitary sewer overflows	Patapsco River / Furnace Creek	1	$10,564,000	$7,568,738
S806300	Big Cypress SPS Retro[2]	**Complete**	Upgrades to Big Cypress sewage pump station	Magothy River Mainstem	1	$2,755,000	$2,754,968
S804200	Riva Woods SPS Upgrades	**Complete**	Design/construct improvements to Riva Woods SPS	South River Mainstem	1	$1,180,500	$1,177,722
S804300	Jennifer Road SPS Upgrade[2]	Active	Upgrades to Jennifer Rd sewage pump station; pump station force main replacement	Severn River Mainstem	1	$10,140,000	$8,580,530
X7388000	Sewer Main Replace/Recon[2]	Active	Maintenance and replacement of sewer main lines countywide	Countywide	0	$52,460,582	$44,327,829

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	$9,169,720
S797800	Furnace Barn Sewer Replacement[2]	Active	Construct a new sewer line under Sawmill Creek	Patapsco River / Furnace Creek	0	$154,000	$52,899
S804500	Pasadena Elementary School (ES) Sewer[2]	**Complete**	Design and construction of a sewage pump station	Severn River Mainstem	1	$1,682,000	$1,682,000
S799000	Ridgeview SPS/FM[2]	**Complete**	Construction of a drywell/wetwell sewage pump station, approximately 2,800 linear feet of 16" force main and 5,800 linear feet of gravity interceptor	Magothy River Mainstem	1	$8,126,000	$8,103,952
S792900	Cayuga Farms PS/FM[2]	**Complete**	Construction of 7,700 feet of interceptor sewer. Design/construct pump station.	Severn River Mainstem	1	$3,401,804	$3,250,432
S806900	Rolling Knolls ES Sewer Extension[1]	Active	Design and construction of sanitariy sewer extension to accommodate new elementary school	South River Mainstem/Severn River Mainstem	0	$3,757,700	$3,431,599
				Total	**43**	**$235,595,117**	**$136,777,496**

[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, as well as projected appropriation requests for FY2017 through FY2021.

[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 bacteria TMDL watersheds; therefore, total project costs are listed.

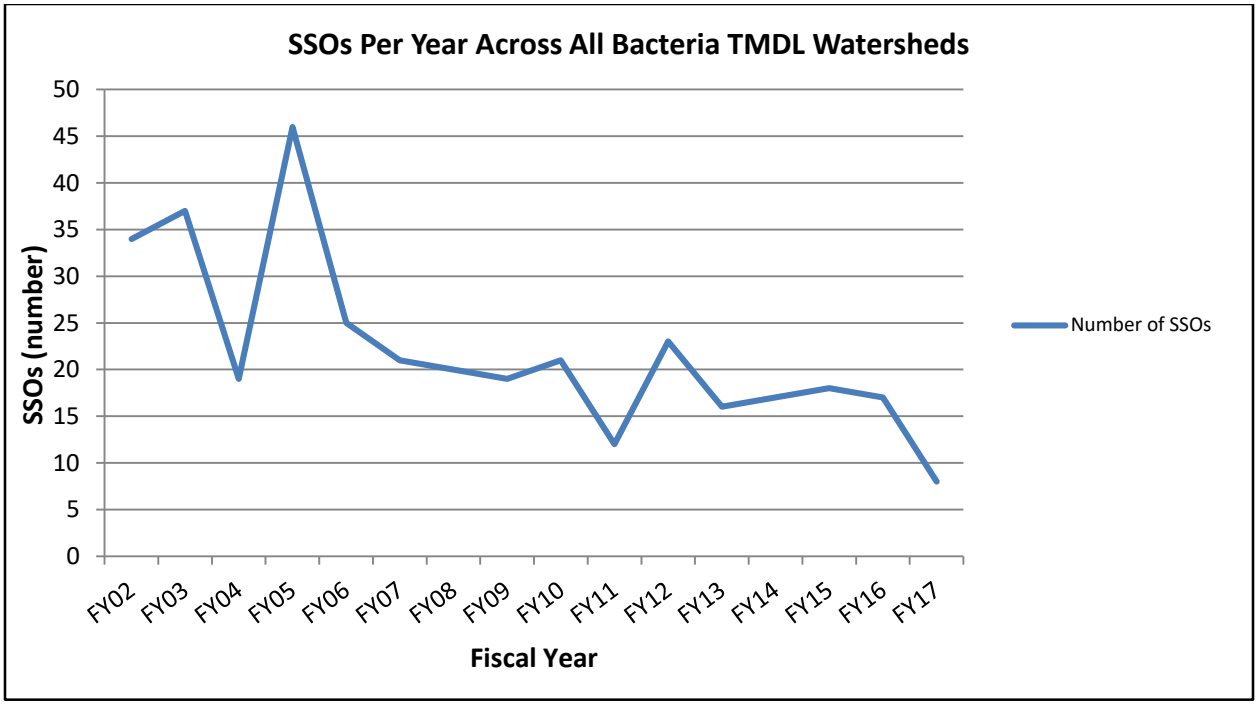

Figure 1. Number of SSOs per year across all Bacteria TMDL watersheds, FY02 – FY17.

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

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 15 On-Site Disposal Systems (OSDS) 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 2017, the County has averaged 20 retired OSDS per year within TMDL watersheds. An additional 14 OSDS were retired in non-TMDL watersheds over that same time period. The County is currently on track with the number of OSDS systems proposed to be retired annually in the TMDL Restoration Plan.

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. Though not identified as a goal in the Restoration Plan, the County has also undertaken an 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. 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.

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 2). 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) will require the construction of regional sewage pumping stations for connection to the sanitary sewer system. Six (6) of the HDPAs (Edgewater Beach North, Laurel Acres, Edgewater Beach South, Palisades on the Severn, Chelsea Beach, and Amberly) are located within the floodplain.

Table 2. Health Department Priority Areas (HDPAs) in watersheds with bacteria-associated TMDLs

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
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

The County has initiated the process of hiring consultants who would assist in implementing the OSDS conversion or retirement program. Targeted approaches such as community-based and/or watershed-based approaches are being considered for implementation. Successful implementation of this program would reduce bacteria loads from OSDS. In February 2017, the 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 include developing recommendations that will inform decision making, and identifying short term strategies and long term approaches to reducing septic system loads. The

task force met monthly from February to July in 2017, with future meeting dates to be determined.

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). As of the time of this report, cost-benefit aspects and policy outcome impacts of the individual projects are still being assessed. The study is due to be completed by March 30, 2018.

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

Fifty-one (54) projects are identified to be complete from 2016 to 2017 within the watersheds with bacteria impairment. 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 Table 3 below. This information was entered into the proposed conditions Center for Watershed Protection's (CWP) Watershed Treatment Model (WTM; Caraco 2013) to estimate the bacteria load reductions that would be attained from implementing this strategy. 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, Table 3 also includes new stormwater management projects planned by the County in the bacteria impaired watersheds.

Table 3: County CIP Urban Stormwater Retrofit Projects Proposed in the Bacteria TMDL Watersheds through FY17.

Project #	Project Name	Proposed Project	BMP Classification	Bacteria TMDL Watershed	Drainage Area Treated (acres)	Impervious Area Treated (acres)	Bacteria Removal Efficiency (percent)	Status as of January 2018	FY
B552402	Pinewood Road and Sycamore Road	SPSC	SPSC	Magothy River Mainstem	26.72[2]	7.79[2]	70	Complete	FY16
B552901	Tarks Lane	Wet Pond[3]	Retention Pond[3]	Magothy River Mainstem	25.9[2]	5.51[2]	70	Complete	FY15
B552901	Copperwood Drive	Wet Pond and SPSC	SPSC	Magothy River Mainstem	7.58[2]	2.89[2]	70	Complete	FY15
B552901	Lahinch Drive	Wet Pond[3]	Retention Pond[3]	Magothy River Mainstem	35.03[2]	7.66[2]	96	Complete	FY15
B552901	Collington Court	Wet Pond	Retention Pond	Magothy River Mainstem	37.41[2]	6.82[2]	70	Complete	FY15
B552901	Mayfield Road at Gladnor Road[4]	Wet Pond	Retention Pond	Magothy River Mainstem	6.18[2]	2.66[2]	70	Complete	FY15
B552901	Amesbury Court	Wet Pond	Retention Pond	Magothy River Mainstem	35.55[2]	4.88[2]	70	Complete	FY15
B552901	Longfellow Drive	Wet Pond and SPSC[3]	Retention Pond and SPSC	Magothy River Mainstem	17.62[2]	4.39[2]	70	Complete	FY15
B552901	262 Finnegan Drive	Wet Pond[3]	Retention Pond[3]	Magothy River Mainstem	7.2[2]	2.23[2]	70	Complete	FY15
B552901	103 Evon Court	Wet Pond	Retention Pond	Magothy River Mainstem	8.9[2]	2.85	70	Complete	FY15
B552901	240 Waycross Way	Wet Pond	Retention Pond	Magothy River Mainstem	45.5[2]	12.82	70	Complete	FY15
B552901	Colleen Garden Lane Pond 2	Wet Pond	Retention Pond	Magothy River Mainstem	3.0[2]	1.1[2]	70	Complete	FY15
B552901	Earliegh Heights B and A Trail	Wet Pond	Retention Pond	Magothy River Mainstem	12.9[2]	3.7[2]	70	Complete	FY15
B552901	Colleen Garden Lane Pond 1	Wet Pond	Retention Pond	Magothy River Mainstem	21.1[2]	5.6[2]	70	Complete	FY15
B552904	109 Chelsea Grove Court	Wet Pond with Micropool	Micropool Extended Detention Pond	Magothy River Mainstem	13.1[2]	2.8[2]	70	Complete	FY16
B552904	8013 Tickneck Road	Wet Pond	Retention Pond	Magothy River Mainstem	52.7[2]	23.1[2]	70	Complete	FY16
B552904	603 Deering Road	Wet Pond with Micropool	Micropool Extended Detention Pond	Magothy River Mainstem	50.1	23.1[2]	70	Complete	FY16
B552904	725 Bridge Drive	Wet Pond	Retention Pond	Magothy River Mainstem	3.9[2]	1.1[2]	70	Complete	FY16

Project #	Project Name	Proposed Project	BMP Classification	Bacteria TMDL Watershed	Drainage Area Treated (acres)	Impervious Area Treated (acres)	Bacteria Removal Efficiency (percent)	Status as of January 2018	FY
B552904	244 Kennedy Drive	Wet Pond with Micropool	Micropool Extended Detention Pond	Magothy River Mainstem	2.3[2]	0.9[2]	70	Complete	FY16
D499946	Anne Arundel Community College	Wet Pond	Retention Pond	Magothy River Mainstem	15.1[2]	12.8[2]	70	Complete	FY16
D499947	Anne Arundel Community College	Stream Restoration-SPSC	Retention Pond	Magothy River Mainstem	No Data	8.71	70	Complete	FY16
D499947	Anne Arundel Community College	Bioretention	Bioretention	Magothy River Mainstem	7.7[2]	6.6[2]	70	Complete	FY16
B552003	Will-o-Brooke Drive	SPSC	SPSC	Magothy River Mainstem	4.7	1.49	70	Planning	FY17
B552005	Old Mill Road Outfall Stabilization[1]	SPSC	SPSC	Magothy River Mainstem	15.1	1.8	70	Planning	FY19
NGO	Randall Road Bioretention[1]	Bioretention	Bioretention	Magothy River Mainstem	1.5	0.4	70	Planning	FY18
B552003	Upper Mill Creek Stream Restoration BMP 824[1]	SPSC	SPSC	Magothy River Mainstem	22.6	4.5	70	Planning	FY20
D499942	Cypress Creek Park and Ride Bioretention[1]	Bioretention	Bioretention	Magothy River Mainstem	6.5	3.8	70	Complete	FY12
D499942	Cypress Creek Park and Ride Bioretention[1]	Bioretention	Bioretention	Magothy River Mainstem	0.8	0.5	70	Complete	FY12
D499943	Dunkeld Manor SWM Retrofit[1]	SPSC	SPSC	Magothy River Mainstem	18.3	7.6	70	Complete	FY12
	Grosvenor Lane Bioretention[1]	Bioretention	Bioretention	Magothy River Mainstem	4.1	0.6	70	Complete	FY15
	Sylvan Avenue Pond Retrofit[1]	Wet Pond	Retention Pond	Magothy River Mainstem	10.4	4.7	70	Complete	FY14
	Sylvan Avenue Pond Retrofit#2[1]	SPSC	SPSC	Magothy River Mainstem	N/A	N/A	70	Complete	FY14
B555302	Riverside Park	SPSC[3]	SPSC[3]	Patapsco River LNB	8.27[2]	4.55[2]	70	Planning	FY18
B555302	Brooklyn Middle School	Infiltration Trench[3]	Infiltration Trench[3]	Patapsco River LNB	7.01[2]	2.80[2]	96	Planning	FY19
B555602	806 Central Avenue, Linthicum	Wet Pond	Retention Pond	Patapsco River LNB	1.53[2]	1.01[2]	70	Complete	FY16
B555701	Behind 419 Jerome Avenue	Infiltration Basin	Infiltration Basin	Patapsco River LNB	4.63[2]	1.54[2]	96	Complete	FY16

Project #	Project Name	Proposed Project	BMP Classification	Bacteria TMDL Watershed	Drainage Area Treated (acres)	Impervious Area Treated (acres)	Bacteria Removal Efficiency (percent)	Status as of January 2018	FY
B555701	Behind 1467 Fairbanks Drive	Shallow Marsh[3]	Shallow Marsh[3]	Patapsco River LNB	14.4[2]	6.35[2]	78	Planning	FY18
B555701	7306 Musical Way, Severn	Infiltration Basin	Infiltration Basin	Patapsco River LNB	16.82[2]	3.77[2]	96	Complete	FY16
B555701	7900 Severn Hills Way	Wet Pond	Retention Pond	Patapsco River LNB	11.2[2]	4.81[2]	70	Complete	FY16
B555702	Gesna Drive off Pinyon Road	Wetland	Shallow Marsh	Patapsco River LNB	30.47[2]	11.81[2]	78	Planning	FY18
B555703	7924 Green Moss Glen	Micro pool Extended Detention[3]	Extended Detention Structure, Wet[3]	Patapsco River LNB	33.20[2]	10.0[2]	70	Proposed	
B555706	6202 Grovel Road	Infiltration Basin[3]	Infiltration Basin[3]	Patapsco River LNB	12.38[2]	3.79[2]	96	Planning	FY18
B555302	Chesapeake Arts Center Stormwater Management Retrofit[1]	Infiltration Trench	Infiltration Trench	Patapsco River LNB	4.09	2.64	96	Planning	FY18
B555601	Maritime Institute (Maritime Blvd) Pond Retrofit[1]	SPSC	SPSC	Patapsco River LNB	17.50	9.20	70	Planning	FY18
Private	Northrop Grumman ESD Pervious Pavement[1]	Pervious Pavement	Pervious Pavement	Patapsco River LNB	1.51	1.20	37	Complete	2016
Private	Northrop Grumman ESD Rain Garden[1]	Rain Garden	Rain Garden	Patapsco River LNB	0.03	0.03	70	Complete	2016
Private	Northrop Grumman Bioretention Area 1[1]	Bioretention	Bioretention	Patapsco River LNB	0.00	0.50	70	Planning	
Private	Northrop Grumman Bioswale 1[1]	Bio-Swale	Bioretention	Patapsco River LNB	0.55	0.55	70	Complete	2017
Private	Northrop Grumman Pervious Pavement 2[1]	Pervious Pavement	Pervious Pavement	Patapsco River LNB	0.53	0.50	37	Complete	2017
Private	Northrop Grumman Pervious Pavement 1[1]	Pervious Pavement	Pervious Pavement	Patapsco River LNB	0.97	0.75	37	Complete	2017
Private	Northrop Grumman Pervious Pavement 3A-2[1]	Pervious Pavement	Pervious Pavement	Patapsco River LNB	1.51	1.20	37	Complete	2017

Project #	Project Name	Proposed Project	BMP Classification	Bacteria TMDL Watershed	Drainage Area Treated (acres)	Impervious Area Treated (acres)	Bacteria Removal Efficiency (percent)	Status as of January 2018	FY
Private	Northrop Grumman Pervious Pavement 3B[1]	Pervious Pavement	Pervious Pavement	Patapsco River LNB	1.26	1.23	37	Complete	2017
Private	Northrop Grumman Grass Swale 1[1]	Grass Swale	Grass Swale	Patapsco River LNB	0.00	1.40	37	Planning	
D537919	Peach Orchard SWM Retrofit[1]	Wet Pond	Wet Pond	Patapsco River LNB	43.70	10.92	70	Complete	FY12
B555707	Ridge Commons Blvd Retrofit[1]	Extended Detention Structure Wet	Extended Detention Structure Wet	Patapsco River LNB	24.08	10.59	70	Planning	FY19
B555701	Tuckerman Drive Retrofit[1]	Extended Detention Wetland	Extended Detention Wetland	Patapsco River LNB	92.56	22.23	78	Planning	2018
B554001	East End of Chalmers Ave	Infiltration Basin	Infiltration Basin	Patapsco River Furnace Creek	18.99[2]	5.31[2]	96	Planning	FY17
B554001	711 Towering Oaks Court	Wet Pond[3]	Wet Pond[3]	Patapsco River Furnace Creek	7.95[2]	3.23[2]	70	Planning	FY19
B554001	Baby Baer Court	Infiltration Basin	Infiltration Basin	Patapsco River Furnace Creek	11.37[2]	3.24[2]	96	Planning	FY17
B554004	1506 Lochaber Court	Wet Pool	Micropool Extended Detention Pond	Patapsco River Furnace Creek	14.64[2]	3.43[2]	70	Complete	FY16
B555602	200 Juneberry Way	SPSC[3]	SPSC[3]	Patapsco Furnace Creek	5.4[2]	3.1[2]	70	Complete	FY16
B555701	17 McNeil Court	Wet Pond	Retention Pond	Patapsco River Furnace Creek	8.15[2]	3.13[2]	70	Complete	FY16
B554102 or B554101	Heritage Hills Back Creek Phase 2 Retrofits[1]	SPSC	SPSC	Patapsco River Furnace Creek	9.53	4.10	70	Planning	FY19
B554102 or B554101	Heritage Hills Back Creek Phase 2 Retrofits[1]	Bioretention	Bioretention	Patapsco River Furnace Creek	4.05	2.40	70	Planning	FY19
B554102 or B554101	Heritage Hills Back Creek Phase 2 Retrofits[1]	Bioretention	Bioretention	Patapsco River Furnace Creek	0.63	0.25	70	Planning	FY19
B554102 or B554101	Heritage Hills Back Creek Phase 2 Retrofits[1]	Bioretention	Bioretention	Patapsco River Furnace Creek	4.29	1.90	70	Planning	FY19

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B554102 or B554101	Heritage Hills Back Creek Phase 2 Retrofits[1]	Bioretention	Bioretention	Patapsco River Furnace Creek	1.96	0.53	70	Planning	FY19
B553703	Sawmill Hollins Ferry RD Pond Retrofit BMP 190[1]	Infiltration Basin	Infiltration Basin	Patapsco River Furnace Creek	32.10	19.45	96	Planning	FY18
B554005	Foxwell Bend Road and Hospital Drive	Extended Detention Pond, Wet[3]	Extended Detention Pond, Wet[3]	Patapsco River Marley Creek	30.090[2]	11.28	70	Planning	FY17
B554005	Fox Cub Court	Extended Detention Pond, Wet[3]	Extended Detention Pond, Wet[3]	Patapsco River Marley Creek	16.19[2]	6.7[2]	70	Planning	FY17
B555605	Hospital Drive	SPSC	SPSC	Patapsco River Marley Creek	31.7[2]	15.8[2]	70	Complete	FY16
B555606	Hospital Drive	SPSC	SPSC	Patapsco River Marley Creek	13	5.8[2]	70	Complete	FY16
NGO	Empowering Believers Church Rain Garden 6[1]	Rain Garden	Rain Garden	Patapsco River Marley Creek	0.173	0.17	70	Complete	FY16
NGO	Empowering Believers Church Rain Garden 2[1]	Rain Garden	Rain Garden	Patapsco River Marley Creek	0.543	0.5	70	Complete	FY16
NGO	Empowering Believers Church Rain Garden 1[1]	Rain Garden	Rain Garden	Patapsco River Marley Creek	0.256	0.3	70	Complete	FY16
D499940	Grays Luck SWMP Retrofit[1]	SPSC	SPSC	Patapsco River Marley Creek	41.9	8.4	70	Complete	FY14
B558111	Mill Race Pond Retrofit[1,5]	Wet Pond-Wetland	Wet Pond-Wetland	Patapsco River Marley Creek	46.790	14.5	70	Planning	FY18
	Sun Valley Condos Pond Retrofit[1]	Wet Pond	Retention Pond	Patapsco River Marley Creek	5.460	1.8	70	Complete	FY16
B558102	Council Oaks Drive	Wet Pond[3]	Retention Pond[3]	Severn River Mainstem	16.49[2]	4.79[2]	70	Complete	FY16
B558103	Western District Police	Wet Pond	Retention Pond	Severn River Mainstem	2.28[2]	1.34[2]	70	Complete	FY16
B558106	Pasture Brook Road bet Silo Rd and Loft Court	Constructed Wetland	Shallow Marsh	Severn River Mainstem	49.42[2]	13.03[2]	78	Planning	FY17
D537916	Old Herald Harbor Road	Constructed Wetland	Shallow Marsh	Severn River Mainstem	34.89[2]	3.31[2]	78	Planning	FY17

Project #	Project Name	Proposed Project	BMP Classification	Bacteria TMDL Watershed	Drainage Area Treated (acres)	Impervious Area Treated (acres)	Bacteria Removal Efficiency (percent)	Status as of January 2018	FY
B551814	Annapolis Mall	Pond	Retention Pond	Severn River Mainstem	No Data	No Data	70	Complete	FY16
Q536401	Brietwert Avenue and Oakton Road	SPSC	SPSC	Severn River Mainstem	24.3[2]	1.73[2]	70	Complete	FY16
Q437358	Buttonwood Trial	SPSC	SPSC	Severn River Mainstem	8.54[2]	3.31[2]	70	Complete	FY16
Q437364 B551802	Olde Severna Park	SPSC	SPSC	Severn River Mainstem	37.83	15.86[2]	70	Complete	FY15
B558112	Lakeland Road	SPSC	SPSC	Severn River Mainstem	44.87[2]	13.05[2]	70	Planning	FY18
B558005	O'Malley Sr Center	Wet Pond	Retention Pond	Severn River Mainstem	3.95[2]	2.04[2]	70	Complete	FY16
B558402	Old Bay Ridge Rail Road	SPSC	SPSC	Severn River Mainstem	126.57[2]	20.06[2]	70	Complete	FY15
NGO	Coventry Court Dry Channel RSC-Category 2[1]	SPSC	SPSC	Severn River Mainstem	2.40	1.50	70	Complete	FY17
B557904	Dellwood Court Infiltration Trench[1]	Infiltration Trench	Infiltration Trench	Severn River Mainstem	0.57	0.31	96	Complete	FY17
B557904	Dellwood Court Outfall Bioretention[1]	Bioretention	Bioretention	Severn River Mainstem	3.88	0.53	70	Complete	FY16
B557904	Dellwood Court Outfall Sand Filter[1]	Sand Filter	Sand Filter	Severn River Mainstem	1.33	0.27	37	Complete	FY17
	Denington Lane Outfall[1]	SPSC	SPSC	Severn River Mainstem	122.37	38.24	70	Complete	FY15
B557904	Fairfield Drive Pond Retrofit[1]	Wet Pond	Retention Pond	Severn River Mainstem	25.31	7.64	70	Complete	FY16
NGO	Herald Harbor Bonaparte Road#2 CPO[1]	SPSC	SPSC	Severn River Mainstem	17.59	4.88	70	Complete	FY17
	Knollwood Road Outfall[1]	SPSC	SPSC	Severn River Mainstem	9.49	2.55	70	Complete	FY15
NGO	Maryland Theraputic Riding Center SPSC[1]	Wet Pond	Retention Pond	Severn River Mainstem	26.60	2.38	70	Complete	FY15
B557901	Sappington Hill Pond Retrofit[1]	SPSC	SPSC	Severn River Mainstem	15.32	3.69	70	Complete	FY16

Project #	Project Name	Proposed Project	BMP Classification	Bacteria TMDL Watershed	Drainage Area Treated (acres)	Impervious Area Treated (acres)	Bacteria Removal Efficiency (percent)	Status as of January 2018	FY
NGO	Winchester on the Severn Dry Channel RSC[1]	SPSC	SPSC	Severn River Mainstem	19	5	70	Complete	
	Windswept Estates Pond Retrofit[1]	SPSC	SPSC	Severn River Mainstem	15.50	6.05	70	Complete	FY14
B558115	1550 Comanche Road	Wet Pond[3]	Retention Pond[3]	Severn River Mill Creek	13.0[2]	2.60[2]	70	Complete	FY16
B558115	48 Old Sturbridge Road	Wet Pond[3]	Retention Pond[3]	Severn River Mill Creek	7.7[2]	1.55[2]	70	Complete	FY16
B558115	1681 Nickerson Way	Wet Pond[3]	Retention Pond[3]	Severn River Mill Creek	3.7[2]	0.75[2]	70	Complete	FY16
B558117	Pennington Lane South Retrofit[1]	Multiple Pond System	Retention Pond	Severn River Whitehall and Meredith Creek	23.85	4.41	70	Complete	FY18
B559702	Loch Haven Road and Havenhill Road	Wet Pond	Retention Pond	South River Mainstem	8.26[2]	2.19[2]	70	Complete	FY15
B560202	Wordsworth and Breckenridge Way	Wet Pond	Retention Pond	South River Mainstem	69.67[2]	27.15[2]	70	Complete	FY17
B560203	Howards Point Road and Stepney Lane	Wet Pond-Wetland	Retention Pond	South River Mainstem	38.82[2]	38.82[2]	70	Planning	No Data
B560204	619 Dillon Court	Wet Pond	Retention Pond	South River Mainstem	15.21[2]	2.80[2]	70	Complete	FY15
D527402	Southdown Road	SPSC	SPSC	South River Mainstem	23.80[2]	3.20[2]	70	Complete	FY15
B559202	Riva Rd at Camp Woodlands	SPSC	SPSC	South River Mainstem	7.80[2]	2.09[2]	70	Complete	FY15
B560206	2662 Riva Rd Retrofit[1]	Bio-Swale	Bioretention	South River Mainstem	19.54[2]	12.53[2]	70	Planning	
B560207	Sharpsburg Drive	Wet Pond	Retention Pond	South River Mainstem	32.96[2]	3.97[2]	70	Completed	FY17
NGO	Londontowne Rain Garden[1]	Rain Garden	Rain Garden	South River Mainstem	0.7	0.5	70	Complete	FY15
	St Andrews Pond Retrofit[1]	Multiple Pond System	Retention Pond	South River Mainstem	7.97	2.45	70	Complete	FY16
NGO	Preserve at Broad Creek Pond Retrofit - SPSC[1]	SPSC	SPSC	South River Mainstem	11.04	4.59	70	Complete	FY15

Project #	Project Name	Proposed Project	BMP Classification	Bacteria TMDL Watershed	Drainage Area Treated (acres)	Impervious Area Treated (acres)	Bacteria Removal Efficiency (percent)	Status as of January 2018	FY
	Cinnamon Lane Outfall Rehabilitation[1]	SPSC	SPSC	South River Mainstem	20.91	0.43	70	Complete	FY16
B559401	Annapolis Harbor Center[1]	Extended Detention, Wet	Extended Detention, Wet	South River Mainstem	36.30	27.10	70	Complete	FY17
	Annapolis Harbor Center SPSC[1]	SPSC	SPSC	South River Mainstem	50.33	3.50	70	Complete	FY16
Private	Annapolis Corporate Park SPSC #2[1]	SPSC	SPSC	South River Mainstem	15.76	4.41	70	Complete	FY15
Private	Annapolis Corporate Park SPSC #1[1]	SPSC	SPSC	South River Mainstem	18.84	0.00[6]	70	Complete	FY15
B560204	Old Annapolis Neck	Wet Pond	Retention Pond	South River Duvall Creek	13.1	1.33	70	Complete	FY15
NGO	Hillsmere Beach Road Kayak Area CPO / Bioretention[1]	Bioretention	Bioretention	South River Duvall Creek	9.0	2.52	70	Complete	FY15
NGO	St. Anne School of Annapolis Rain Garden[1]	Rain Garden	Rain Garden	South River Duvall Creek	0.63	0.37	70	Complete	FY15
NGO	Avalon Shores Fire Dept Stormwater Wetland[1]	Bio-Swale	Bioretention	West River	1.3	0.86	70	Complete	FY16

[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 2016 Annual TMDL Assessment Report (January 2017)

[2] Data has been updated since being listed in Table 2 of the 2016 Annual TMDL Assessment Report (January 2017).

[3] The type of proposed project has been updated since being listed in Table 2 of the 2016 Annual TMDL Assessment Report (January 2017)

[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

[5] This project is included in the Marley Creek Watershed in this Plan even though it is listed under Severn River Watershed in the County GIS data. This is due to a discrepancy in the watershed boundaries between the County and the MDE GIS data

[6] At the time of this report, the actual number of impervious acres treated had not yet been provided to the County. This table will be updated when the correct information is received.

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, according to the WSA website, planted 2000 tree seedlings in Anne Arundel County in 2017.

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

The County is collaborating with the University of Maryland, as part of the Partnership for Action Learning in Sustainability program, on a prototype for implementing pet waste education. In addition, as with Riparian Buffer Education, 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. Prompted by a citizen complaint, the County continued its outreach efforts with an informational flyer mailed to residents of targeted neighborhoods in the northern part of the county.

In early 2017, the County partnered with the Chesapeake Bay Program's Citizen Stewardship Team in developing a citizen stewardship survey, which included questions regarding pet waste disposal; the survey was distributed to 600 random households in the County. Survey data was received by the County in October 2017 and is currently being used to determine the extent of proper pet waste disposal County-wide, and to inform a pilot outreach campaign in neighborhoods within the Rhode River/Cadle Creek and Magothy Mainstem watersheds, which is scheduled to launch in Spring 2018. The pilot project will explore and evaluate different outreach strategies and will also include quantitative monitoring of pet waste in neighborhood common areas.

The County will also be distributing a short survey to neighborhood and homeowners associations in Spring 2018 in an effort to obtain information regarding which neighborhoods have pet waste stations, how many they have, and who maintains them. The survey will also be used to gauge communities' interest in obtaining pet waste stations. The WPRP has purchased

several pet waste stations which it will make available to communities that express interest. 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 2018.

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. Anne Arundel County Soil Conservation District reported that 2,077 linear feet of livestock exclusion fencing was installed in the West River watershed in FY17. 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 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 several programs related to marina outreach are being conducted in the bacteria impaired watersheds. In May 2017, the County produced an informational brochure regarding bacteria pollution in the Rhode River with boaters and being the target audience. The brochures covered proper boat sewage

disposal practices and included a map of all pumpout locations along the Rhode River. Brochures were given to four marina locations on the Rhode River to distribute to patrons. The West/Rhode Riverkeeper was also given brochures to hand out at community events. West/Rhode Riverkeeper, Inc. also operates a pump-out boat Fridays through Mondays from 9 AM to 5 PM which can be hailed by boaters via phone, text, or VHS radio. In December 2017, approximately 145 acres of shellfish harvesting waters in the upper Rhode River were upgraded from "restricted" to "conditionally approved" by MDE.

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. With the addition of two certifications in November 2017, 48 of the estimated 165 marinas in Anne Arundel County are now certified Clean Marinas (Maryland DNR, 2017).

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 2017 County information, the following restoration strategies were modeled using CWP's Watershed Treatment Model to update the bacteria load reductions. Data sources for the 2017 model include:

- Restoration of 20 percent of the untreated impervious area through urban stormwater management retrofits based on 2017 updated County data

- Elimination of household connections based on 1,963 sampled outfalls under the Illicit Discharge Detection and Elimination program from 2005 to 2017.

- Abatement of sanitary sewer overflows (SSOs) for Magothy River Mainstem and Severn River Mainstem based on the new sewage pump station projects identified by the Department of Public Works and

Table 4 provides a comparison of bacteria load reductions quantified for the three above mentioned strategies as modelled between reporting years 2016 and 2017.

Implementation of urban stormwater management retrofits reduced bacteria loads in the Patapsco River/Furnace Creek, West River Mainstem, South River/Duvall Creek, and South River/Whitehall and Meredith Creek watersheds as compared to modelling results from the previous year (2016). Bacteria loads resulting from urban stormwater management retrofits increased slightly in the Magothy Mainstem, Patapsco River/Marley Creek, Severn River Mainstem, Severn River/Mill Creek, and South River Mainstem watersheds as compared to the previous year. A more significant load increase was noted in the Patapsco River Lower North Branch watershed. Overall, load reductions from stormwater retrofit projects decreased by 6 percent across all watersheds from the previous year.

Bacteria loads decreased as a result of elimination of household illicit connections in all but five watersheds as compared to the previous reporting year. The load reduction across all watersheds via illicit discharge elimination totaled 4.2 percent. In the five watersheds where load reductions were not observed, loads remained the same as the previous year. Loads from illicit discharges did not increase in any watershed.

No progress was made since the last reporting period towards reducing bacteria loads via SSO abatement as no new SPS upgrades or WWTP extension projects were implemented in TMDL watersheds during this reporting period.

No changes or updates occurred to the data related to the Retirement of County Septic Systems and Riparian Buffer Education strategies, bacteria load reduction from which was also quantified using CWP's Watershed Treatment Model. The County has initiated the expanded pet waste outreach program through collaboration with University of Maryland, therefore additional information such as pre-/post-survey data, monitoring in the pet waste outreach focus areas would be needed to evaluate the progress and quantify the bacteria load reductions from the implementation 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, bacteria loads slightly increased by 1.8 percent across all TMDL watersheds when compared to 2016 modeling results. As compared to 2016 results, bacteria loads decreased in 10 TMDL watersheds (Magothy River/Forked Creek, Magothy River/Tar Cove, Patapsco River/Furnace Creek, Patapsco River/Marley Creek, Patuxent River Upper, Severn River Mainstem, Severn River/Whitehall and Meredith Creek, South River/Duvall Creek, South River/Ramsey Lake, and West River Mainstem). In these 10 watersheds, bacteria load reductions total 3.6 percent. A total increase in bacteria loads of 5.4 percent was observed in four watersheds (Magothy Mainstem, Patapsco River Lower North Branch, Severn River/Mill Creek, and South River Mainstem). Loads remained the same in the remaining five watersheds.

Table 4. Estimated Load Reductions for Proposed Strategies in Bacteria TMDL Watershed

Watershed	Estimated Reductions Based on 2016 Modelling Results			Estimated Reductions Based on Updated Modeling Results (2017)		
	Restoration of 20% Untreated Impervious Area through Urban Stormwater Management Retrofits (%)	Eliminate Illicit Household Connections (%)	Abatement of SSOs (%)	Restoration of 20% Untreated Impervious Area through Urban Stormwater Management Retrofits (%)	Eliminate Illicit Household Connections (%)	Abatement of SSOs (%)
Magothy	1.9	9.7	1.37	1.0	10.2	1.37
Magothy River/Forked Creek	N/A	1.2	N/A	N/A	1.3	N/A
Magothy River/Tar Cove	N/A	0.7	N/A	N/A	0.8	N/A
Patapsco River Lower North Branch	4.8	12.6	5.0	1.1	13.2	5.0
Patapsco River/Furnace Creek	0.1	8.9	3.8	0.5	9.4	3.8
Patapsco River/Marley Creek	1.2	12.0	2.1	0.8	12.6	2.1
Patuxent River Upper	N/A	1.2	N/A	N/A	1.3	N/A
Rhode River/Bear Neck Creek	N/A	0.6	N/A	N/A	0.6	N/A
Rhode River/Cadle Creek	N/A	0.3	8.5	N/A	0.3	8.5
Severn River Mainstem	1.1	20.8	0.45	0.7	21.5	0.45
Severn River/Mill Creek	0.7	1.7	N/A	0.1	1.8	N/A
Severn River/Whitehall and Meredith Creek	0.0	1.0	N/A	0.6	1.1	N/A
South River Mainstem	2.8	12.3	0.3	0.8	12.9	0.3
South River/Duvall Creek	0.8	0.7	6.4	1.7	0.8	6.4
South River/Ramsey Lake	N/A	0.12	N/A	N/A	0.13	N/A
South River/Selby Bay	N/A	0.2	N/A	N/A	0.2	N/A
W. Chesapeake Bay/Tracy and Rockhold Creeks	N/A	0.3	N/A	N/A	0.3	N/A
West River Mainstem	N/A	1.5	N/A	0.1	1.6	N/A
West River/Parish Creek	N/A	0.2	12.9	N/A	0.2	12.9

SECTION TWO MONITORING

As noted in the Restoration Plan, there are five 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 2017) monitoring water quality at select locations along the Magothy River, Rock Creek and Severn River; and the County's Stream Restoration Project Monitoring, 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. 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 intent of this work is to determine what, if any, unknown source of bacteria is contributing to the disparity in results observed between these two stations.

2.2 SHELLFISH HARVESTING

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 42 monitoring stations in 15 available TMDL watersheds (as presented in Appendix C of the Restoration Plan) can be found in Appendix 1 of this Annual Asesessment. A comparison of MDE's monitoring data for FY16 and FY17 is provided in Table 5 (note: only 41 stations were actively monitored during the FY16-FY17 timeframe).

Analysis of the historical data shows an overall downward trend in yearly median bacteria concentrations at 28 monitoring stations and an upward trend in yearly median bacteria concentrations at 12 monitoring stations. Annual median bacteria concentrations for FY17 were below the MDE criterion level at 34 monitoring stations and above the MDE criterion level at 7 stations.

Median bacteria concentrations decreased at 15 stations from FY16 to FY17 and increased at 15 stations from FY16 to FY17; median bacteria concentrations remained the same at 11 stations. 90th percentile bacteria concentrations were FY17 were at or below the MDE criterion level at 22 monitoring stations and above the MDE criterion level at 19 stations. 90th percentile bacteria concentrations decreased at 16 stations from FY16 to FY17 and increased at 24 stations from FY16 to FY17; median bacteria concentrations remained the same at 1 station.

In December 2017, approximately 145 acres of shellfish harvesting waters in the Rhode River receiving drainage from the Rhode River/Bear Neck Creek TMDL watershed were upgraded from "restricted" to "conditionally approved" by MDE. MDE has noted that when the upper Rhode River was initially placed under restriction, the source of elevated bacteria levels was unknown; as such, the reason behind the improvement is also unknown (J. Backus, personal communication, October 31, 2017), though it was coincident with the County's enhanced bacteria education efforts. Subsequently, MDE established a second monitoring station within the remaining restricted waters of the Rhode River. 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 5. Comparison of MDE Shellfish Harvesting Area Monitoring Data

Bacteria TMDL Watershed	Monitoring Data Source	Monitoring Station	Median (MPN/100ml)[1]		90th Percentile (MPN/100ml)[2]	
			FY16	FY17	FY16	FY17
Magothy Mainstem	MDE	0301001	3.6	1.0	36.2	23.0
Magothy Mainstem	MDE	0301001A	9.1	9.1	196.6	43.0
Magothy Mainstem	MDE	0301001C	3.6	1.0	8.0	9.1
Magothy Mainstem	MDE	0301800	3.6	1.0	9.1	9.1
Magothy River/Forked Creek	MDE	0301011	23.0	23.0	898.6	43.0
Magothy River/Tar Cove	MDE	0301005C	7.3	3.6	200.6	39.0
Magothy River/Tar Cove	MDE	0301006B	15.0	11.2	210.6	204.0
Magothy River/Tar Cove	MDE	0301801	1.0	1.0	13.5	12.7
Magothy River/Tar Cove	MDE	0301802	1.0	1.0	8.0	12.8
Rhode River/Bear Neck Creek	MDE	0307120A	9.0	4.0	166.4	20.2
Rhode River/Cadle Creek	MDE	0307019	9.0	5.0	284.0	34.2
Severn River Mainstem	MDE	0304152	23.0	42.1	83.0	150.0

Bacteria TMDL Watershed	Monitoring Data Source	Monitoring Station	Median (MPN/100ml)[1]		90th Percentile (MPN/100ml)[2]	
			FY16	FY17	FY16	FY17
Severn River Mainstem	MDE	0304150	5.5	42.3	23.0	139.9
Severn River Mainstem	MDE	0304002A	3.3	3.6	72.0	39.6
Severn River Mainstem	MDE	0304005	1.0	3.6	32.8	22.2
Severn River Mainstem	MDE	0304008	3.6	1.0	23.0	41.0
Severn River Mainstem	MDE	0304011	3.6	3.6	23.0	416.3
Severn River Mainstem	MDE	0304016	1.0	2.3	67.8	40.2
Severn River Mainstem	MDE	0304020	3.6	3.3	8.6	41.0
Severn River Mainstem	MDE	0304028	1.0	1.0	9.1	110.3
Severn River Mainstem	MDE	0304029	1.0	1.0	3.6	139.3
Severn River Mainstem	MDE	0303200	1.0	1.0	36.4	43.0
Severn River Mainstem	MDE	0303202	1.0	2.3	1.0	416.3
Severn River Mainstem	MDE	0303204	2.3	2.3	13.2	6.9
Severn River/Mill Creek	MDE	0303006	16.1	9.3	43.0	225.3
Severn River/Whitehall and Meredith Creek	MDE	0303005	6.4	5.4	65.4	23.0
Severn River/Whitehall and Meredith Creek	MDE	0303005A	19.0	31.0	174.9	144.3
South River/Duvall Creek	MDE	0306104	3.6	9.1	37.0	240.0
South River/Duvall Creek	MDE	0306013A	2.3	16.1	32.8	23.0
South River Mainstem	MDE	0306110	9.1	7.3	37.0	240.0
South River Mainstem	MDE	0306211	3.6	2.3	23.0	218.3
South River Mainstem	MDE	0306002	8.2	9.1	23.0	41.0
South River Mainstem	MDE	0306205	6.4	7.3	37.0	376.6
South River Mainstem	MDE	0306111	3.6	23.0	37.0	75.0
South River Mainstem	MDE	0306208A	3.6	3.6	72.0	88.0
South River/Ramsey Lake	MDE	0306115A	12.1	13.3	78.0	225.3
South River/Selby Bay	MDE	0306801	6.4	23.0	43.0	240.0
South River/Selby Bay	MDE	0306115	1.0	3.6	10.4	23.0
W. Chesapeake Bay/Tracy and Rockhold Creeks	MDE	0501004	23.0	9.1	132.9	200.6
West River Mainstem	MDE	0307205	3.6	3.6	43.0	79.0
West River/Parish Creek	MDE	0307011	6.2	3.6	93.0	43.0

[1] The MDE Criterion for Median Sample (MPN/100ml) is 14

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

2.3 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.

2.4 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 throughout Anne Arundel County for 42 years. In 2017, Operation Clearwater conducted weekly monitoring of microbial (Enterococci) water quality at 42 recreational swimming areas in the County from Memorial Day through Labor Day. Further information about Operation Clearwater, including monitoring data, can be found online at http://severnriver.org/projects/clearwater/.

The West/Rhode Riverkeeper also conducted weekly water quality monitoring for Enterococci bacteria from Memorial Day through Labor Day in 2017 at 14 sites along the West and Rhode Rivers. 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 a full season of post-conversion monitoring is scheduled to begin in 2018.

2.5 CIP RESTORATION PROJECT MONITORING

In Furnace Branch, located in Glen Burnie, MD, the County is removing 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 from locations along the main stem that bracket known sewer crossings, as well as from any storm drain outfalls discharging to the reach of interest. These samples are collected under base flow conditions and, as possible, during storm events.

SECTION THREE CONCLUSION

In Section 7 (Implementation Schedule and Milestone) of the TMDL Restoration Plan, the following programmatic criteria were identified to be achieved in the 2017 milestone year by the County towards meeting the TMDL goals. Table 6 provides the County's progress towards achieving the implementation milestones.

Table 6. 2017 Milestone Programmatic Criteria

Programmatic Criteria	Progress
25% of all planned new and retrofit stormwater management facilities complete	The County continues to make progress towards completing new and and retrofit stormwater management facilities projects in accordance with County goals.
Continued triennial inspection and maintenance of constructed BMPs.	During 2017 the County continued triennial inspection and maintenance of constructed BMPs to verify functionality.
25% of planned septic systems connected to sewers, if funding allows	The County successfully secured Chespeake 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 and through the use of consultants. New site specific studies have not bee initiated but are anticipated in 2018.
Pet waste education program fully planned and coordinated, begin media campaign via television PSAs, videos on County website, and social media	Throughout 2017 the County highlighted proper pet waste management practices through its social media outlets, and at community events and presentations. Over 500 pet waste bags and "tip cards" were distributed at community events. These expanded education efforts and the findings of the Anne Arundel County Stormwater Survey are being incorporated into a more structured pet waste management initiative that will then be evaluated for its effectiveness in 2018.
Implement livestock fencing in the Patuxent River Upper and West River mainstem.agricultural watersheds*	Two livestock fencing projects were implemented in the West River watershed during 2017.

The County continues to make progress towards meeting the bacteria TMDL goals through a combination of stormwater management retrofits, elimination of illicit household connections, and abatement of SSOs. The County will continue to implement stormwater management practices with high bacteria removal efficiency such as infiltration basins and SPSC. The County continues to improve the reliability of the sanitary sewer system to minimize SSO by rehabilitating old sewer pipes, and retrofitting and replacing of the SPS through their CIP program. An increase in the rate of the retirement of septic systems could be expected through the initiative by the County to hire consultants who would assist in the implementation of the County developed strategy for retirement of OSDS. Elimination of household illicit connections is conducted as part of the requirement of the County's NPDES MS4 Permit and an increase in rate of identification and elimination is observed since 2005 indicating progress in elimination of cross connections. To quantify the effectiveness of these strategies, the CWP's Watershed Treatment model will be updated as and when latest data related to the restoration strategies is available.

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 initiated the development of a robust pet waste outreach program, with a pilot program to be launched in the Rhode River/Cadle Creek and Magothy Mainstem watersheds in spring 2018. The results of the pilot program 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.

The County is also making progress towards implementing additional outreach efforts targeting marinas and the boating community, such as the launching of a pump-out boat service in the West/Rhode River watershed which aims to minimize boat waste discharges.

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. MDE collected monitoring data from shellfish harvesting monitoring stations as well as the Integrated Report for Surface Water Quality should be continued 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 are removed from the TMDL list through the achievement of water quality standards for bacteria.

SECTION FOUR REFERENCES

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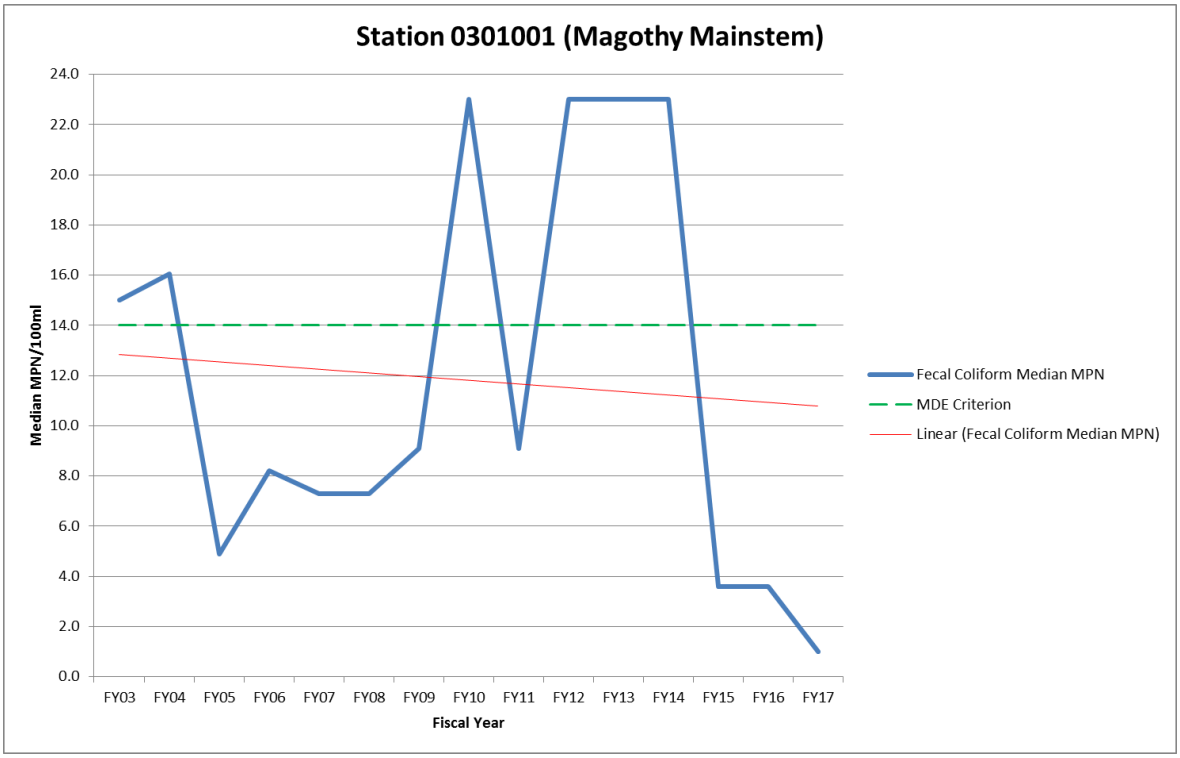
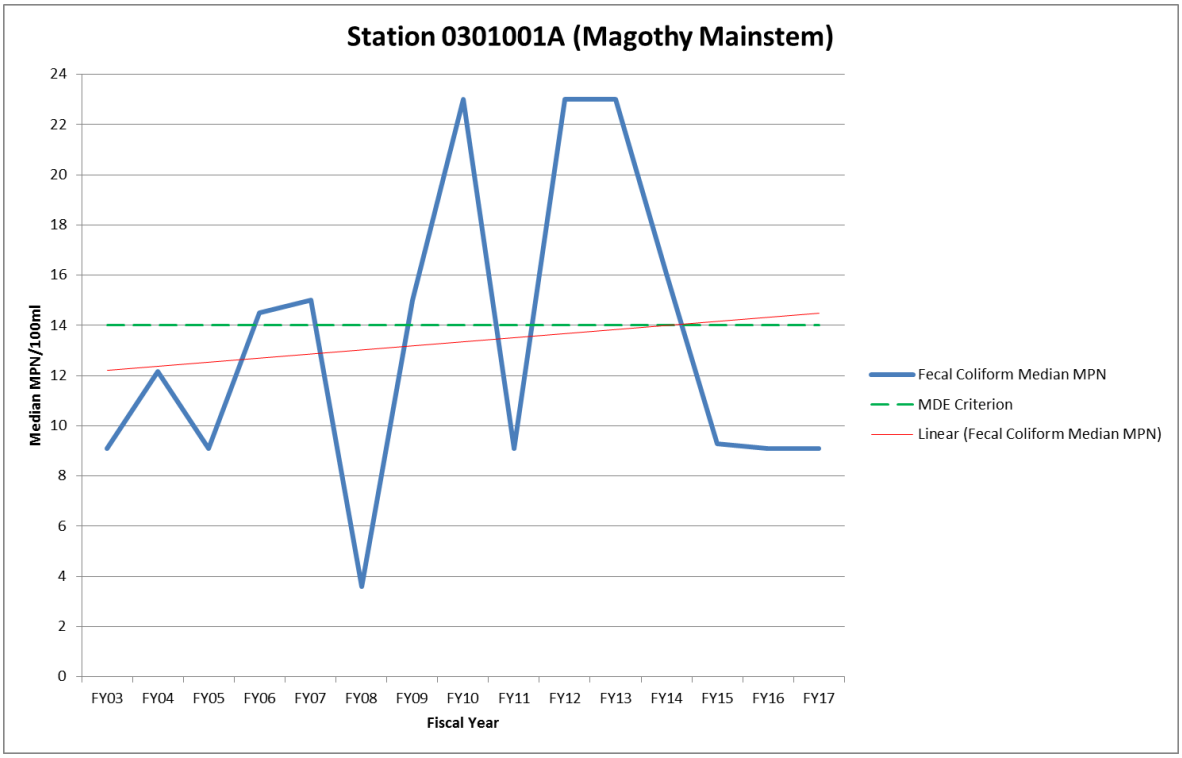
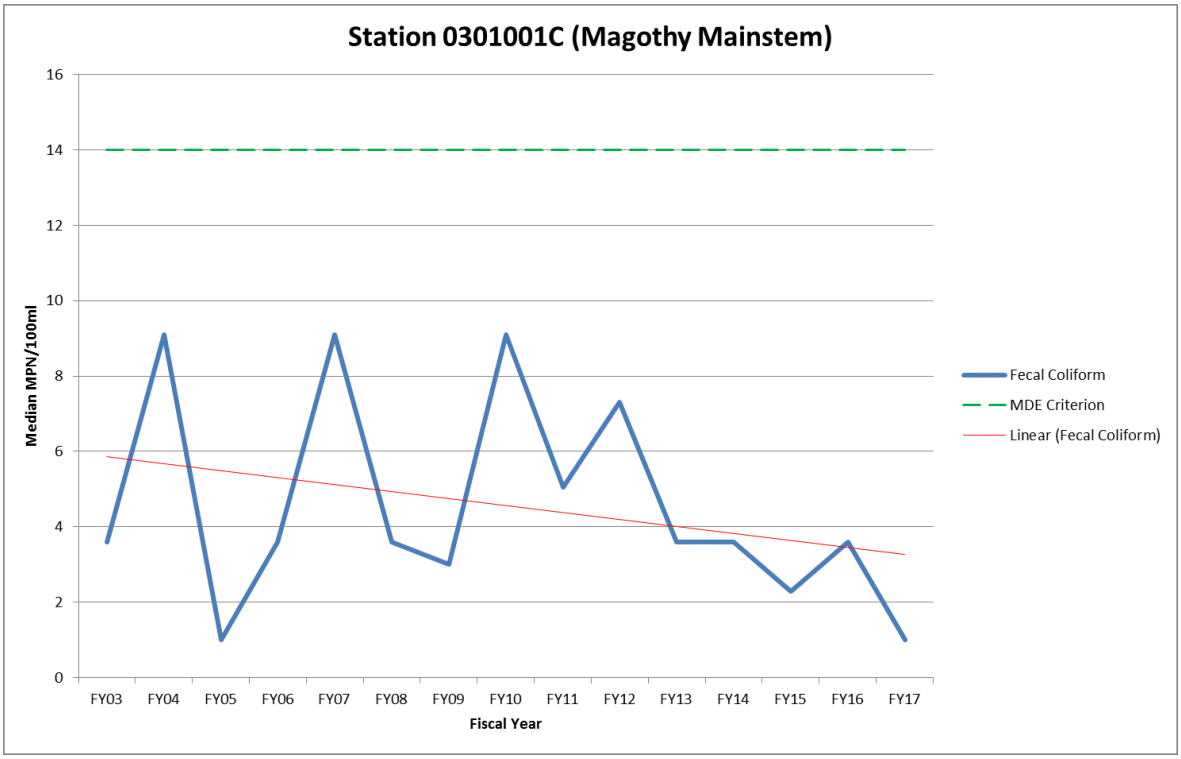
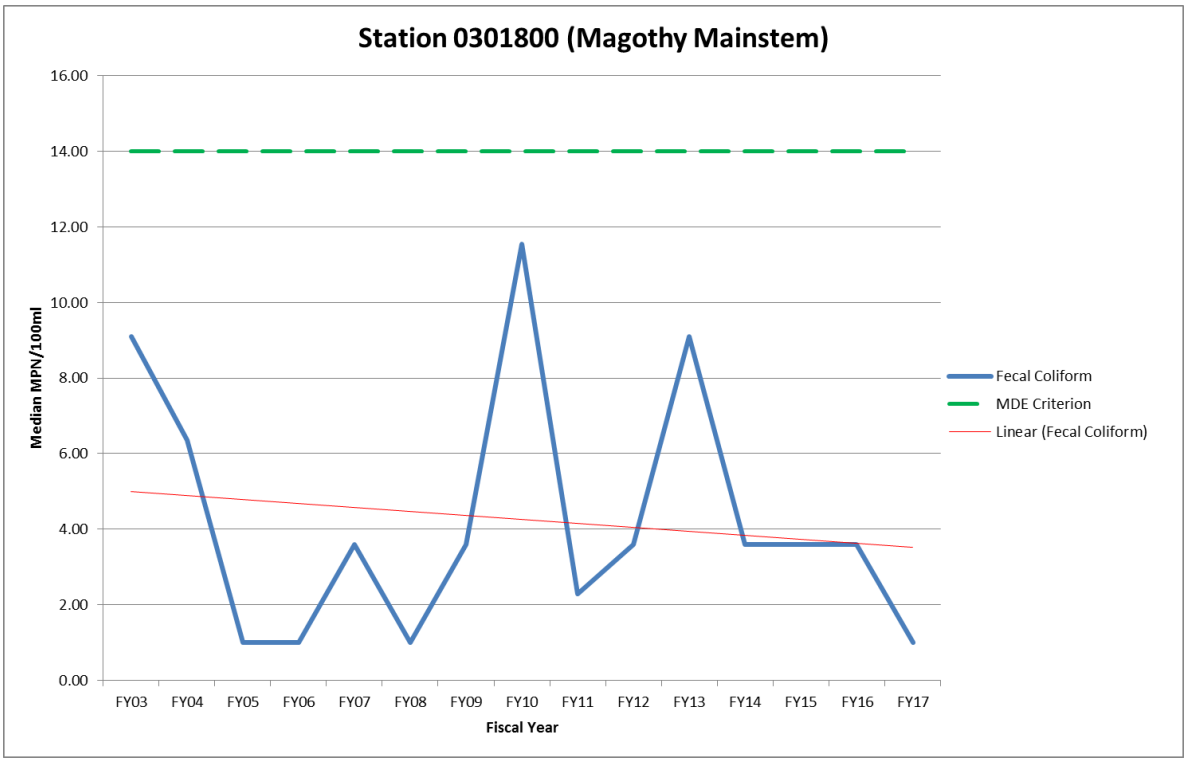
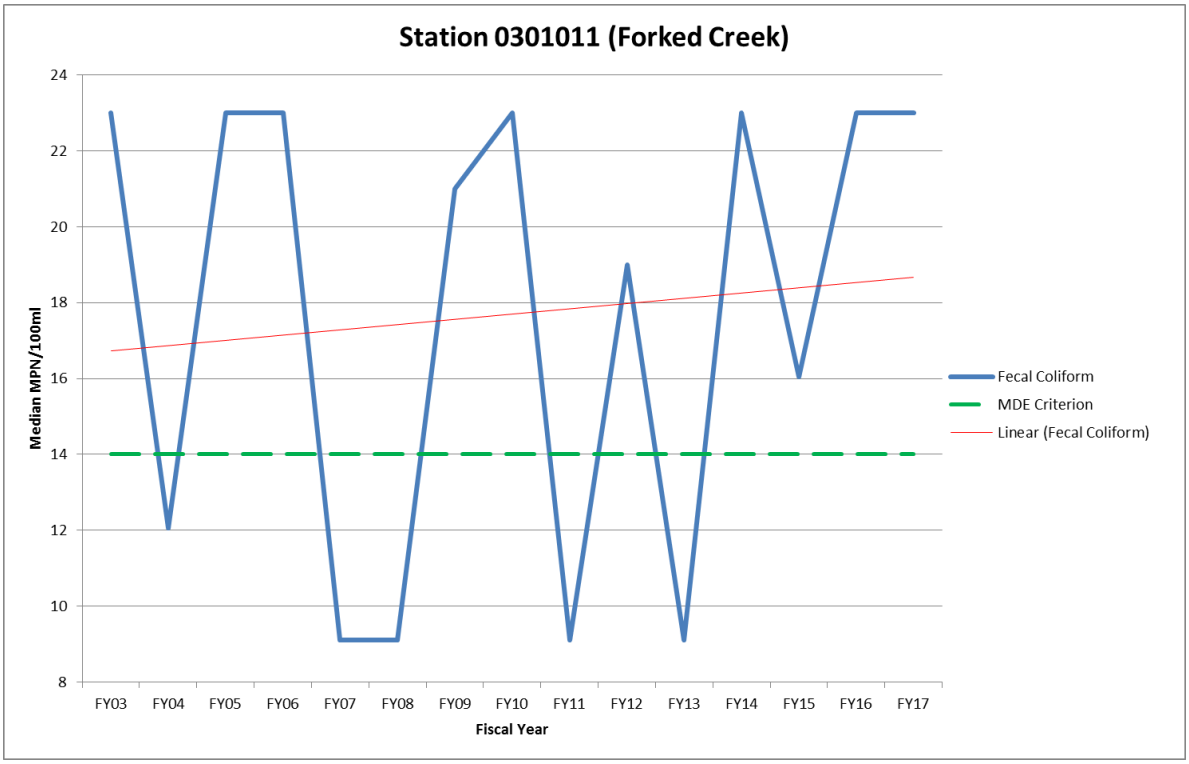
Appendix A: Annual Median Bacteria Concentrations at MDE Shellfish Harvesting Monitoring Stations within TMDL Watersheds

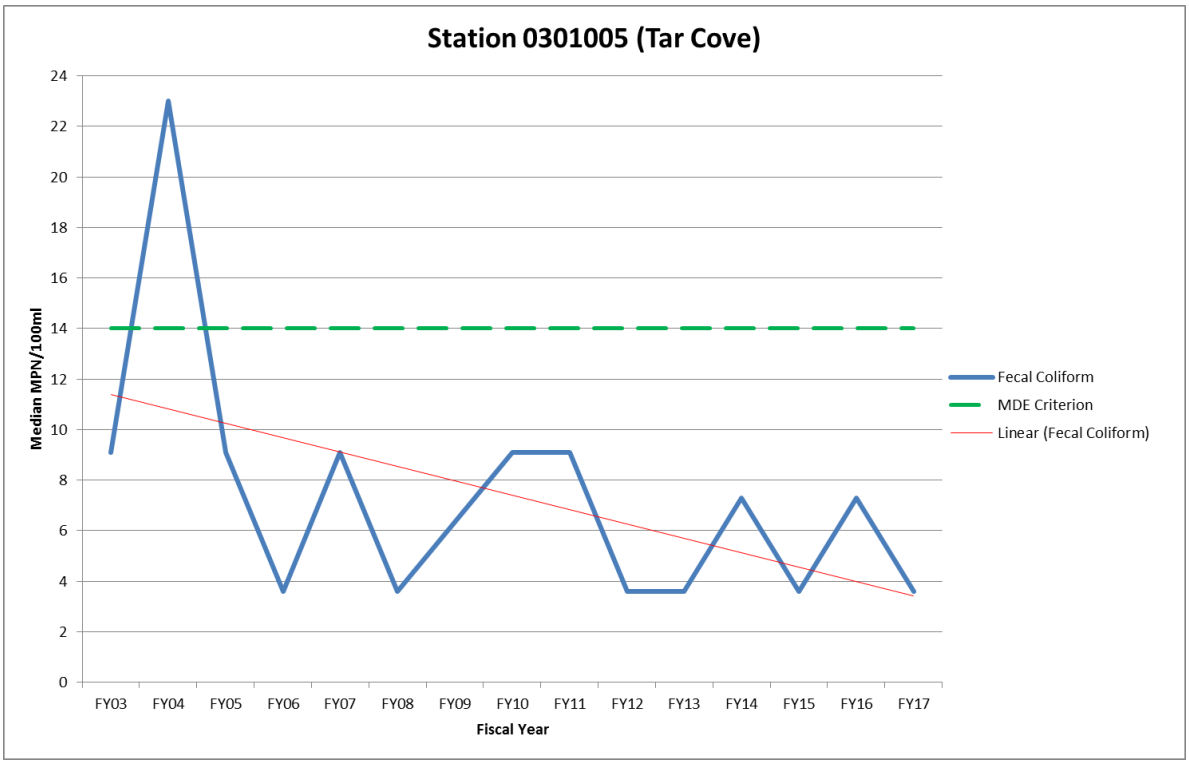

Station 0301001 (Magothy Mainstem)
Median MPN/100ml
24.0
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17
Fiscal Year
Fecal Coliform Median MPN
MDE Criterion
Linear (Fecal Coliform Median MPN)

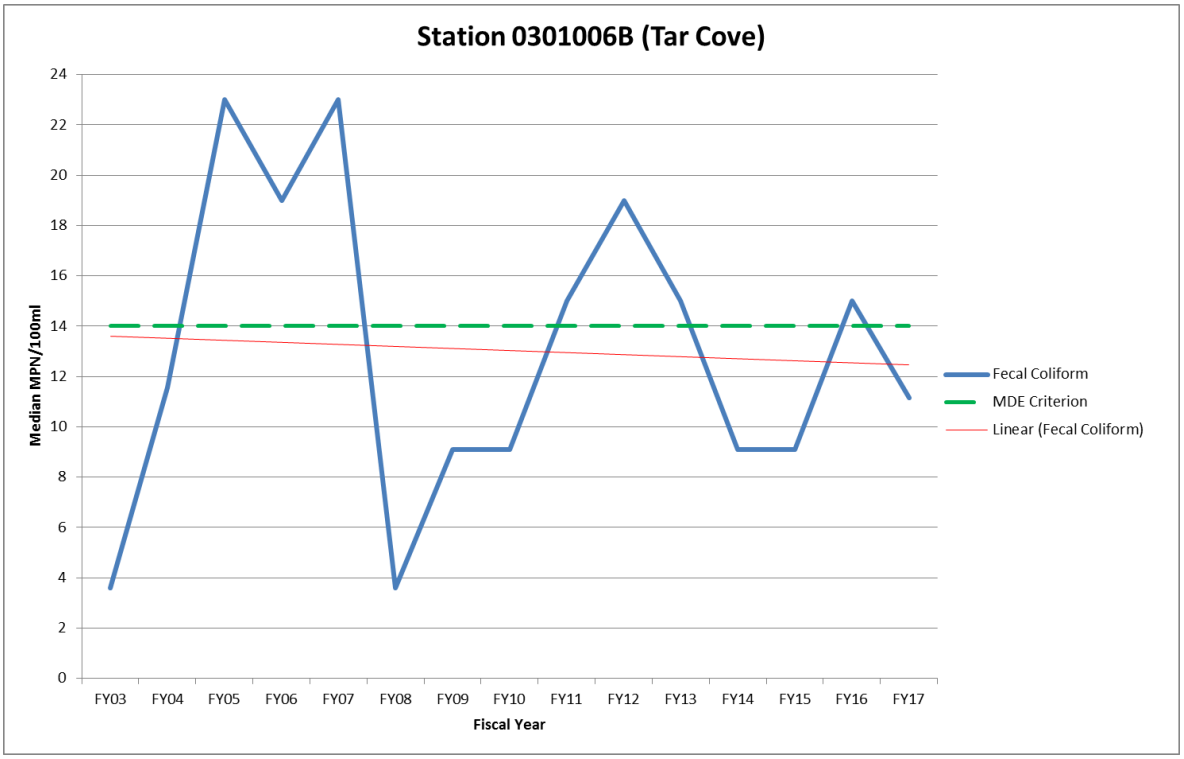

Station 0301001A (Magothy Mainstem)
Median MPN/100ml
24
22
20
18
16
14
12
10
8
6
4
2
0
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17
Fiscal Year
Fecal Coliform Median MPN
MDE Criterion
Linear (Fecal Coliform Median MPN)

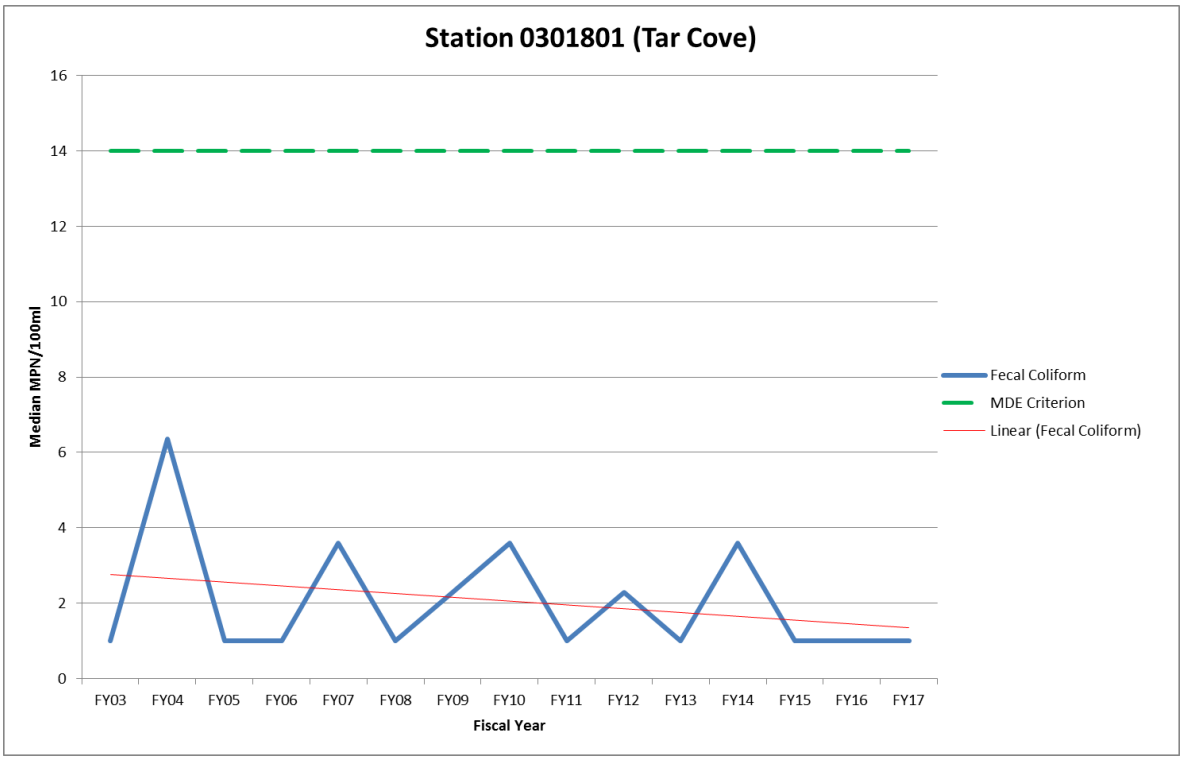

Station 0301001C (Magothy Mainstem)
Median MPN/100ml
16
14
12
10
8
6
4
2
0
FY03
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

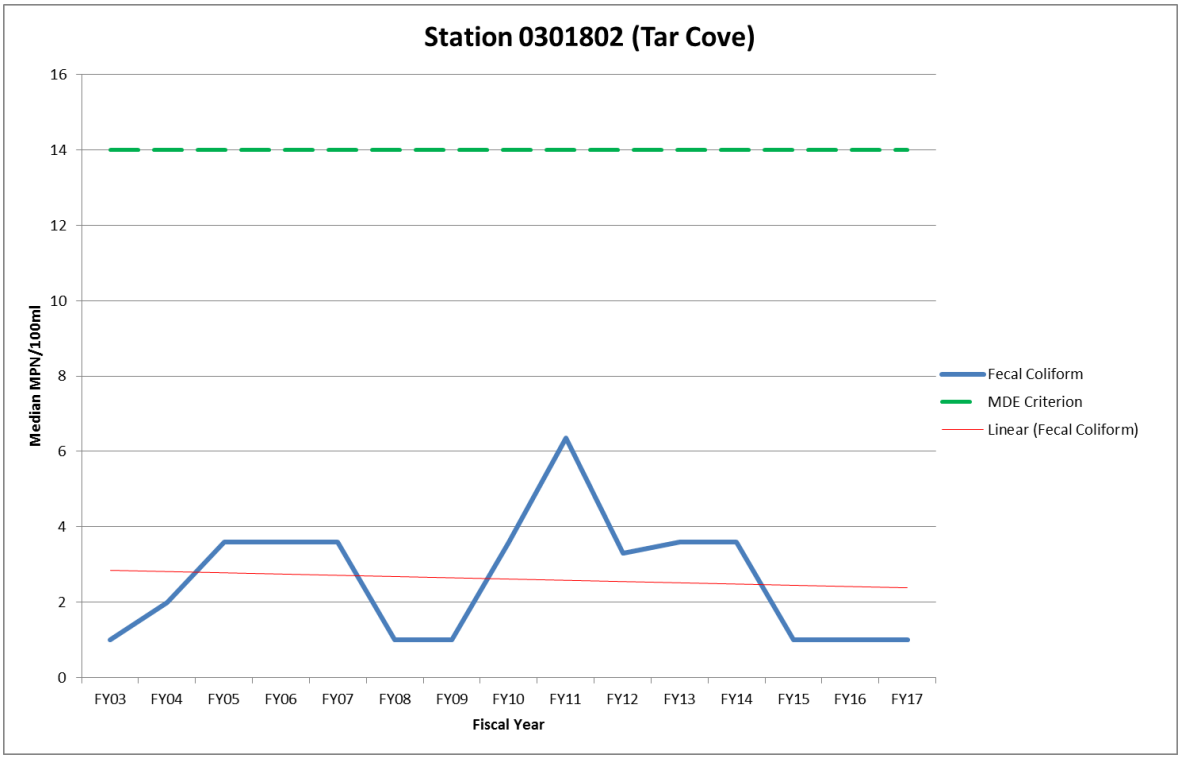

Station 0301800 (Magothy Mainstem)
Median MPN/100ml
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
FY03
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

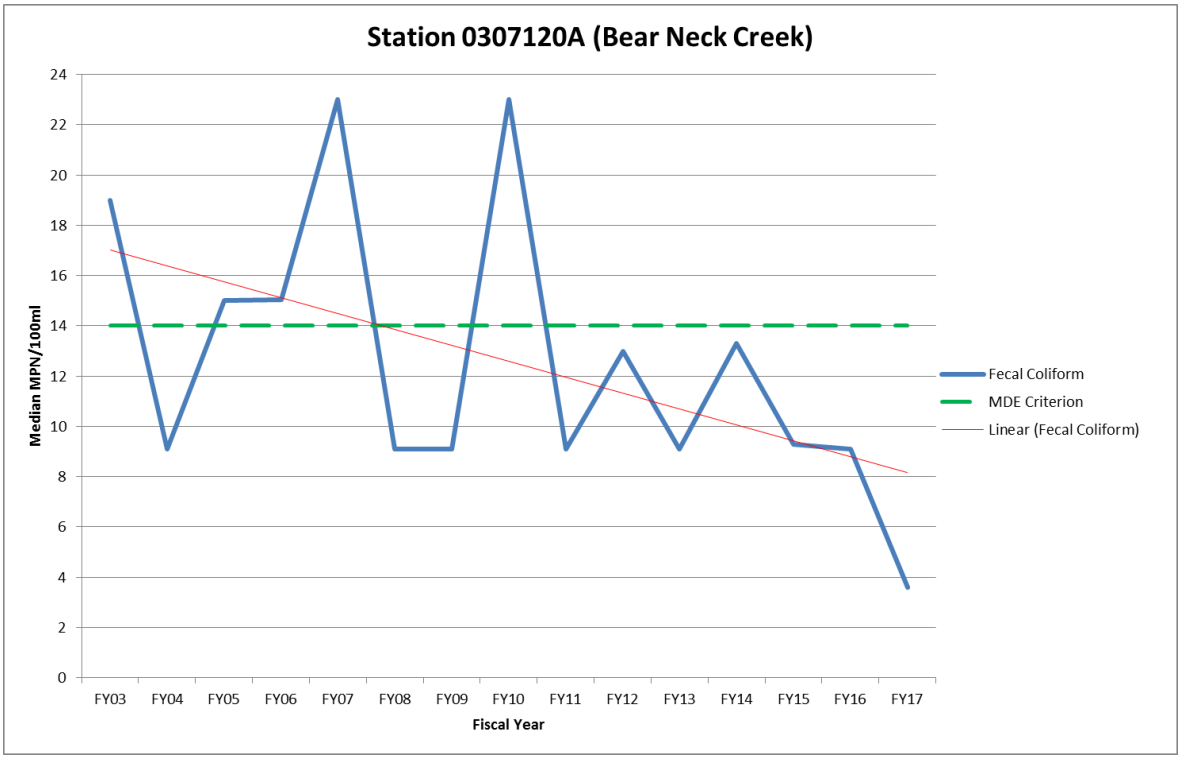

Station 0301011 (Forked Creek)
Median MPN/100ml
24
22
20
18
16
14
12
10
8
FY03
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

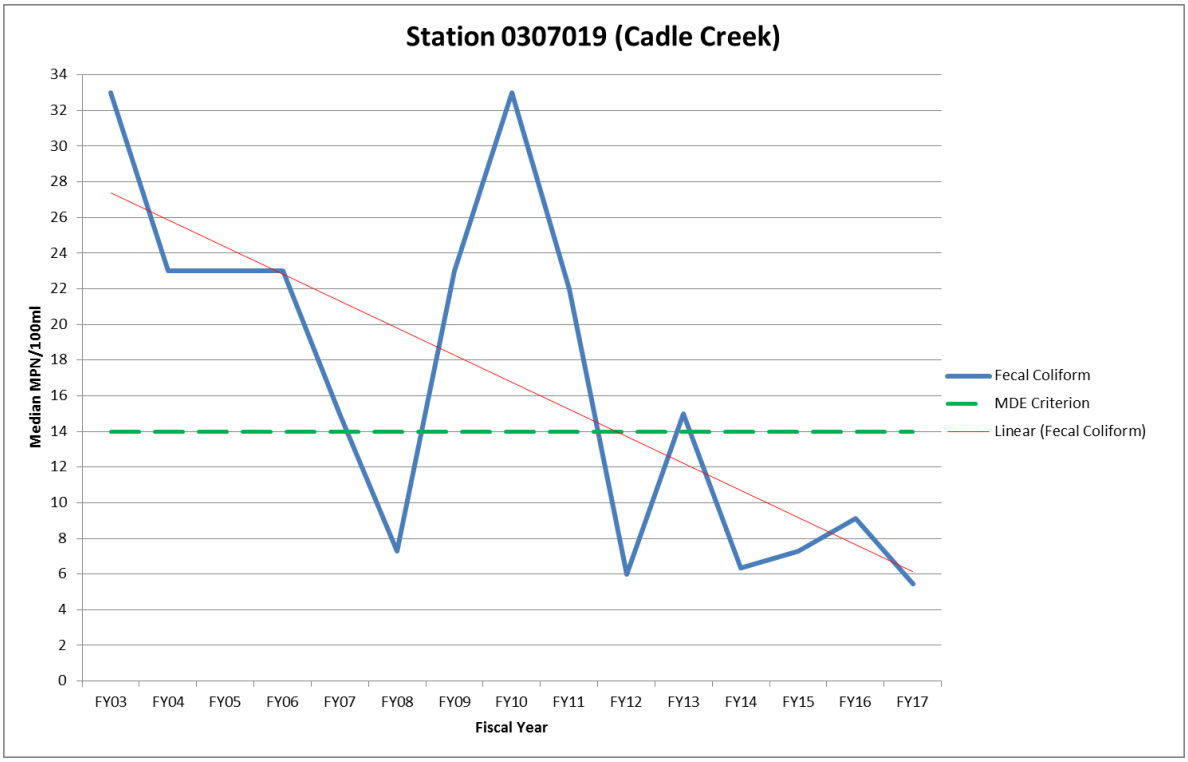

Station 0301005 (Tar Cove)
Median MPN/100ml
24
22
20
18
16
14
12
10
8
6
4
2
0
FY03
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

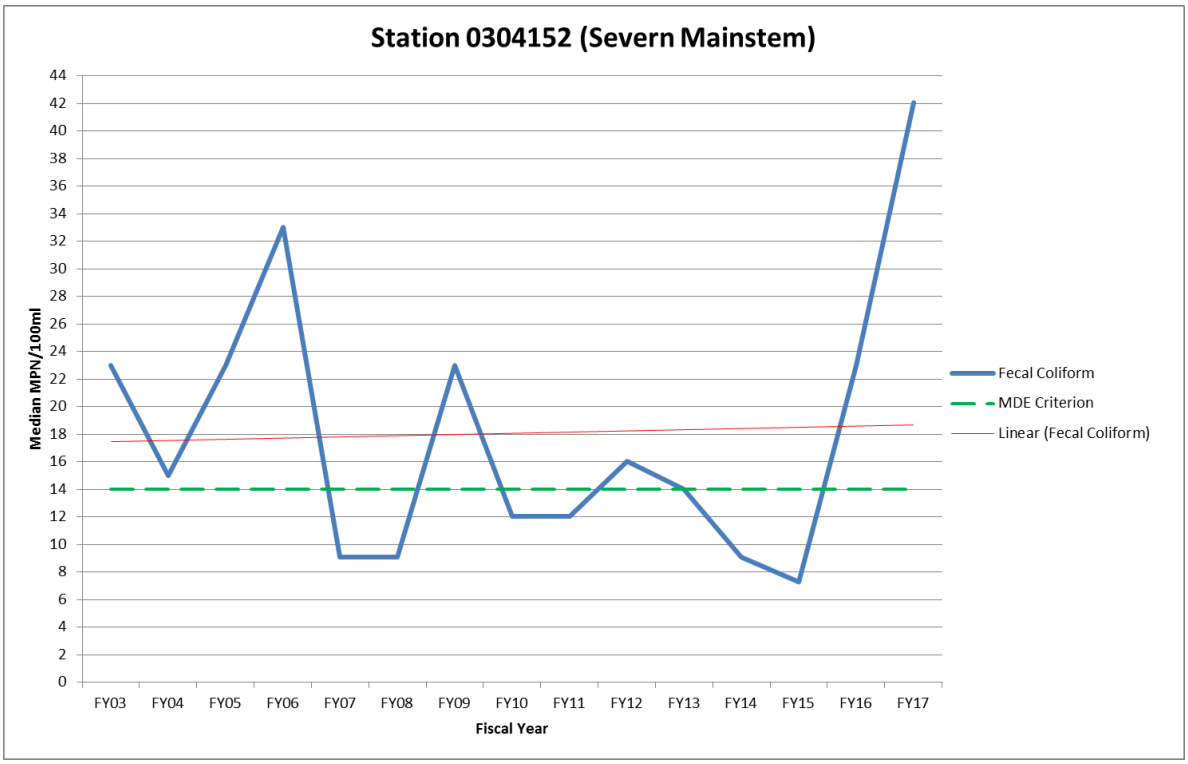

Station 0301006B (Tar Cove)
Median MPN/100ml
24
22
20
18
16
14
12
10
8
6
4
2
0
FY03
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

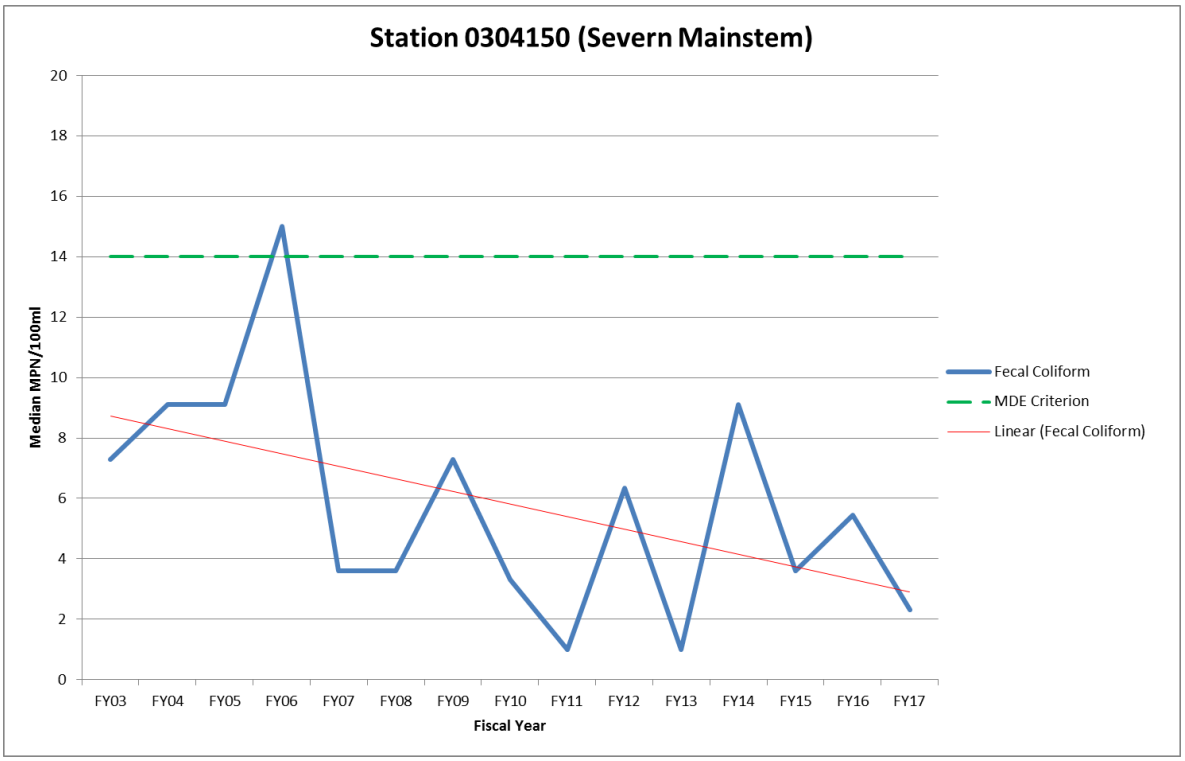

Station 0301801 (Tar Cove)
Median MPN/100ml
16
14
12
10
8
6
4
2
0
FY03
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

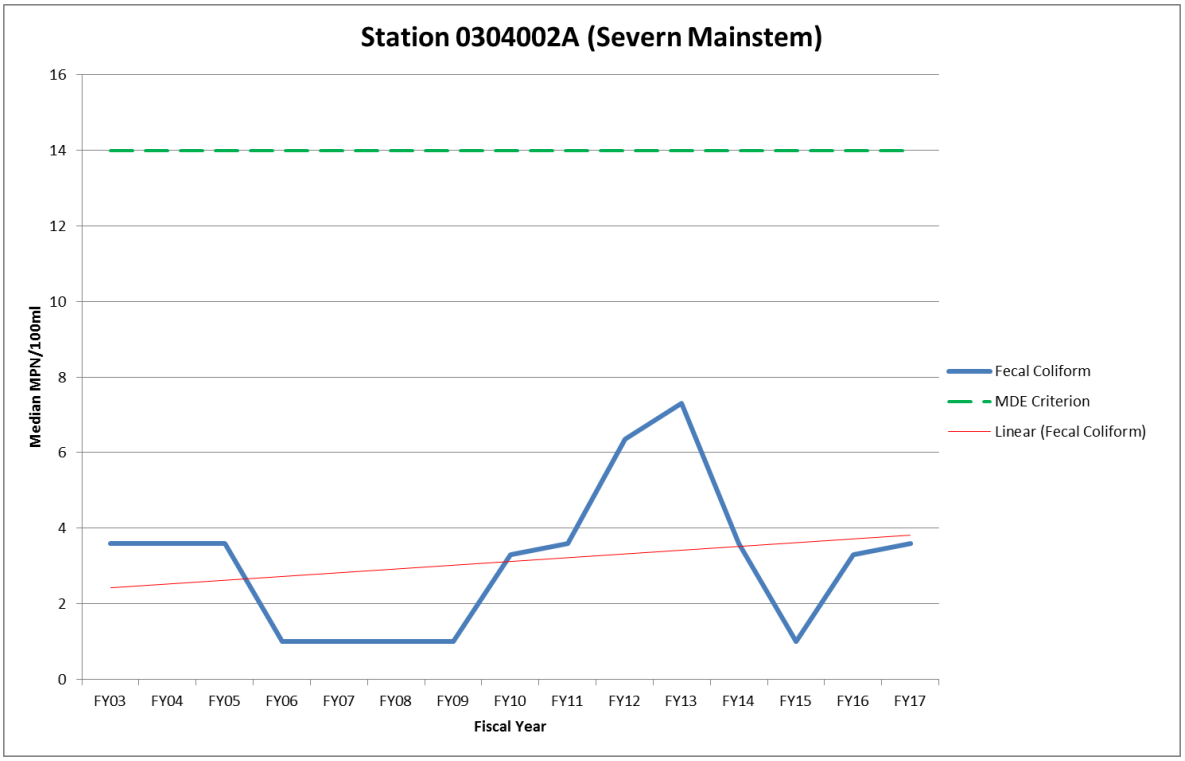

Station 0301802 (Tar Cove)
Median MPN/100ml
16
14
12
10
8
6
4
2
0
FY03
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)


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
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
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)


Station 0304152 (Severn Mainstem)
Median MPN/100ml
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
FY03
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
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
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)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Median MPN/100ml
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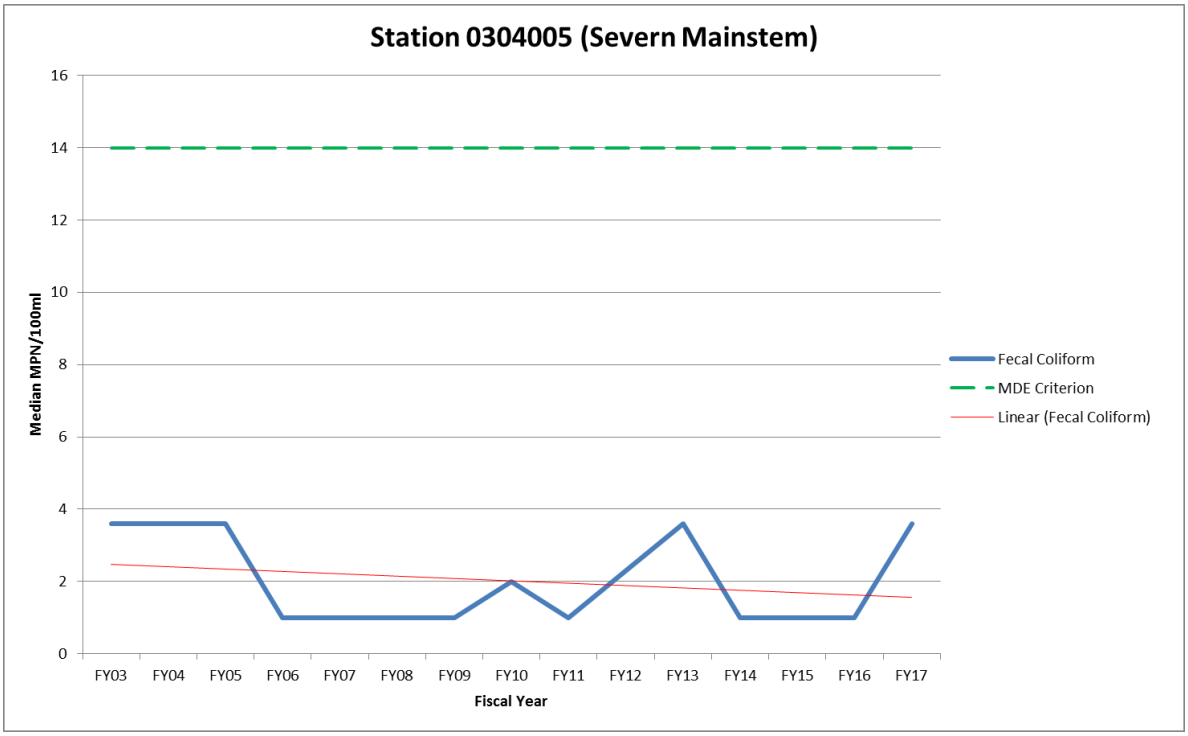
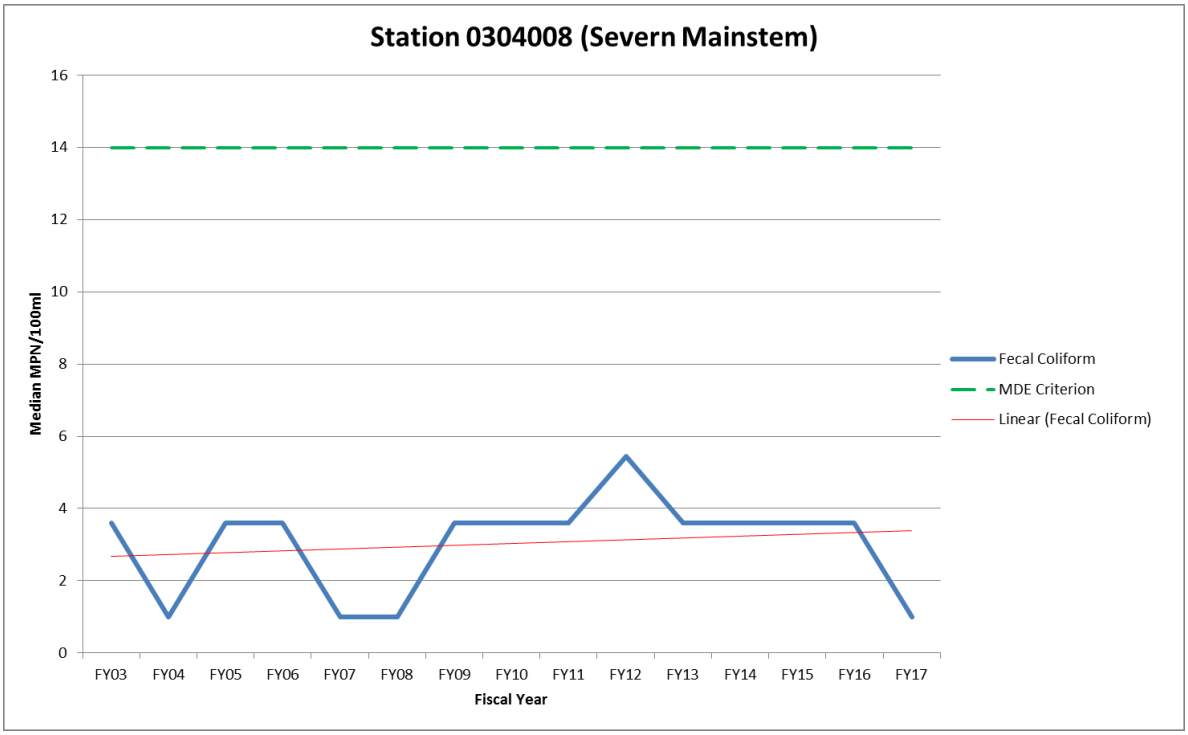
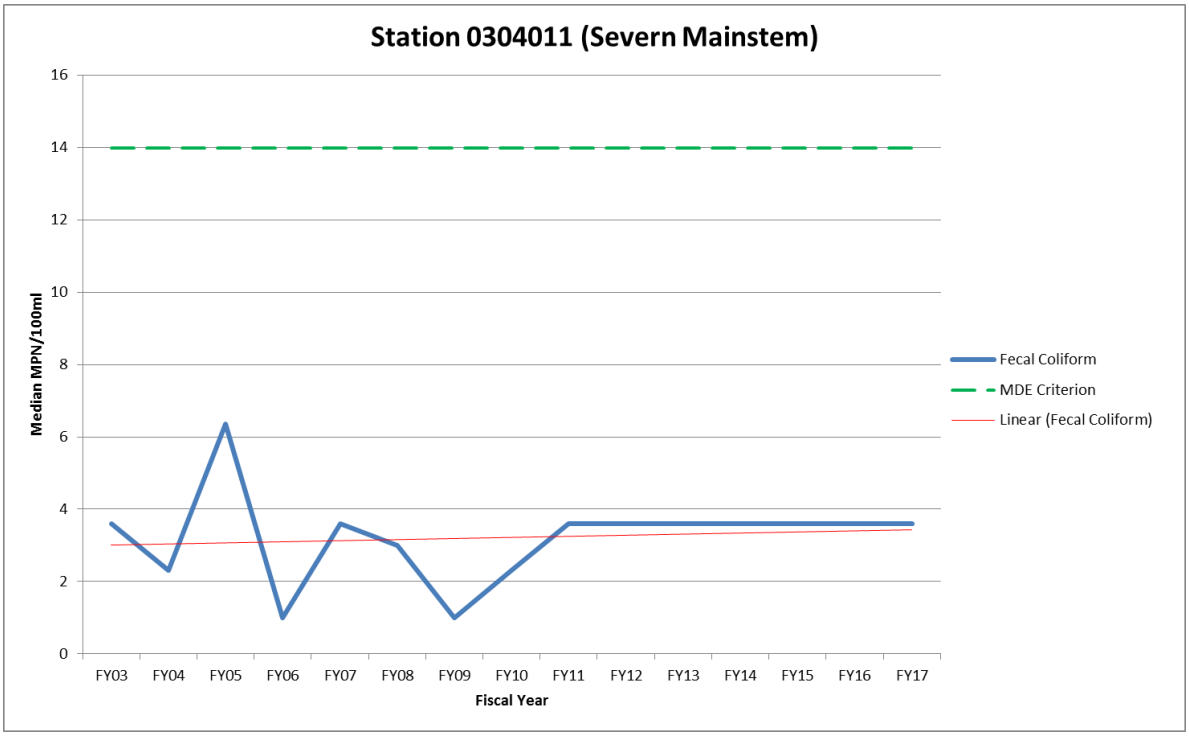
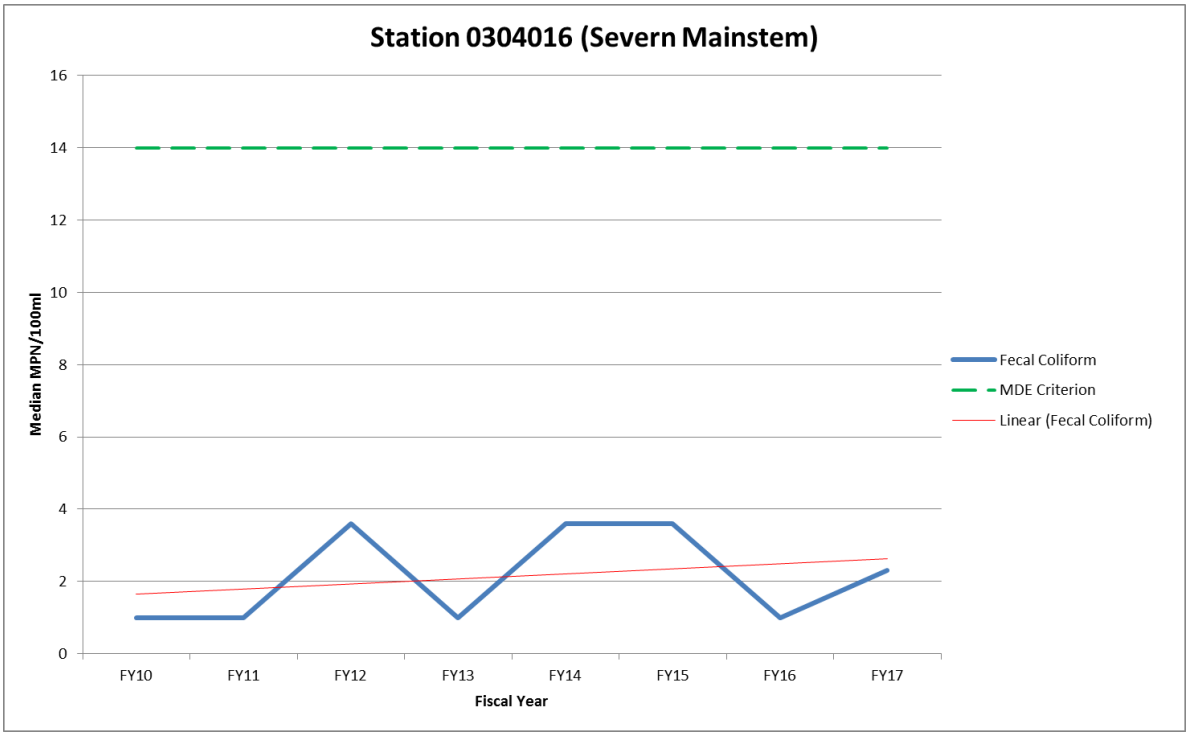
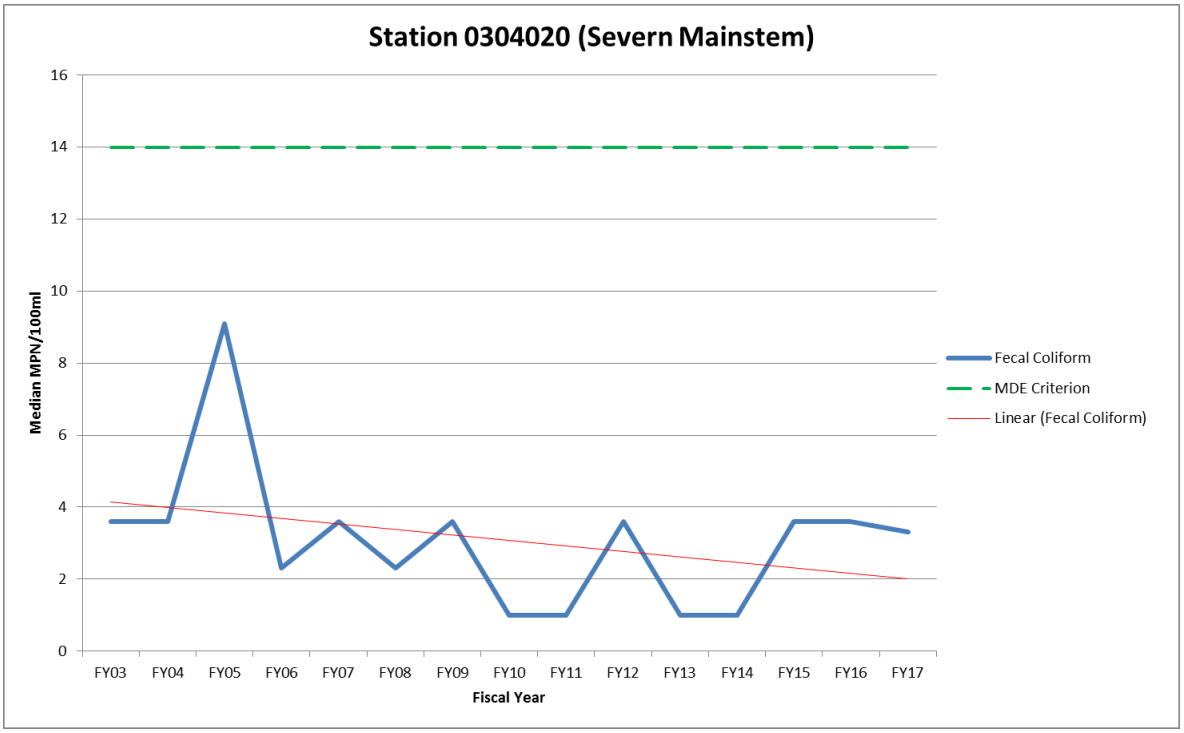
14
12
10
8
6
4
2
0
FY03
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

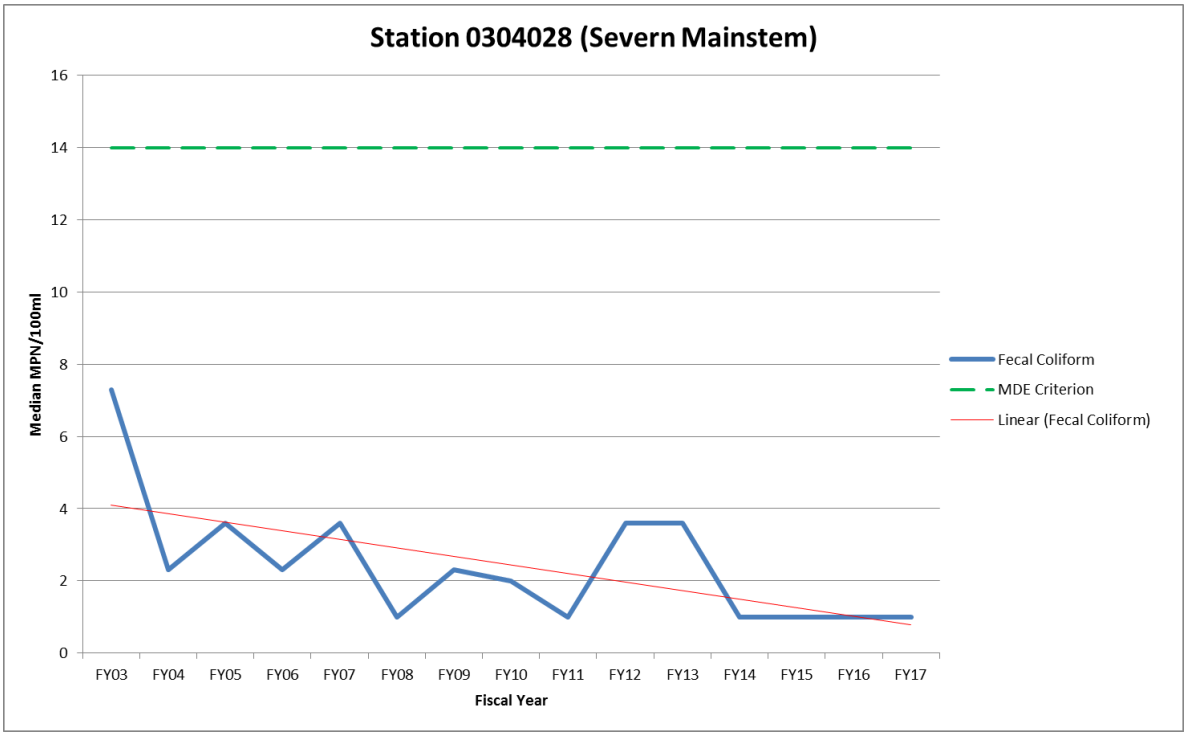

Station 0304005 (Severn Mainstem)
Median MPN/100ml
16
14
12
10
8
6
4
2
0
FY03
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)


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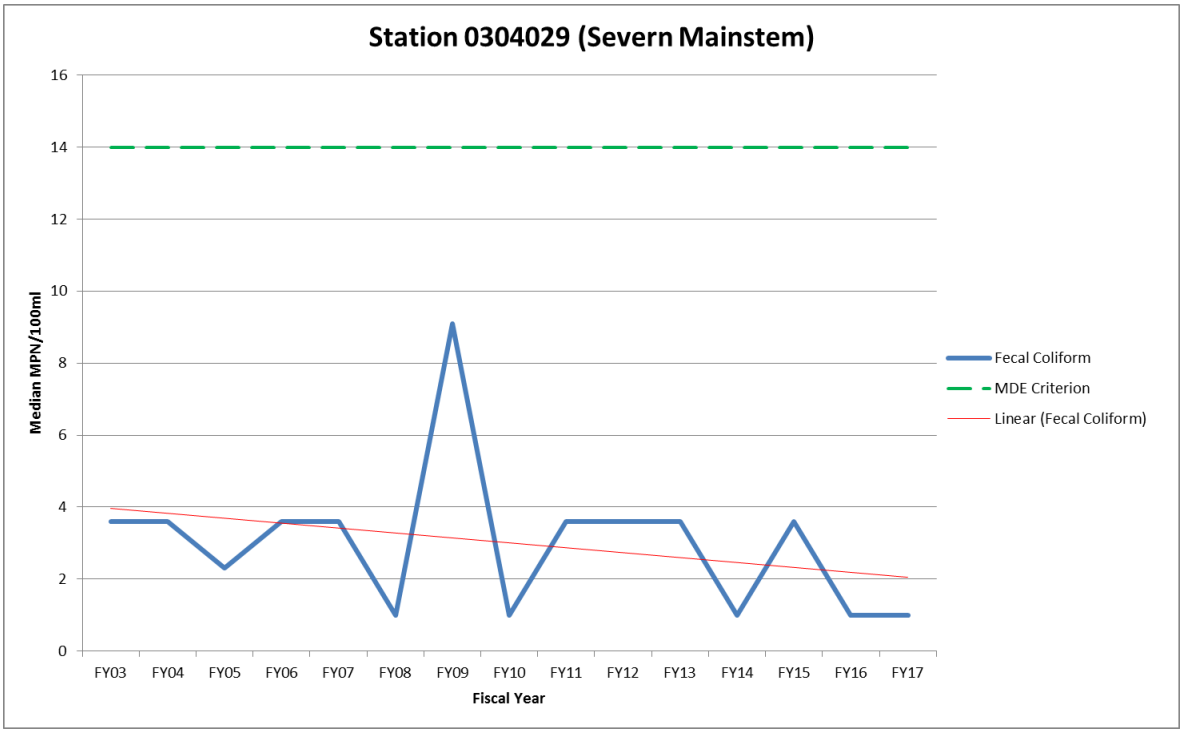
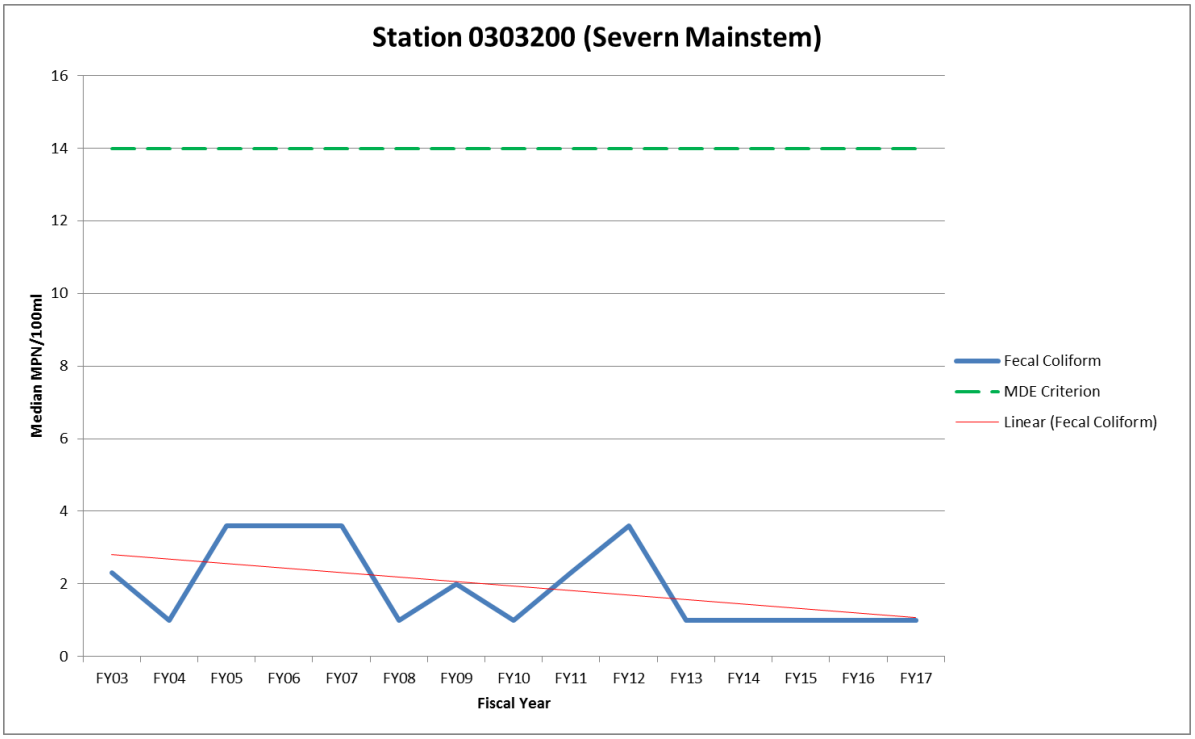
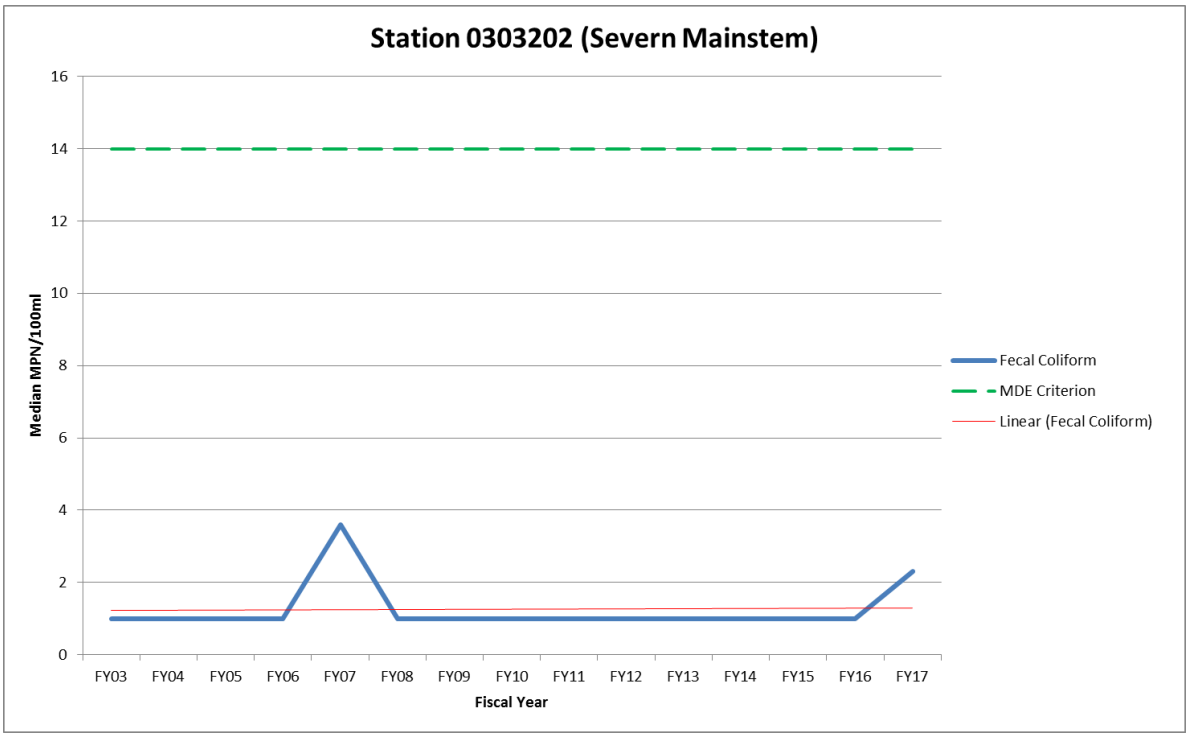
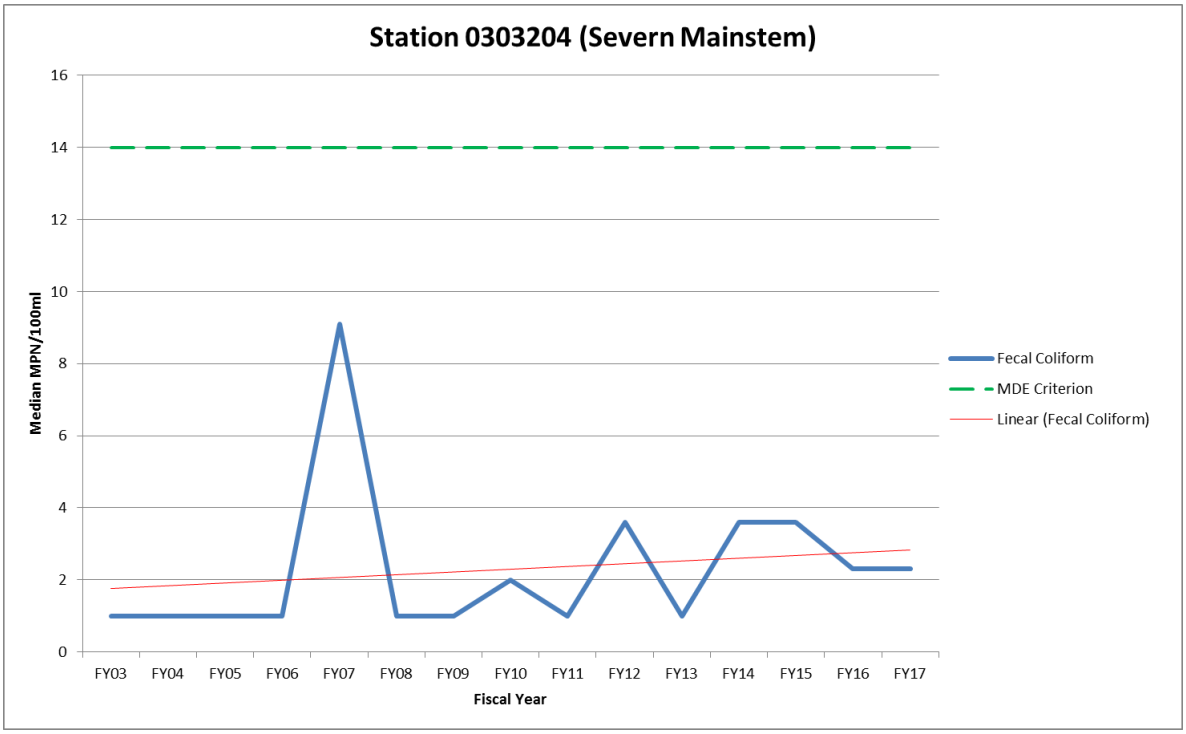
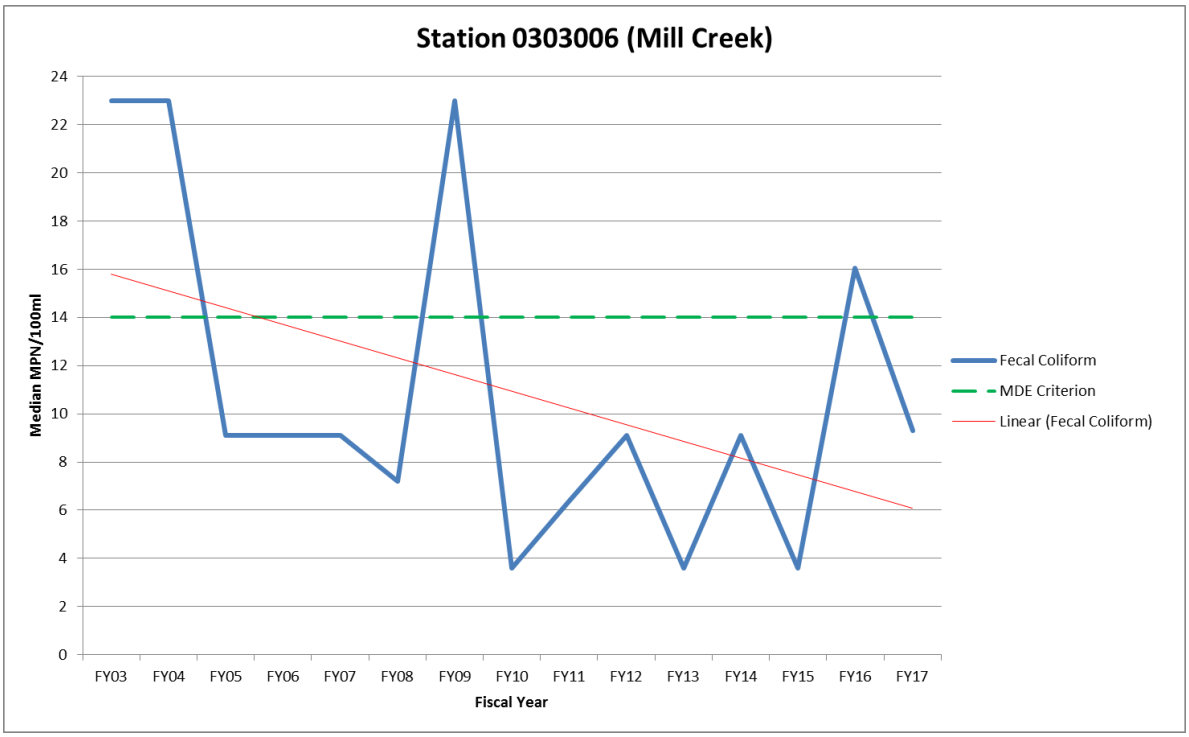
Median MPN/100ml
16
14
12
10
8
6
4
2
0
FY03
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

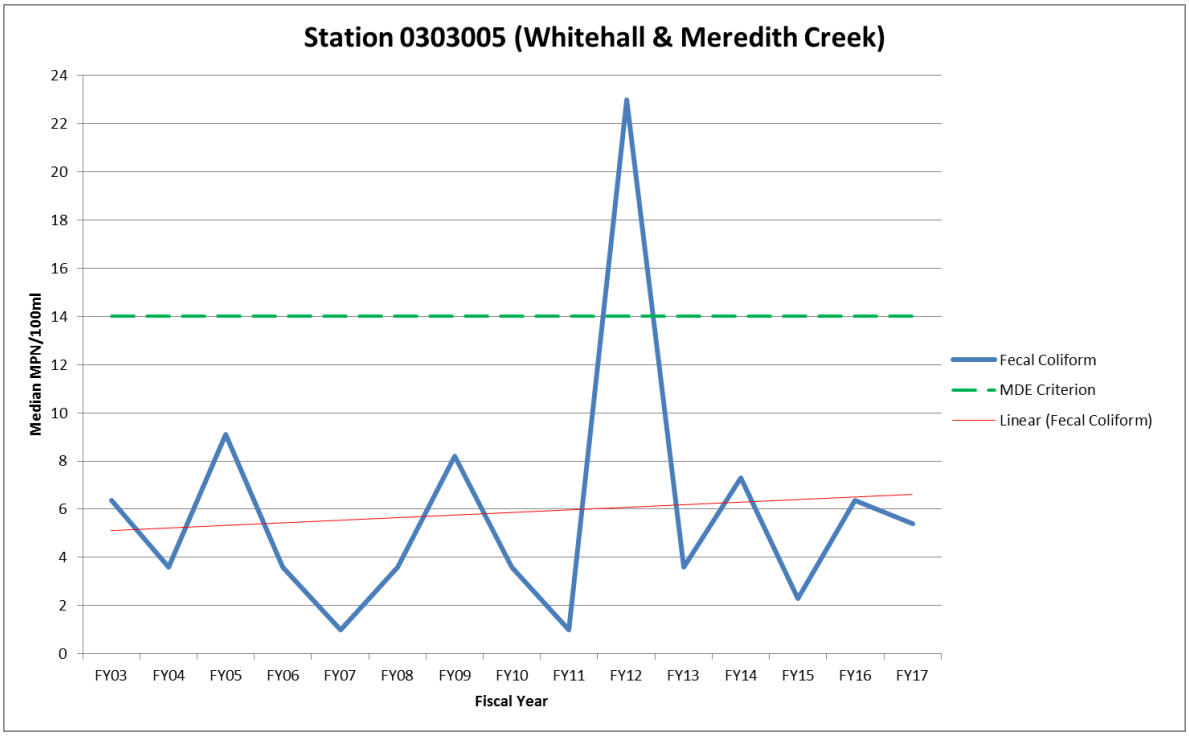

Station 0304029 (Severn Mainstem)
Median MPN/100ml
16
14
12
10
8
6
4
2
0
FY03
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

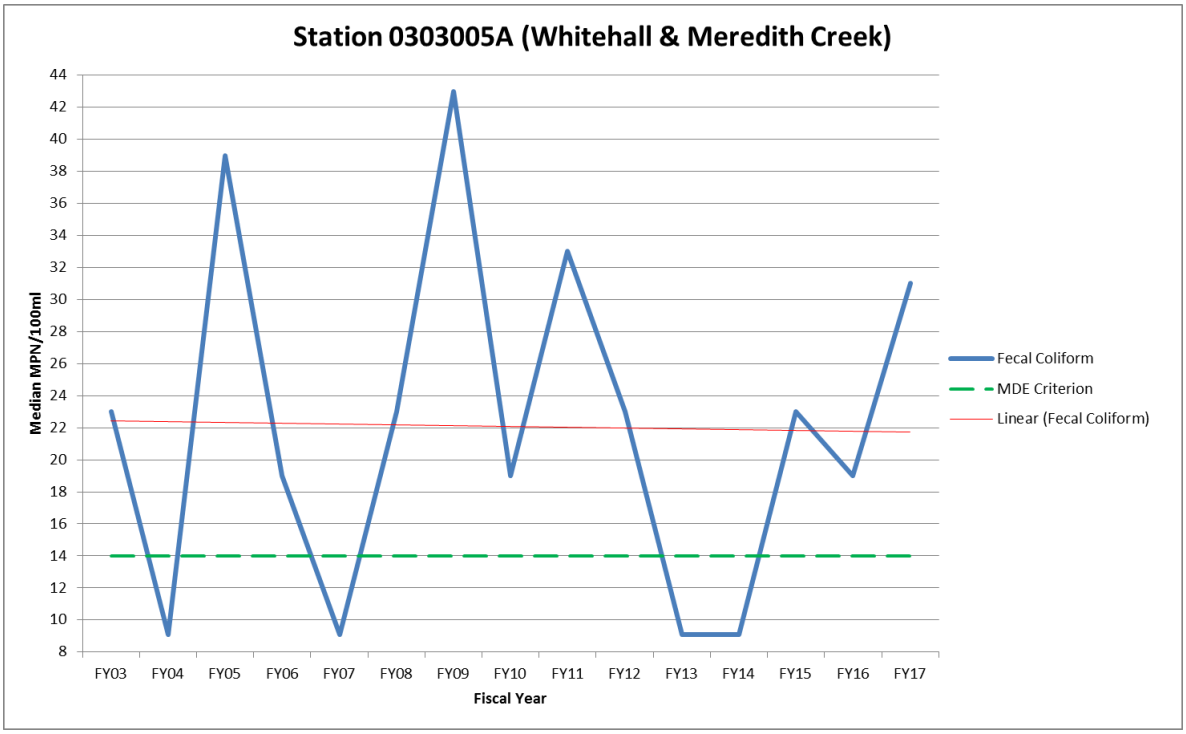

Station 0303200 (Severn Mainstem)
Median MPN/100ml
16
14
12
10
8
6
4
2
0
FY03
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

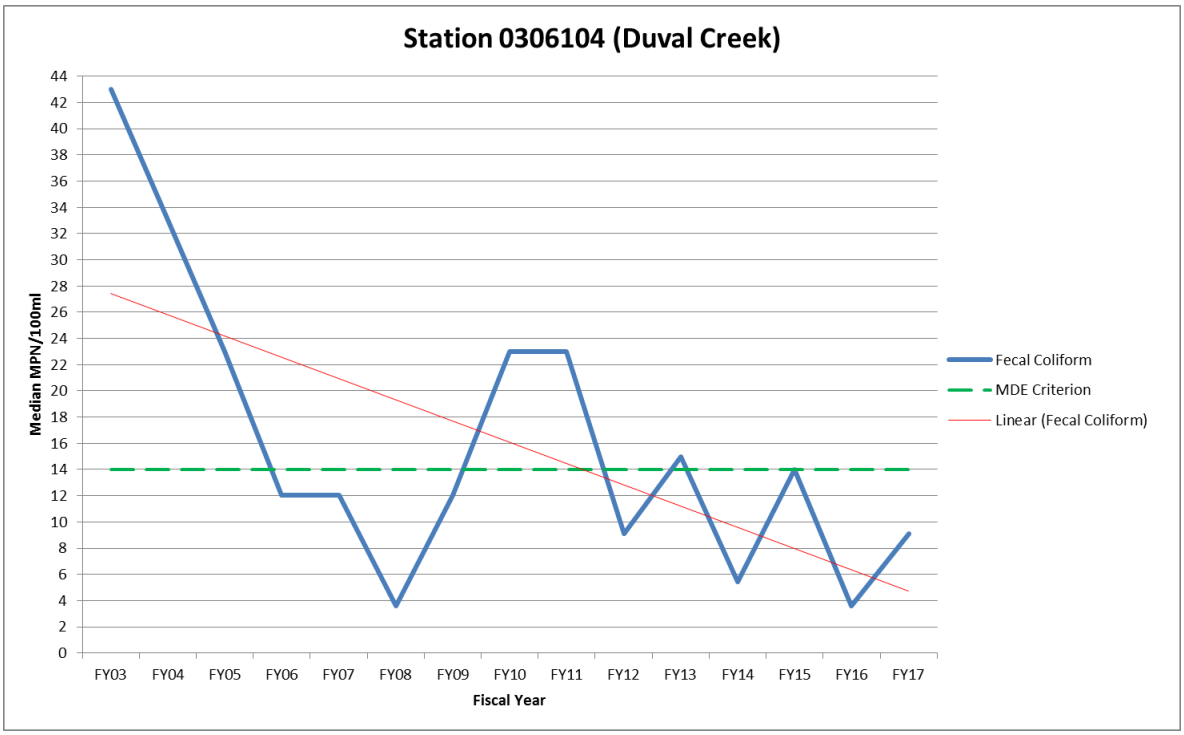

Station 0303202 (Severn Mainstem)
Median MPN/100ml
16
14
12
10
8
6
4
2
0
FY03
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

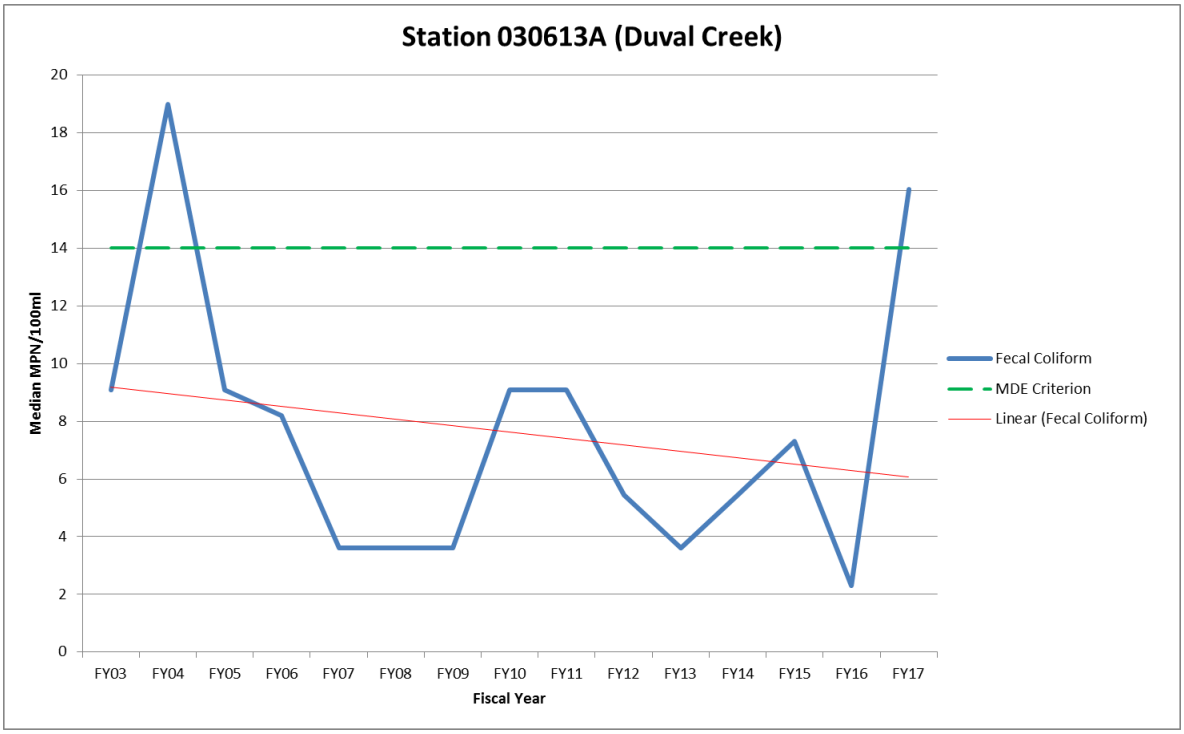

Station 0303204 (Severn Mainstem)
Median MPN/100ml
16
14
12
10
8
6
4
2
0
FY03
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

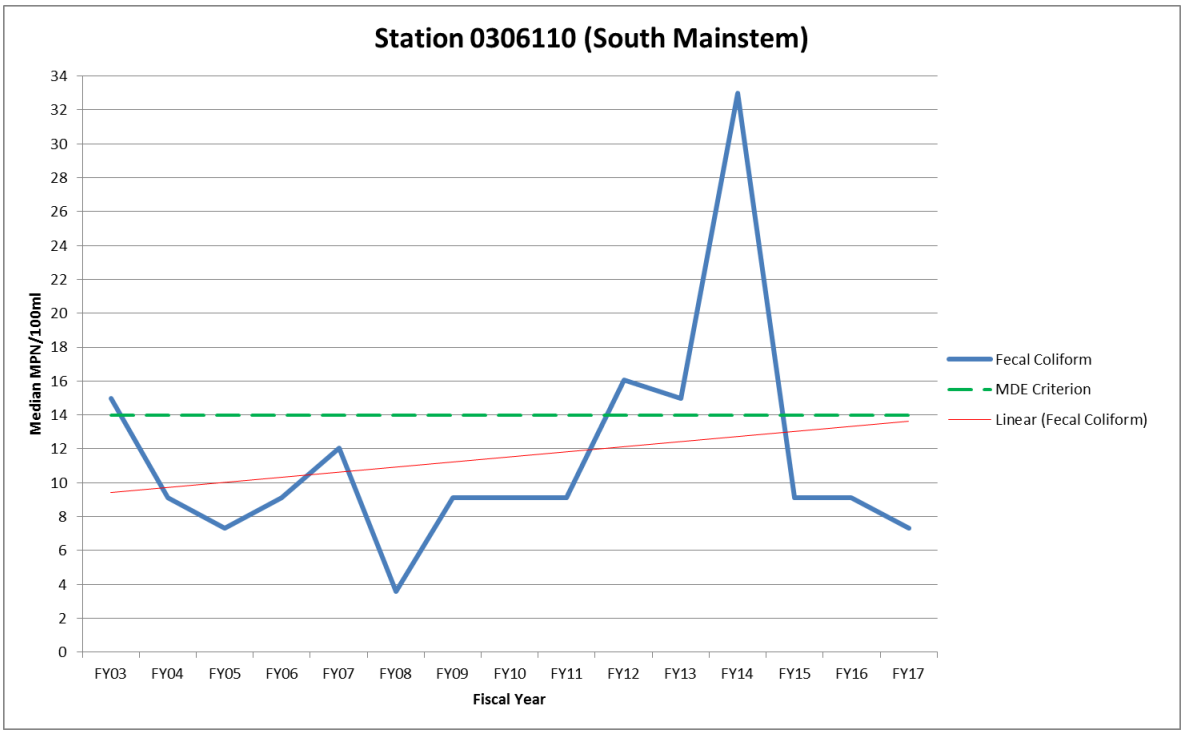

Station 0303006 (Mill Creek)
Median MPN/100ml
0
2
4
6
8
10
12
14
16
18
20
22
24
FY03
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

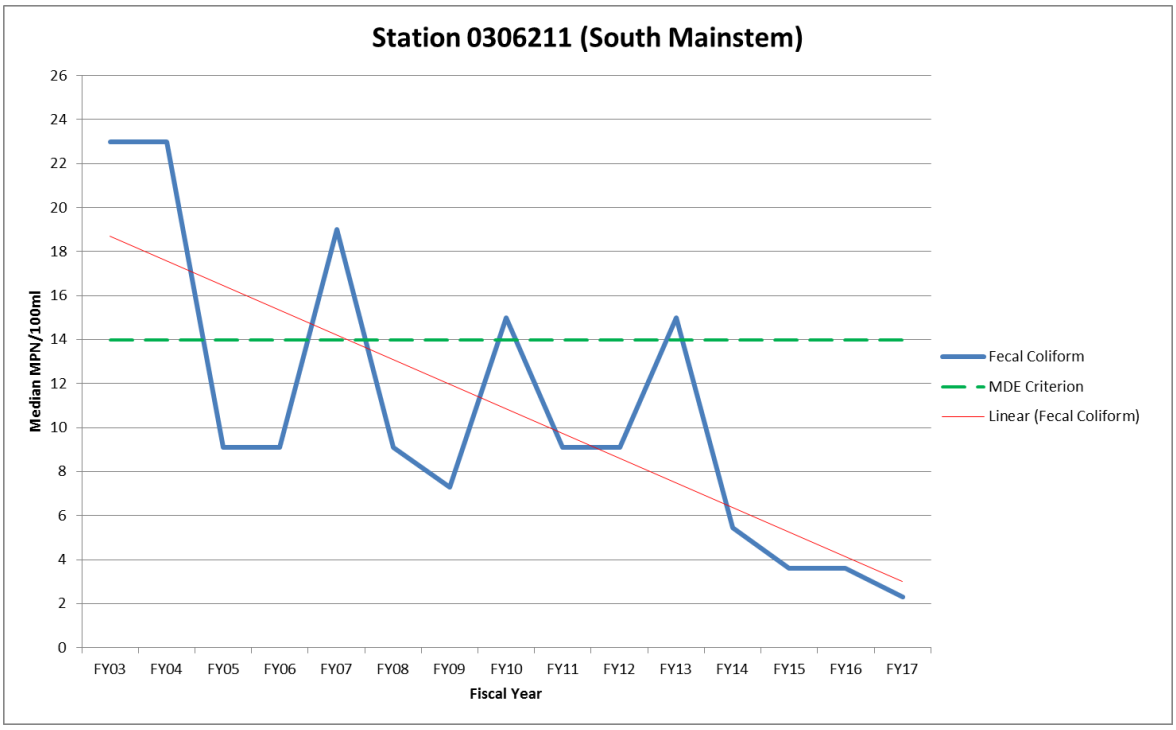

Station 0303005 (Whitehall & Meredith Creek)
Median MPN/100ml
0
2
4
6
8
10
12
14
16
18
20
22
24
FY03
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

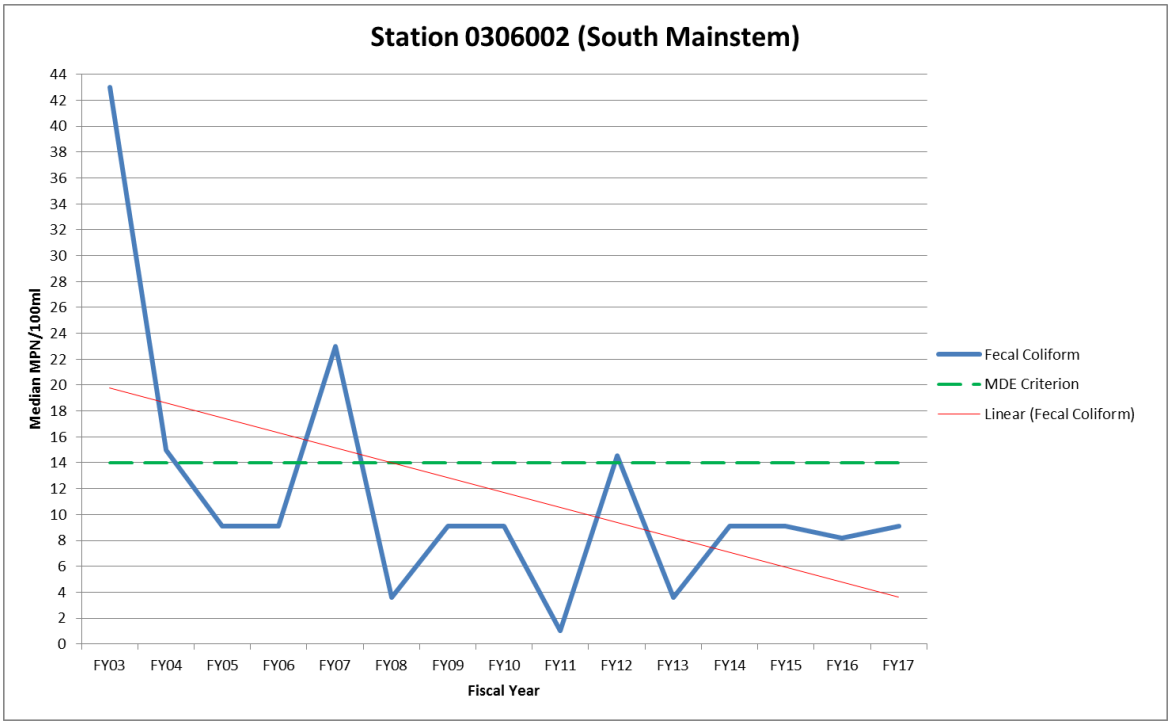

Station 0303005A (Whitehall & Meredith Creek)
Median MPN/100ml
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

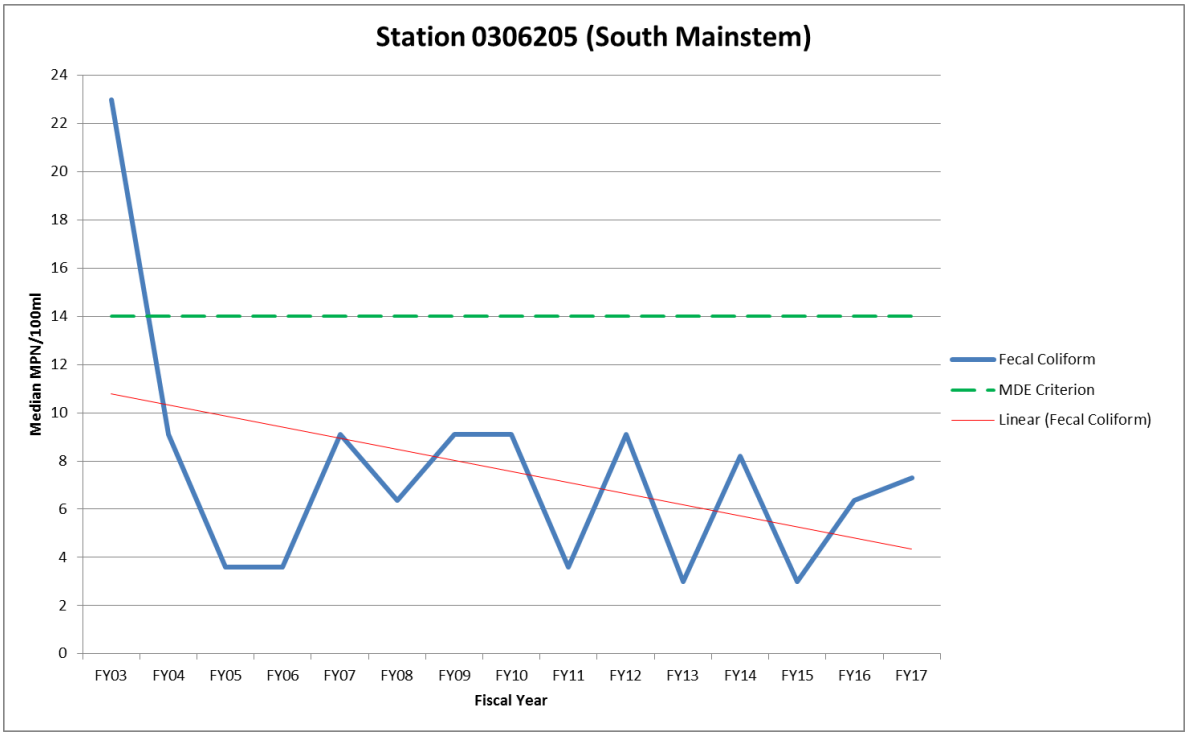

Station 0306104 (Duval Creek)
Median MPN/100ml
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
FY03 FY04 FY05 FY06 FY07 FY08 FY09 FY10 FY11 FY12 FY13 FY14 FY15 FY16 FY17
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

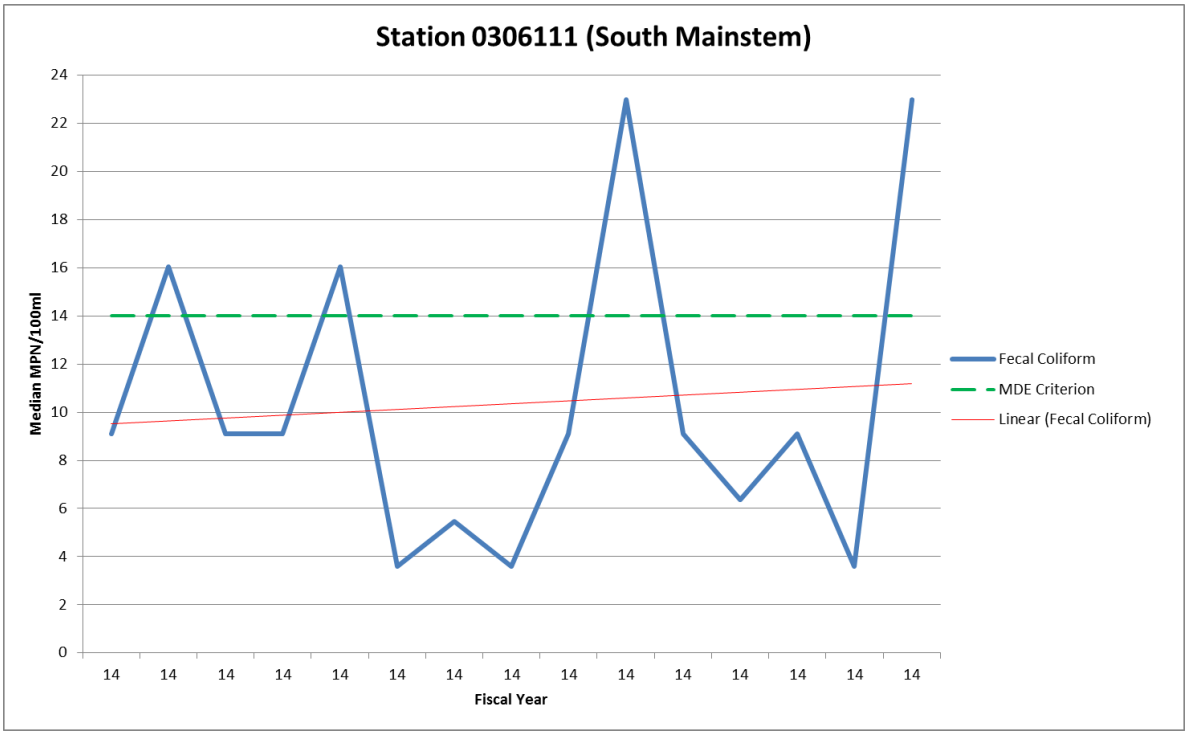

Station 030613A (Duval Creek)
Median MPN/100ml
0
2
4
6
8
10
12
14
16
18
20
FY03
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

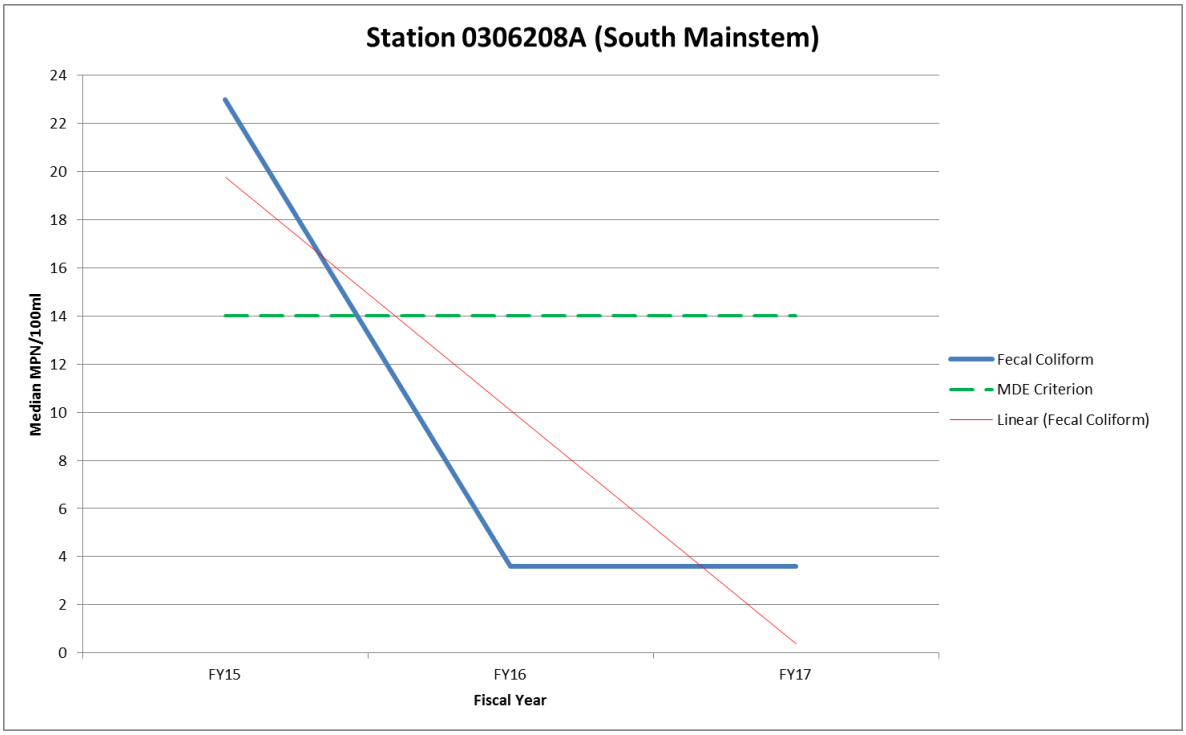

Station 0306110 (South Mainstem)
Median MPN/100ml
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
FY03
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

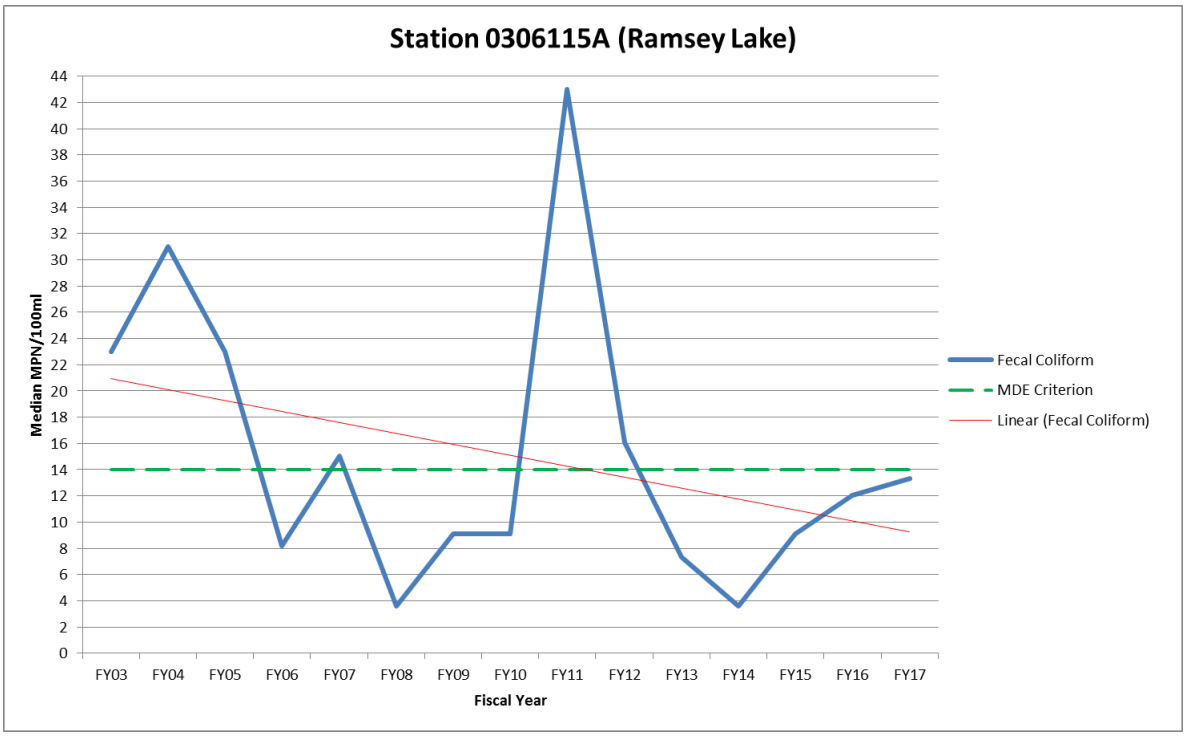

Station 0306211 (South Mainstem)
Median MPN/100ml
26
24
22
20
18
16
14
12
10
8
6
4
2
0
FY03
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

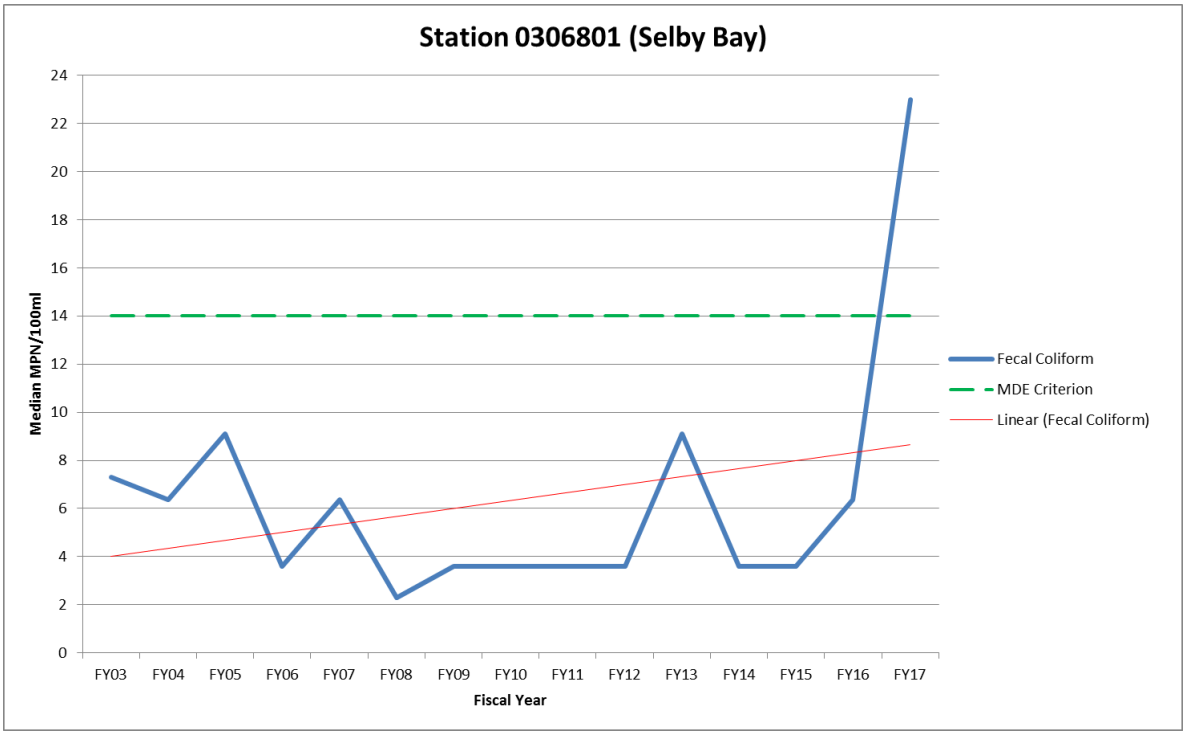

Station 0306002 (South Mainstem)
Median MPN/100ml
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
FY03
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

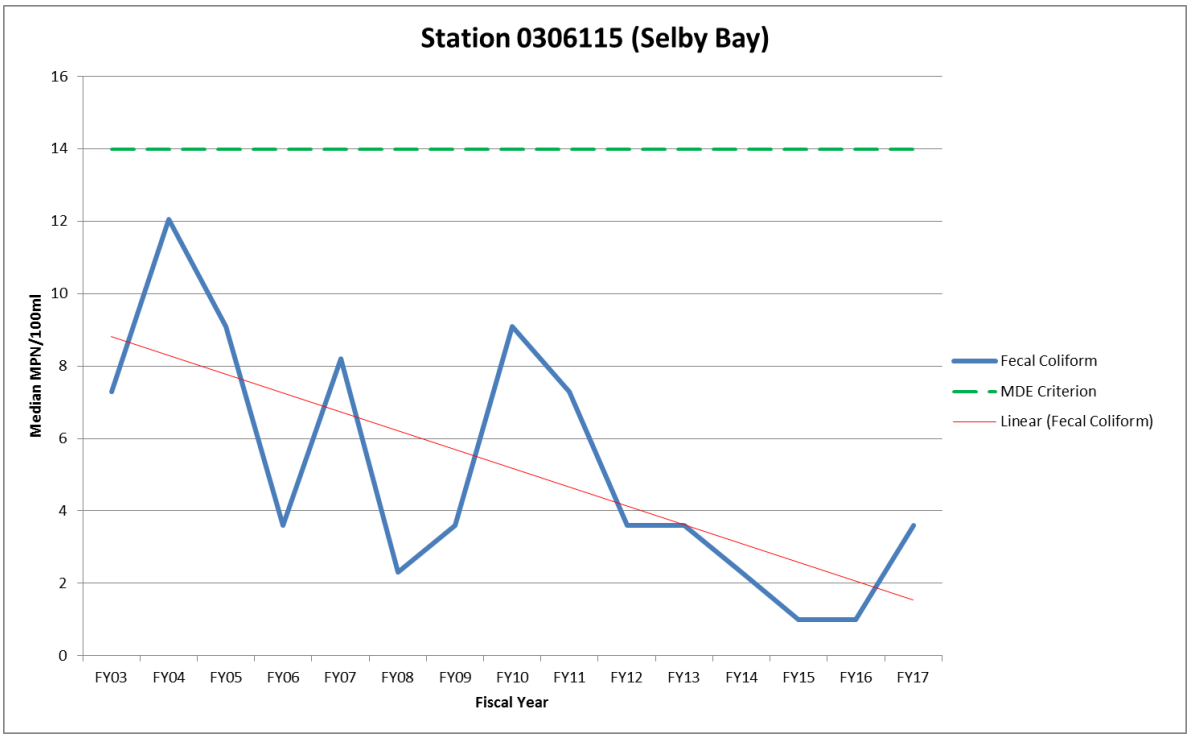

Station 0306205 (South Mainstem)
Median MPN/100ml
0
2
4
6
8
10
12
14
16
18
20
22
24
FY03
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

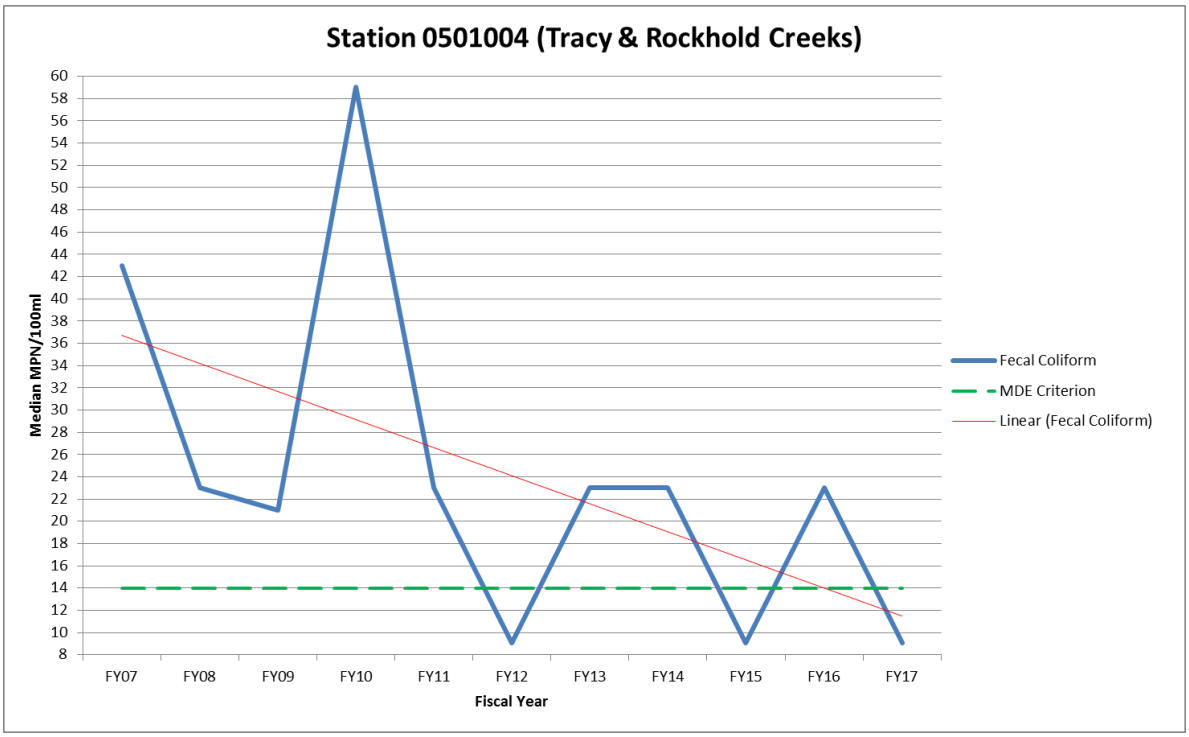

Station 0306111 (South Mainstem)
Median MPN/100ml
0
2
4
6
8
10
12
14
16
18
20
22
24
14
14
14
14
14
14
14
14
14
14
14
14
14
14
14
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

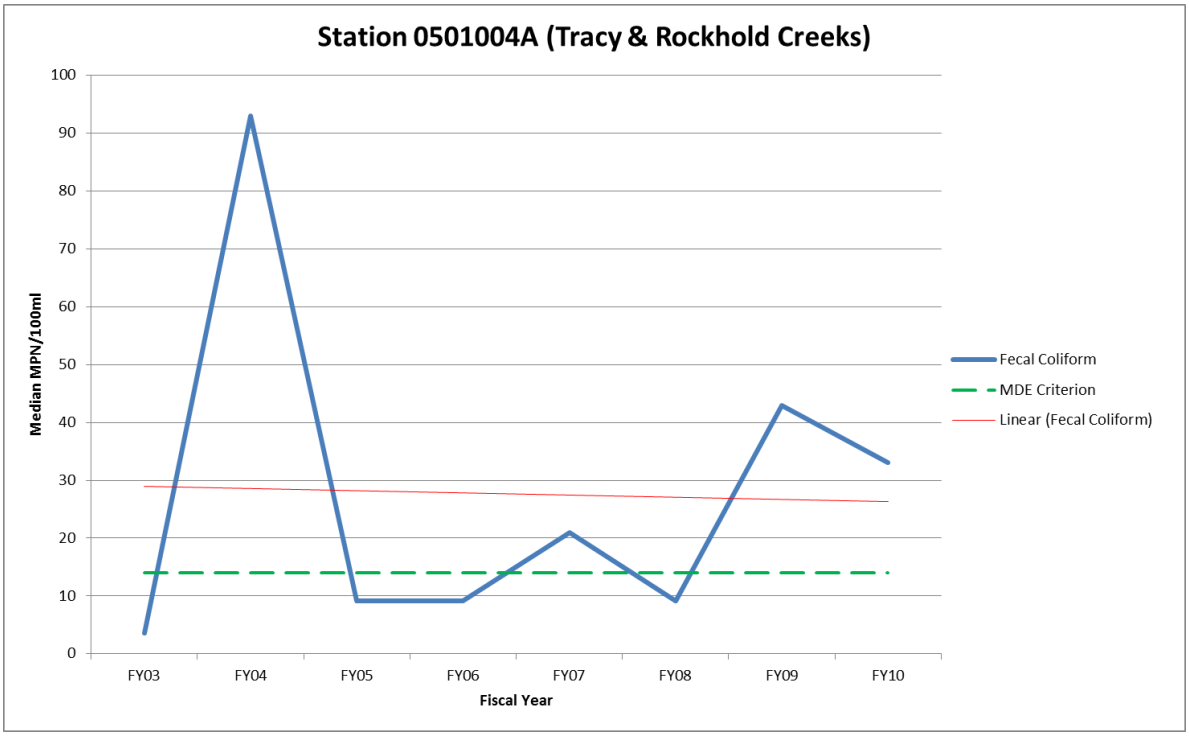

Station 0306208A (South Mainstem)
Median MPN/100ml
24
22
20
18
16
14
12
10
8
6
4
2
0
FY15
FY16
FY17
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

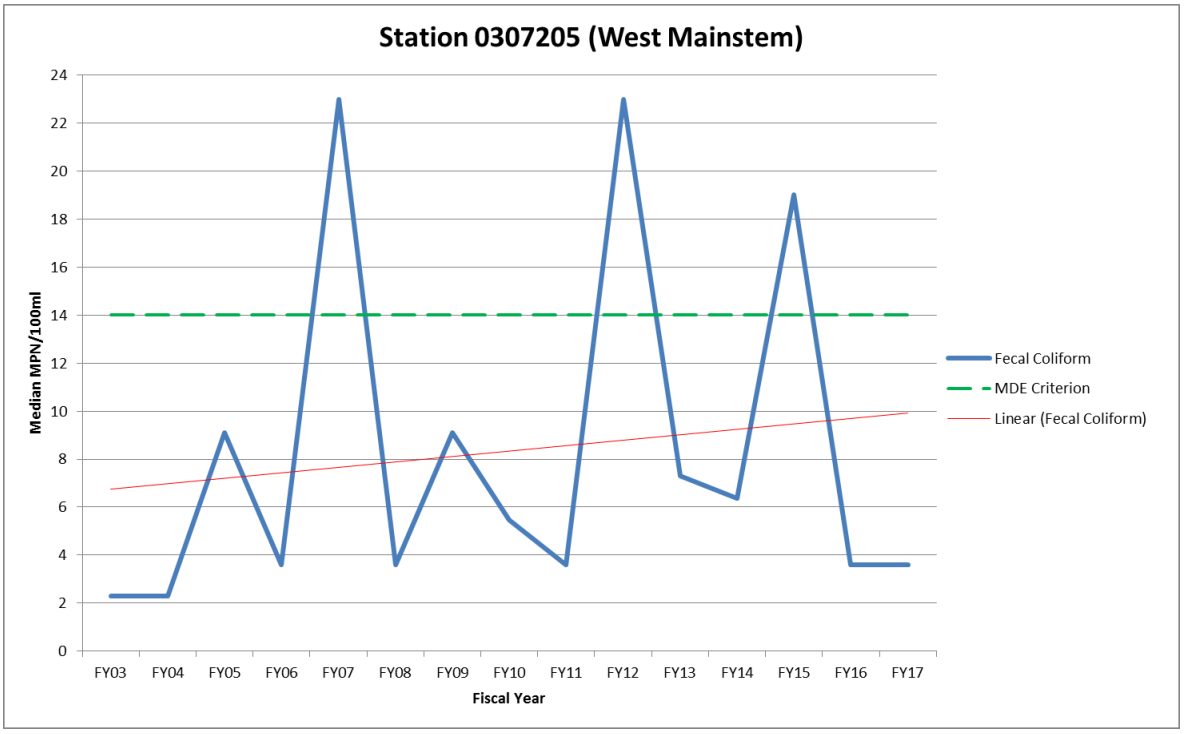

Station 0306115A (Ramsey Lake)
Median MPN/100ml
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
FY03
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

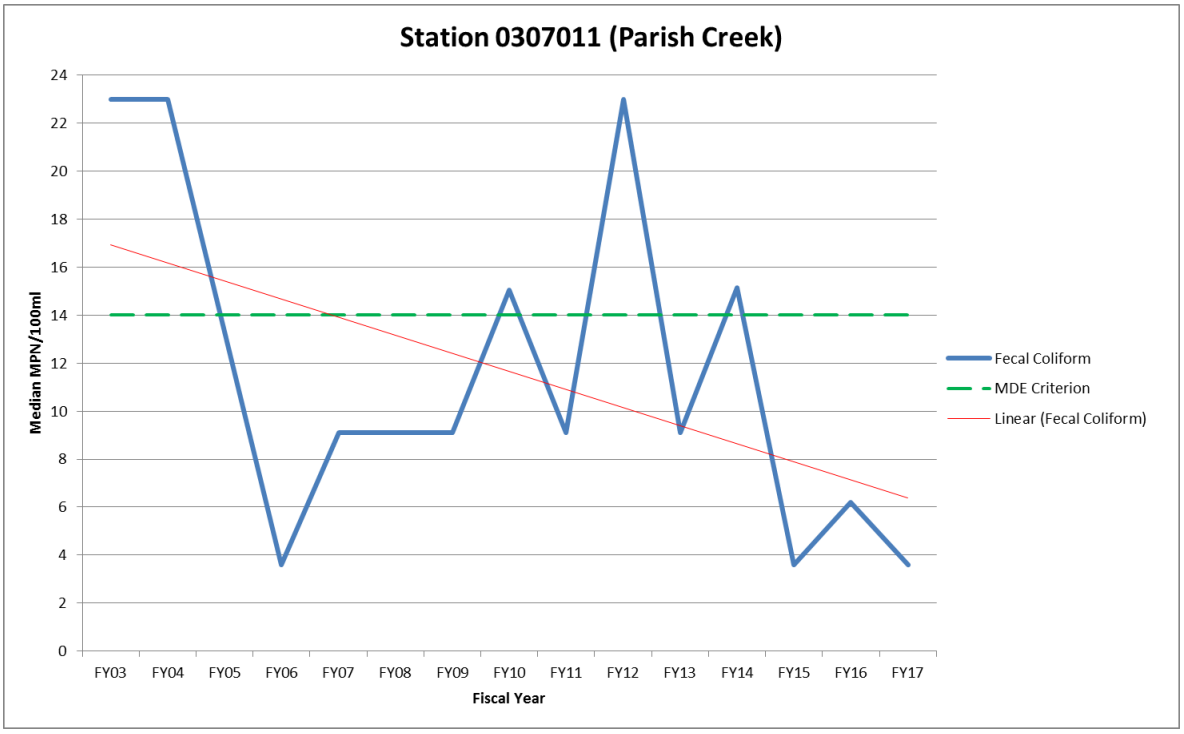

Station 0306801 (Selby Bay)
Median MPN/100ml
0
2
4
6
8
10
12
14
16
18
20
22
24
FY03
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)


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


Station 0501004A (Tracy & Rockhold Creeks)
Median MPN/100ml
100
90
80
70
60
50
40
30
20
10
0
FY03
FY04
FY05
FY06
FY07
FY08
FY09
FY10
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)


Station 0307205 (West Mainstem)
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
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)


Station 0307011 (Parish 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
Fiscal Year
Fecal Coliform
MDE Criterion
Linear (Fecal Coliform)

Appendix B: Response to MDE Comments

MDE Science Services Administration provided comments on the TMDL Compliance sections of Anne Arundel County's 2016 NPDES MS4 Annual Report on July 14, 2017. Anne Arundel County's Response to the comments on the 2016 Bacteria TMDL Annual Assessment Report follows:

MDE Comment 1:

The County provides a detailed report assessing progress towards Bacteria SW-WLAs throughout the County. Relative to the County's Tier 1 strategies, a lot of good information on recent activities related to IDDE, SSO elimination and sanitary sewer system repairs, and septic system connections is provided. For some of these, the County only provides information on recent years. It would be helpful for the purposes of demonstrating progress towards bacteria SW_WLAs to see how some of these activities have changed since TMDL baseline conditions (for most bacteria TMDLs in the County, baseline conditions are early 2000's). For instance, the County could provide a graph on the volume of SSOs since baseline conditions. Ideal trends would show SSO volumes decreasing over time, as sanitary sewer repairs occur. Or, the County could provide a graph showing the number of septic systems connected to the sanitary system over time, or the percent of households on septic vs sewer over time. Ideally, since baseline conditions we would see that the number of households hooked up over time, or the percent of households on sewer, has increased. These trends could then be used to explain any potential decreases in fecal bacteria concentrations reported later in Table 3 in the 2016 Annual Assessment.

County Response:

The County included a graph in its 2017 Annual Assessment showing the number of SSOs per year across all Bacteria TMDL watersheds. This graph, Figure 1, presents data from FY 2002 through FY 2017 and shows an overall downward trend in the number of SSOs over that time period.

MDE Comment 2:

To clarify, when the County refers to retiring septic systems, they are referring to connecting these systems to the sanitary sewer system, correct?

County Response:

That is correct.

MDE Comment 3:

The County indicates that it has plans to connect 20,000 septic systems to its sanitary sewer service system. It is assumed the plan is to connect these systems to an existing sanitary sewer service area and plant, correct? It is also assumed that the County has the capacity at the plant to handle these additional flows, correct?

County Response:

Yes, septic systems are connected to the County's sanitary sewer system within an existing sewer service area and existing wastewater treatment plant. Capacity is available at existing plants to handle these additional flows from the septic systems that are connected.

MDE Comment 4: The County makes excellent use of MDE's shellfish monitoring station data to assess progress towards the applicable bacteria TMDLs. A few suggestions. The County only reports the monitoring daa for the past several years, dating back to 2013. The County may want to consider presenting the data back to the TDML baseline conditions. The County could present graphs per station showing annual median concentrations. This would allow for a better trend analysis to see if these has been any decrease in median concentrations since the TMDL baseline conditions. The County may also want to include a comparison to the criteria concentrations as well. Lastly, for those watersheds where MDE does not have established monitoring stations (i.e., non-shellfish waters: Patuxent River Upper, Patapsco LNB, and Marley and Furnace Creeks), the County may want to consider establishing long term fecal bacteria monitoring stations of its own to assess progress and adaptively manage its bacteria SW-WLA implementation.

County Response:

In response to Comment 4A, the County analyzed all available data dating back to FY 2003 from MDE's Shellfish Harvesting Monitoring Program. . Results of the data analysis are discussed in Section 2.2. of the 2017 Annual Assessment report. The data is presented in Appendix A as graphs of median fecal coliform concentrations plotted over the time period from FY 2003 through FY2017 for each monitoring station. To date, the County has not established long term monitoring stations, but relies on MDE's Shellfish monitoring stations for data. However, in 2017 the County initiated bacteria monitoring in the headwaters of Furnace Creek which is listed as impaired for Enterococci. Water quality monitoring is being done in advance of a stream restoration project programmed for the watershed. During the pre-restoration monitoring occasional elevated bacteria (E. coli) counts and observation of an overflowing sewer manhole (repaired following discovery in 2017), prompted a more thorough investigation of conditions along the channelized portion of the stream upstream of the water quality monitoring station. During the summer of 2017, the County collected additional bacteria samples from locations along the mainstem that bracket know sewer crossings, as well as from storm drain outfalls discharging to the reach of interest. These samples are collected under base flow conditions and, as possible, during storm events. Sampling will continue until project construction is initiated.