

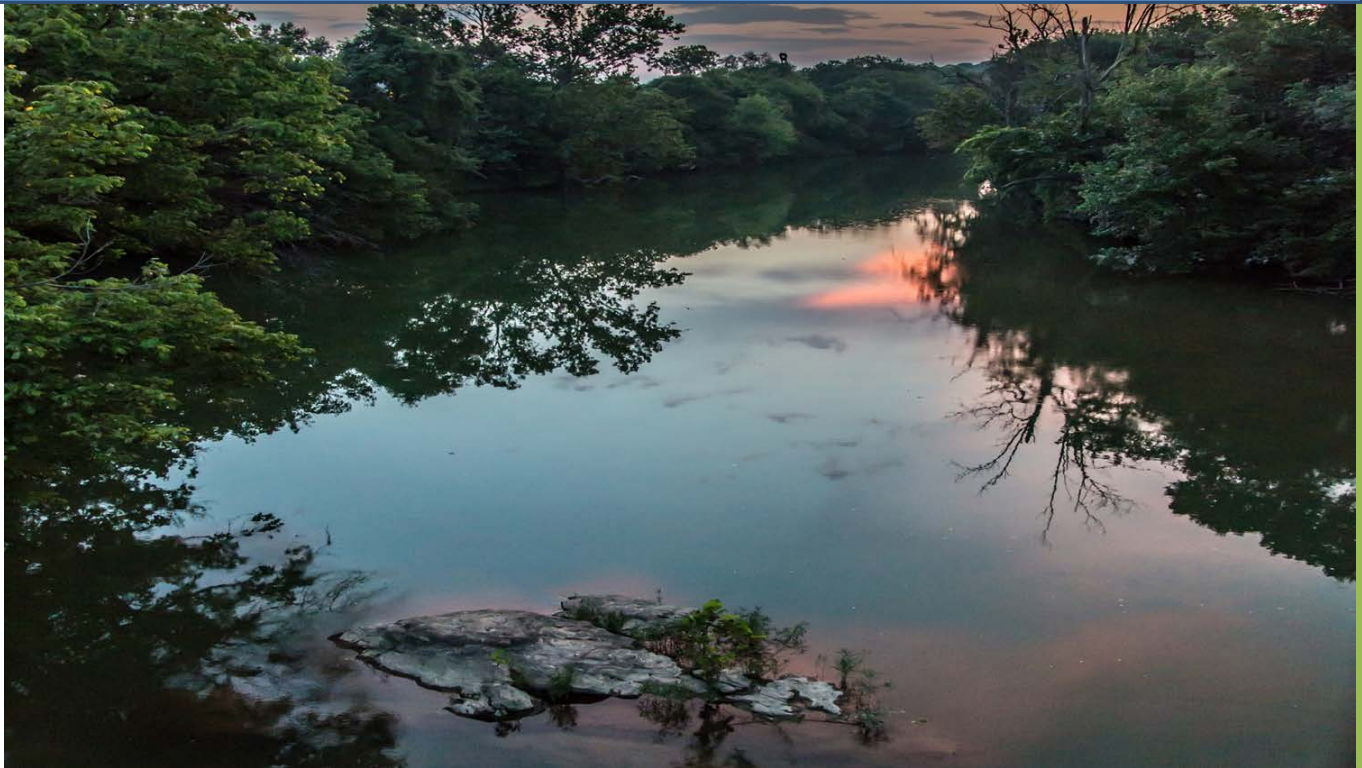


Submitted to:

*The Virginia Department of
Environmental Quality*

*Blue Ridge Regional DEQ Office
MS4 Stormwater Permitting Division
3019 Peters Creek Road
Roanoke, VA 24019*

City of Roanoke Sediment and Bacteria TMDL Action Plan



Effective July 1, 2015



*Stormwater Utility
Public Works Service Center
1802 Courtland Road, NE
Roanoke, VA 24012*

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SECTION 1: BACKGROUND

1.1 ESTABLISHED TMDL'S AND WLA'S

Bacteria Total Maximum Daily Loads (TMDLs) have been created for the following tributaries in the Upper Roanoke River Watershed: Carvin Creek, Glade Creek, Laymantown Creek, and Lick Run which all flow into Tinker Creek. Additionally, Wilson Creek, Ore Branch, and the Roanoke River are impaired by bacteria and have established TMDLs. The Roanoke River also has an established TMDL for Benthic Invertebrates.

The following stream assessments were included with the Roanoke River TMDL Implementation Plan as nested segment impairments and are applicable to the City: Mason, Mudlick, Murray Run, and Peters Creek.

- MapTech, Inc., Virginia Tech Crop & Soil Sciences, and Roanoke Valley-Alleghany Regional Commission. (March 2004). *Fecal Coliform TMDL Development for Glade, Tinker, Carvin, Laymantown, and Lick Run*. Retrieved from:
<http://www.deq.virginia.gov/portals/0/DEQ/Water/TMDL/apptmdls/roankrvr/tinkerfc.pdf>
- George Mason University and Lewis Berger Group, Inc. (February 2006). *Bacteria TMDL for Wilson Creek, Ore Branch and Roanoke River Watersheds*. Retrieved from:
<http://www.deq.virginia.gov/portals/0/DEQ/Water/TMDL/apptmdls/roankrvr/uroanec.pdf>
- Lewis Berger Group, Inc. (March 2006). *Benthic TMDL Development for the Roanoke River, Virginia*. Retrieved from:
<http://www.deq.virginia.gov/portals/0/DEQ/Water/TMDL/apptmdls/roankrvr/uroanbc.pdf>
- Lewis Berger Group, Inc. (April 2015). *Roanoke River Bacteria and Sediment TMDL Implementation Plan, Appendix A*. Retrieved from:
http://www.deq.virginia.gov/Portals/0/DEQ/Water/TMDL/ImplementationPlans/Drafts/Upper_Roanoke_Draft_IP.pdf

Verified 6/13/15:

<http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/TMDL/TMDLDevelopment/ApprovedTMDLReports.aspx>

The following table provides a summary of the Waste Load Allocations (WLAs) that are under the jurisdiction of the City MS4. These figures represent the portions of the specified surface water body that fall within the municipal boundary of the City of Roanoke (henceforth referred to as the "City").

Surface Water Body	Benthic Macro Invertebrates-Sedimentation	Bacteria - E. Coli
Roanoke River	953 tons/yr	1.93E+11 cfu/yr
Tinker Creek		2.24E+12 cfu/yr
Carvin Creek		1.04E+12 cfu/yr
Glade Creek		1.13E+11 cfu/yr
Lick Run		6.84E+10 cfu/yr
Ore Branch		2.02E+10 cfu/yr

Impaired streams without a separate TMDL study and identified MS4 WLA were added as nested segments in the Roanoke River Bacteria and Sediment TMDL Implementation Plan. These load allocations (LAs) labeled as “nested” reference non-point pollution sources throughout the entire identified watershed.

Mason Creek		4.42E+12 cfu/yr (nested LA)
Peters Creek		1.50E+12 cfu/yr (nested LA)
Mudlick Creek, Murray Run, and Ore Branch		8.59E+11 cfu/yr (nested LA)

1.2 SIGNIFICANT SOURCES OF POC’S OWNED BY THE OPERATOR

As part of the City’s Virginia Pollutant Discharge Elimination System (VPDES) permit requirements for Permit Year 2012-2013, a list was compiled of all City properties, and then examined to determine which properties may contain the potential for releasing TMDL priority pollutants (bacteria & sediment). The list is mostly comprised of office buildings and park structures with no significant sources of priority pollutants; the exception is the Public Works Service Center which houses field operations that were identified as having the potential to release pollutants.

The Public Works Service Center (PWSC) at 1802 Courtland Road, NE serves as a base of field operations for many City functions including the Transportation, Stormwater and Solid Waste Management Divisions within the Public Works department and the Fleet Management and Facilities Management Divisions within the General Services Department. Also included are the Parks Division of the Parks and Recreation Department and the Radio Technology Division of the Department of Technology.

The 12.5 acre PWSC campus houses operations for all elements of public right-of-way maintenance, solid waste and recycling collection, City-owned facility maintenance, City-owned fleet maintenance and park maintenance. The PWSC also houses bulk petroleum storage; participates in bulk petroleum transfer; and open stores mulch, sand, and similar aggregate materials; fertilizer, insecticides, and pesticides; waste paint; and generation of other hazardous wastes. Additionally, solid waste trucks parked on site contribute to the potential of solid waste leachate and other parked vehicles may contribute to residual fluids on pavement. These combined risks have led to the identification of this property as potential sources for priority TMDL pollutants.

In the permit year 2014-2015, the City added two dog parks as significant sources due to the potential for larger than normal bacterial contamination loads. Thrasher Park has a fenced, leash free acre-sized dog yard which is located within both Tinker Creek and Glade Creek watersheds and is geographically closer to Glade Creek. Highland Park also features a leash free acre-sized dog yard and is in close proximity to the Roanoke River. No additional areas have been identified.

SECTION 2: OPERATOR EFFORTS AT REDUCING POLLUTANT LOADS

2.1 LEGAL AUTHORITIES

2.1.1 Stormwater Management Ordinances – City Code Chapter 11

Primary TMDL Target: Sediment and E. coli bacteria.

Chapter 11.3 – Stormwater Discharge Requirements

This chapter of City Code provides controls to prevent illicit discharges of pollutants into the stormdrain system as mandated for the City's MS4 permit under the National Pollutant Discharge Elimination System (NPDES) and Clean Water Act.

Section 11.3-4 includes language to prohibit discharge of any method and material whether purposeful or accidental and prevents illegal connections to the stormdrain system.

Section 11.3-5 gives the City the authority to inspect and monitor the stormdrain system to determine compliance including testing at illicit discharge sites.

Chapter 11.5 – Stormwater Utility

This chapter of City code created the City's Stormwater Utility and took effect on July 1, 2014 with the intent to provide dedicated resources to operate and maintain the City's stormwater drainage system, improve water quality, and comply with the legal requirements of the City's MS4 permit.

Additionally, the Stormwater Utility is to address drainage challenges by designing, managing and implementing capital improvement design projects in combination with best management practices that address effective stormwater movement and flooding concerns while improving water quality.

Chapter 11.6 – Stormwater Management

This chapter of City code was created is to minimize and mitigate the adverse effects of land development. The City Ordinance, under the new Chapter 11.6 titled *Stormwater Management*, outlines the technical criteria for developing Stormwater Pollution Prevention Plans (SWPPPs) for some regulated land-disturbing activities. Land disturbing activities include development or redevelopment projects with a disturbed area of 10,000 sq. ft. or more. These permit-based activities are subject to plan review, construction inspection, as-built plan review, maintenance requirements, and long-term inspection to insure proper function of BMP's. The Stormwater Management Ordinance gives the City authority to enforce requirements by issuing notices of violation, stop work orders, fines and civil penalties. The Stormwater Management Design Manual provides standards to successfully abide and implement the City's Stormwater Ordinance.

Implementation Schedule and Key Milestones:

- FY2014-2015 – City Code Chapter 11.6 - Stormwater Management Ordinance was fully revised to reflect new VSMP requirements and went into effect July 1, 2014.
- FY2014-2015 – City Code Chapter 11.5 - Stormwater Utility was created provide dedicated funding for stormwater management to protect the general health, well-being and safety of the City's residents and went into effect July 1, 2014.

2.1.2 Solid Waste Ordinance – City Code Chapter 14.1

Primary TMDL Target: Sediment and E. coli bacteria.

This chapter of City code promotes public awareness and education about all aspects of Solid Waste Management including acceptable and unacceptable solid/hazardous waste materials for collection. Dumping of solid wastes within the City limits is prohibited at any place not designated by the City. Littering, as a form of dumping is also strictly prohibited.

Chapter 14.1 also mandates that fats, oils, and grease resulting from food preparation must be kept at all times in a tamper resistant, watertight, stationary, and anchored container. The container and surrounding area must be kept clean and sanitary while spillage or leaks of the fats, oils or grease from the container must not be allowed to enter the right-of-way or stormdrain system. If a spillage incident occurs, owner or occupant must notify emergency management by calling 911.

Further, the City arranges to hold special dates for bulk & brush collection and bagged leaf collection.

Finally, the City is a member of the Roanoke Valley Resource Authority (RVRA) which handles all household hazardous waste. As a result of the City's membership, its residents are able dispose of chemical wastes at the RVRA site on every 3rd Saturday throughout the year. The RVRA located at 1020 Hollins Road, Roanoke, VA.

Implementation Schedule and Key Milestones:

Centralized Waste Compactors:

- FY2013-2014 - The City began operation of the first of 5 planned centralized waste management compactors located within our downtown central business district. The compactors provide for all necessary solid waste containment and disposal needs of downtown residents and commercial facilities in discrete centralized locations that are equipped with security cameras and radio frequency identification (fob) controlled access. This program has greatly reduced the amount of solid waste and related liquid run-off that previously occurred with decentralized curbside collection of bagged waste, thereby reducing sediment and bacteria pollution. *Note that restaurants are still required to maintain their own waste fats, oils and grease recycling facilities per City Code.
- FY2014-2015, two additional identical compactors began operation in other sectors of the central business district.
- FY 2015-2016 - A fourth sealed compactor was installed in another section of the central business district. Downtown Roanoke Inc. (DRI) continued to purchase additional smaller public-use solar belly compactors for the central business district. These donated units replaced standard metal litter containers.
- FY 2016-2017 - A fifth sealed compactor was installed in another section of the central business district. This completes the plan for sealed compactors servicing the central business district. Once this is placed into service no further curbside trash or recycling collections will take place within the central business district. DRI is also planning on purchasing additional two solar compactors and donate them to the city.

Single Stream Recycling:

- FY2015-2016 - The City began Single Stream Pick-up of household recyclables on October 5, 2015.
- FY2016-2017 - The City made available a Recycle Coach App to help citizens track collection dates based on addresses, set calendar reminders for collection dates, holiday schedule changes, and a disposal database of what items can be recycled in our area.

Leaf and Bulk Waste Collection:

- FY2015-2016 - On October 5, 2015 the City initiated a weekly collection of brush and bulk waste. Leaves packed in biodegradable bags are collected both in the fall on designated weeks and one week in the spring. Information is posted via brochures and social media.

Fats, Oils and Grease:

- FY2016-2017 - City Departments including Solid Waste, Office of Environmental Management and the Stormwater Division, along with Downtown Roanoke Inc. are working on a plan to enhance restaurant grease management in the CBD. The group is gaining information through selective survey to establish what downtown restaurants' protocols are for grease disposal as well as cleaning range hood filters and grease traps. The goal is to determine what grease management education is needed and if a mandatory SOP for grease management for downtown restaurants needs to be created.
- FY2017-2018 - Evaluate and revise Solid Waste Ordinance to specifically address FOG wastestream.
- FY2017-2018 - Create multi-lingual educational materials on FOGs to be direct mailed to target audiences.
- FY2017-2018 - Evaluate inlet marking in CBD locations to see where additional inlets marking should be implemented.

2.1.3 Sewers and Sewage Disposal Ordinance – City Code Chapter 26

Primary TMDL Target: All pollutants including Sediment and E. coli bacteria.

This chapter of City code authorizes The Western Virginia Water Authority (WWA) to provide water, sewer service, and sewage treatment to the residents of the City.

Chapter 26-1.1. - Sewer use standards of the Western Virginia Water Authority including sewer connection and acceptable hook-up standards.

Chapter 26-11. - Discharge of contents of septic tank cleaning trucks into sanitary sewer

Chapter 26-45. - Prohibited discharges

2.1.4 Zoning Ordinance – City Code Chapter 36

Primary TMDL Target: Sediment and E. coli bacteria.

Chapter 36.2-335 - River and Creek Corridors Overlay District (RCC)

This section of the City's zoning ordinance recognizes the value of the Roanoke River and its tributaries and designates a level of protection for riparian buffers, thereby supporting the natural functions that riparian buffers provide. A riparian buffer must be 50' in width as measured horizontally on a line perpendicular to the surface water, landward from the top of the bank on each side of the river or tributary and every effort must be made to retain and support indigenous vegetation. The district imposes restrictions on plant removal, clearing and grading, as well as, land uses and development activities. The riparian buffer district is required to be clearly marked on-site prior to any land disturbing activities and remain in place throughout the duration of the

project. This district works in conjunction with base zoning district regulations and the Floodplain Overlay District.

Implementation Schedule and Key Milestones:

FY 2015-2016 – Stormwater reviewed the River and Creek Corridors Overlay to identify gaps in coverage.

FY 2016-2018 – The Stormwater Division will work with the Planning Department to see if the RCC Overlay District can be expanded to include all parcels adjacent to a surface water body (see Combined Table: Goal 1(A-D)).

Chapter 36.2-333 - Floodplain Overlay District

This section of the City’s zoning ordinance outlines mandatory floodplain restrictions for FEMA compliance and additional standards to restrict impervious surfaces within the floodplain, ultimately reducing threats to loss of life and property and optimizing water quality. All development within the floodplain must be issued a zoning permit by the Zoning Administrator and include a standard FEMA elevation certificate by a licensed surveyor or engineer. The floodplain district allows for the storage of materials and equipment provided that they are not buoyant, flammable, or explosive and that such material shall be firmly anchored to prevent floatation or movement.

Implementation Schedule and Key Milestones:

FY2016-2017 – The City’s floodplain ordinance must be amended and adopted to be in complete compliance with the National Flood Insurance Program (NFIP).

FY 2017 – The City’s Floodplain Overlay District (ordinance) was revised, adopted, and is available [online](#).

2.1.5 Right-of-Way Excavation Permits – City Code Chapter 30

Primary TMDL Target: Sediment

Chapter 30 – Article III – Street Excavations

This article of City code chapter 30 requires a permit to be obtained before any excavation or opening in the pavement surface of any City street, alley or public right-of-way. The permit requires that Stormdrain inlets be protected during work; that no excavation may be left uncovered at night; and that the excavation must be fully restored in accordance with City Right-of-Way Excavation Permit standards.

2.1.6 Assembly & Street Vending Permits – City Code Chapter 30

Primary TMDL Target: Sediment and E. coli bacteria

Chapter 30 – Article VI – Permit for Public Assemblies and Sec. 30-9.2.- Street Vending

These sections of City code chapter 30 require a permit to be obtained before conducting a public assembly on any public street, sidewalk, alley or other portion of the public right-of-way, or in any public park or on any public property. Further, section 30-9.2 requires vendors to obtain a permit before vending food or beverages, or both, either within city rights-of-way or on city-owned properties, including, but not limited to, public parks and greenways. Permits require a trash receptacle within 20’ of site if a public receptacle is not available. Collection and daily waste removal to a proper receptacle is also required. Location of trash receptacles should

not obstruct pedestrian and vehicular flow nor should they present a hazard to general public health, safety and welfare.

Liquid wastes including, but not limited to, grease, oil, trash, washing and sanitizing water must be collected, managed, and disposed of properly in a liquid waste tank or septic collection service to avoid accidental spills and contamination of the City stormdrain system.

2.2 PRACTICES, TECHNIQUES, AND DESIGNS

2.2.1 Streetsweeping

Primary TMDL Target: Sediment and E. coli bacteria.

The streetsweeping program is an integral part of the City’s sediment and bacterial reduction plan, because we recognize the association between bacteria and sediment loading in the Roanoke River and its tributary watersheds. The City’s streetsweeping section also collects animal carcasses to reduce bacterial contamination and health concerns. During FY2016-2017, 1,240 carcasses were collected, a decrease from 1326 in FY2015-2016.

The City’s streetsweeping program covers 1287 lane miles. Total lane miles swept are tracked and tonnage of sediment and debris removed is recorded prior to disposal at Roanoke Valley Resource Authority.

The Central Business District and the Arterial/Collector streetsweeping frequency will remain unchanged as the current frequency is already optimized. The City is planning to expand the residential streetsweeping program as shown below which is slightly adapted from the 2016-2017 Action Plan. The City purchased two new regenerative air sweepers (Combined Table: Goal 2, C) which were in use as of 12/13/16 and began daily use on 1/12/17. Four new crew members have been hired from January-July 2017 in order to achieve sweeping residential streets three additional times, enabling the City to reach the 7,208 residential lane mile goal. A full-time sweeper mechanic was added to staff to optimize streetsweeper field operations due to sweeper repair downtime.

- 901 lane miles for Residential Streets
 - FY 2015-2016 = Cycle completed 4x = 3,604 total residential lane miles/year
 - FY 2016-2017 = Cycle completed 5x = 4,505 total residential lane miles/year
 - FY16-17 91% of 4 cycle achieved = 3,280.
 - FY 2017-2018 = Cycle completed 8x = **7,208 total** residential lane miles/year
- 48 lane miles Central Business District/Business District/Industrial Districts
 - FY 2015-2018 = **6,581 total lane miles/year** (Cycle varies by location and district.)
- 338 lane miles Arterial/Collector Streets
 - FY 2015-2018 = Cycle completed 12 times = **4,056 total arterial lane miles/year**

Implementation Schedule and Key Milestones:

Street Sweeping Program				
Program Year	Projected Lane Miles Swept	Projected Tons Removed	Estimated Lane Miles Swept	Actual Tons Removed
FY 2014-15			13,430	1264.17

FY2015-16	14,241 lane miles	1281.69	14,241	1299.18
FY2016-17	15,142 lane miles	1362.78	13,917	1444.84
FY2017-18	17,845 lane miles	1662.00	17,845	TBD

2.2.2 Stormdrain Cleaning

Primary TMDL Target: Sediment and E. coli bacteria.

The City purchased an additional Vactor truck during FY2015-2016 for a total of two Vactor trucks in service. These Vactor trucks will be used to remove sediment and debris from the 10,033 existing stormdrain inlets and 415.6 linear miles of existing stormdrain pipe. This BMP aids in reducing the floatables, sedimentation and other pollutant sources before they reach the 930 stormdrain outfalls that flow directly into the Roanoke River and its tributaries.

The City's stormdrain maintenance crews are equipped with two CCTV Inspection trucks that can be used to identify and gain more information on any stormdrain and pipeline issues, including investigating illicit discharges.

The City's stormdrain maintenance crews are updating the stormdrain asset inventory and concurrently verifying the City's stormdrain GIS layer data using an iPad ArcGIS Collector App. GPS-enabled technology readily identifies stormdrain features on GIS including manholes, pipe orientation, termination points and outfalls. The watershed asset inventory verification is in conjunction with the development of the City's individual tributary Watershed Master Plans that are being developed in collaboration with Virginia Tech's Department of Civil and Environmental Engineering.

Implementation Schedule and Key Milestones:

Stormdrain Asset Inventory:

FY2014-2015 Lick Run Asset Inventory

- Verification of the Lick Run watershed asset inventory began in March 2015 and was completed September 11, 2015.

FY2015-2016 Tinker Creek, Glade Creek, Carvin Creek

- Verification of Tinker, Glade, and Carvin watershed asset inventory began in October 2015 and was completed June 2016.

FY2016-2017 Trout Run

- Verification of Trout Run inventory began in June 2016 and was substantially completed July 2017.

FY2017-2018 Peters Creek

- Peters Creek watershed asset inventory has begun and is projected to be complete by summer 2018.

Subsequent asset inventory verification will be completed for all other watersheds within City limits: Barnhardt Creek; Mud Lick Creek, Murdock Creek; Murray Run, Ore Branch; and the Roanoke River.

CCTV Inspection

- FY2014-2015 – 17,479 linear feet of the stormdrain system were inspected.
- FY2015-2016 – 73,099 linear feet of the stormdrain system were inspected.
- FY2016-2017 – 331,927 linear feet of the stormdrain system were inspected for this reporting fiscal year, which is 22% of the City's existing stormdrain system.
- FY2015-2016 - Additional Vector Truck and CCTV Inspection truck will be added to Stormwater Fleet as well as replacement of an existing CCTV Inspection truck
 - FY2016-17 Additional Vector Truck is on order with anticipated arrival in October and projected to be in service in November.
 - Two new CCTV trucks were in service as of February 2016. The new CCTV trucks have allowed considerable progress to be made on stormdrain system inspections with average length of 759'/day.
- FY2016-2017 - CCTV Inspection goals: 90,000-120,000' year/crew for a total asset inventory and inspection length of 180,000'-240,000' or 16 % of the City's existing stormdrain system. [The CCTV Inspection goals remain the same for FY 2017-2018.](#)
- FY2016-2017 - Stormdrain cleaning goal is to clean 900-1200 inlets/year/crew or 12% of City's existing stormdrain inlets. [The Stormdrain cleaning goal remains the same for FY 2017-2018.](#)
- FY2016-17 Investigate options for better containment and ease of debris removal at Vector Truck dump site. The existing area is cleaned out once a week with an average decanted weight of 12-13 tons. Estimated annual removed tonnage at 42 weeks is 504 tons.
 - [For FY 2017-2018 - Estimated annual removed tonnage at 52 weeks is 179.81 tons. This figure is based on Roanoke Valley Resource Authority weight tickets.](#)

2.2.3 Illicit Discharge Detection and Elimination (IDDE)

Primary TMDL Target: All pollutants including E. coli bacteria and Sediment

As a part of the City's MS4 permit and in compliance with MCM#3, the City's Office of Environmental Management (OEM) oversees IDDE activities. This program completes field screenings to identify potential illicit discharges during dry weather on a minimum of 50 outfalls annually by permit year. The program follows through on any potential or confirmed illicit discharge or illegal connections through established Standard Operating Procedures (SOP) for response and enforcement of the IDDE ordinance and process for tracking violations and actions taken.

Implementation Schedule and Key Milestones:

Outfall Inspections

- FY2015-2016 – Outfall inspections were conducted using a fillable PDF form on iPads and then saved to the City's network. This system was found to be inadequate for staff needs.

- FY2016-2017 – With the hire of a full-time Stormwater GIS employee, the goal is to develop a GIS-based system that will retain old data and allow additional data to be added in successive timeframes.
 - FY2016-2017 – This goal was achieved through the creation of a GIS-based iPad app and implemented during this fiscal year for outfall inspections.
- FY2016-2018+ – To maintain optimal outfall numbering accuracy, Stormwater’s GIS specialist will manually control outfall numbering in the GIS system.

Monitoring

- FY2016-2017 – The OEM will trial several colorimetric meters to assess effectiveness and ease of use prior to purchasing a unit. The goal is to engage in real-time field analysis for faster illicit discharge resolution.
 - FY2017-2018 – Stormwater and OEM continue to work to determine the optimal tool to assess illicit discharges in the field.
- FY2016-2017 - Develop prioritization for additional outfall monitoring in each watershed based on catchments and outfalls in identified hotspots (Combined Table: Goal 2, C).
 - FY2017-2018 – Priority outfalls, identified in completed Watershed Master Plans were and will continue to be monitored as part of the 50 sites (Combined Table: Goal 2, C).
- FY2016-2017 – Stormwater, in cooperation with OEM’s IDDE will begin developing a bacteria monitoring program. Standard operating procedures and QA/QC will be used to deliver Level II quality data. Optimal sites will be chosen to maximize efficiency. Samples will be taken 1x/month by the Stormwater Division.
 - FY2017-2018 – This bacteria monitoring program will continue to establish baseline bacteria levels in city streams. Potential program additions are: adding some volunteer university/college sample collectors, starting some MS4 wet weather monitoring, and researching feasibility of moving to Level III quality data.

2.2.4 Public Works Service Center Standard Operating Procedures

Primary TMDL Target: All pollutants including E. coli bacteria and Sediment

The City has developed Standard Operating Procedures (SOP) for the PWSC. The latest version was published in 2013. This SOP establishes directive for the utilization of BMPs that prevent or mitigate any environmental impacts to the stormdrain system that may occur as a result of daily operations at the PWSC. PWSC personnel must incorporate all applicable BMPs into their job functions.

Individual SOPs include:

- Aggregate Storage Areas
- Cross Contamination
- Engine and Equipment Idling
- Environmental Exposures
- E-Waste Handling and Recycling
- Filling and Dispensing Fuel from Portable Cans or Truck Mounted Auxiliary Tanks
- Fueling Area and Aboveground Storage Tanks (AST) / Underground Storage Tank (UST) Fuel Delivery
- Hazardous Waste Generated Off Site
- Hydraulic Spills
- Management of Waste from Public Safety
- Moving Trucks and Large Vehicles
- Oil-Water Separator
- Pesticide Storage
- Pesticide, Herbicide, and Fertilizer Application
- Pressure Washing
- PWSC Best Management Practices
- Salt Brine
- Salt Delivery and Storage
- Satellite Accumulation Area
- Spill Response Stations
- Storage of Flammables
- Storm Drain Cleaning
- Stormwater Bacteria TMDL
- Stormwater PCB TMDL
- Stormwater Sediment TMDL
- Traffic Marking Paint
- Used Fuel Filters
- Used Oil and Extractor Device
- Used Oil Disposal
- Vapor Monitoring of Underground Storage Tanks (USTs)
- Vehicle Fueling
- Waste Antifreeze
- Waste Batteries
- Waste Disposal
- Waste Disposal and Recycling
- Waste Fluorescent Bulbs
- Waste Fuel
- Waste of City Property
- Waste Silk Screen Rags
- Waste Small Batteries
- Waste Tires
- Waste Vehicle Batteries

Implementation Schedule and Key Milestones:

- Existing - The PWSC Environmental and Sustainability Management System team is responsible for reviewing the documentation spreadsheet and ensuring that each BMP is completed and procedures were followed within the specified timeframe.
- Existing - The Office of Environmental Management leads semiannual PWSC lot walks with the ESMS team/PWSC department representatives to identify areas for improvement.
- FY2015-2016 – Development of PWSC SWPPP.
- FY2016-2017 – The preliminary PWSC SWPPP is complete and in the interdepartmental comment phase. Finalization will be complete in December 2016 and implementation will occur in 2017.
 - [FY 2017-2018 – PWSC SWPPP revisions will continue as needed.](#)

2.2.5 Oil & Grease Drip and General Clean Up at the City’s Market Square

Primary TMDL Target: Sediment, including oil pollutants

The City is trial testing enzyme cleaners to remove oil and grease stains left by farmer’s market vendor vehicles and temporary food service vendors in the downtown Market Square area.

Implementation Schedule and Key Milestones:

- FY2015-2016 - Present - Enzymatic cleaner trial is proving effective in spot treating smaller spots. More emphasis continues to be placed on stopping sources than reliance on clean up measures.

- FY2015-2016 - Present - In cooperation with Downtown Roanoke Incorporated (the entity responsible for coordinating and facilitating commerce in our Central Business District), the City implemented a proactive program requiring all market and food service vendors to place absorbent materials beneath all areas with potential for oil or grease drips or spills.
- FY2016-2017 - The City's Market Square will begin a program to quarterly pressure wash sidewalks and vendor canopies and steam food debris off the brick courtyard using biodegradable/enzymatic cleaners. This will be executed by the Facilities Department. Proposed products may include FOGwash, BioSolv and Borax. Inlet protection will be used.
- FY2017-2018 - The City's Market Square will continue to be pressure washed as noted above. A [SOP](#) guides this activity and can be found in the City of Roanoke Program Plan, 2017 Revision. Only hot water/steam is used for this activity.

2.2.6 Use of Issue Tracking System (QAlert & VueWorks)

Primary TMDL Target: All pollutants including E. coli bacteria and Sediment

The City's QAlert system was established in 2014 as a database for customer service requests and is applicable to all departments. Service requests may be entered by either City field staff or by Citizens via the QAlert iPhone App or by calling the City's customer service center at 853-2000. Service request types relevant to this Action Plan include: Illegal Dumping into Stormdrains, Pollution Complaints, Drainage Complaints, Stormdrains, Ditches, etc. Once a service request is logged, the appropriate City party is notified via email or text to investigate. If the situation is the City's responsibility, either maintenance crews will address the request, or a stormwater engineer will review for possible addition to the stormwater Capital Improvement Project program.

Implementation Schedule and Key Milestones:

- Existing - "If you see something, say something": The iRoanoke Program, which creates a QAlert and routes it to the appropriate staff member, gives the public a method to report a potential illicit discharge or other stormwater related problem.
- FY2017-2018 - Twitter is being pilot-tested for use with the QAlert System.
- FY2017-2018 - VueWorks Asset Inventory system may be in use before June 30, 2018. This asset management system will integrate stormwater infrastructure, the City's GIS data, maintenance work orders, and assist in tracking projects, among many other functions.

2.2.7 Mutt Mitt Station Program

Primary TMDL Target: E. coli bacteria

The City provides pet waste stations at hotspot locations primarily in parks, along greenways, and downtown. Most locations are maintained 2-3x/week. Pet waste stations are also prominent at both dog parks and are restocked 3-4x/week. Additionally, new stations are installed as requested.

Implementation Schedule and Key Milestones:

- FY2015-2016 - Pet waste station map was updated to identify gaps of coverage and to plan additional stations.

- FY 2016-2017 – The Mutt Mitt station map was updated to reflect the 46 new installation sites for a total of 88 sites.
 - FY2016-2017 – Seven Mutt Mitt stations were installed in downtown Roanoke to accommodate the increase in dog owner traffic at the Farmer’s Market and also due to the increase in downtown apartment housing and registered dog owners.
 - FY2016-2017 – Thirty-nine additional Mutt Mitt stations have been planned in the Lick Run and Tinker Creek watersheds and along the Roanoke River Greenway.
- FY2017 – Pet waste/water quality educational signs, approximately 12-18” will be added above some Mutt Mitt stations. “Take one for the Road” stickers may be added to stations to encourage use.
- FY 2017-2018 – The [Mutt Mitt Station Program](#) has grown to 90 stations. A generous grant from the Mill Mt. Garden Club has allowed pet waste educational signs to be developed and printed. These signs will be fully installed during FY 2018. More stations will be added to publically owned land as needed.

2.2.8 Green Infrastructure (LID Designs) for City Capital Improvement Projects

Primary TMDL Target: All pollutants including E. coli bacteria and Sediment

The City plans to increase use of Green Infrastructure or Low Impact Development (LID) Design to achieve overall project effectiveness, support stream delisting, and make progress toward TMDL WLA goals while being cognizant of budgetary constraints. To that end, the City plans to host on-site Institute for Sustainable Infrastructure (ISI) Envision Certification training for applicable City staff, surrounding localities, and any interested local consultants.

Implementation Schedule and Key Milestones:

- FY2015-2016 - Present – Project designers will begin to become familiar with case studies, integrate optimal treatment chains where applicable and view projects within a watershed-based context. Project aesthetics will help with public buy-in of such projects and will be a consideration during project development.
- FY2015-2016 – The City hosted an on-site ISI Envision Certification training for City staff, surrounding localities, and interested local consultants. Fourteen total people were in attendance, including nine city staff members who have taken the test and received their ISI Envision Certification status.
- FY2016-2017 – Stormwater has hired a part-time engineer to score the past stormdrain capital improvement projects that the city has implemented using the ISI Envision rating system to measure the current level of sustainability of the stormdrain infrastructure system. This information will inform future capital improvement project designs; from assessing costs and benefits over the project lifecycle to evaluating environmental benefits and using outcome-based objectives.
 - [FY2016-2017 ISI Envision CIP Rating Results Completed:](#)
 - [Roanoke Stormwater Benchmarks Capital Projects Using Envision](#)
 - [Envision Rating Report](#)
- FY2016-2017 Stormwater staff is conducting a Green Streets Assessment to evaluate potential sites to incorporate this type of green infrastructure in major stormdrain capital improvement projects with the

expectation of enhancing water quality prior to stormwater entering the traditional stormdrain system (See Combined Table: Goal 1,D). Perspective locations include:

- The Garden City area
- The 1500 block of Main Street in the Wasena Area
- Campbell Ave. SW
- Forest Park Blvd.

- FY2016-2017 Stormwater prepared the following document to facilitate discussion for inclusion of green infrastructure into the City's new Downtown Neighborhood Master Plan: [Exploration of Green Infrastructure for Stormwater Management, 2017 Downtown Roanoke](#)

- FY2017-2018 - Stormwater will continue to work with the Planning Department to integrate green infrastructure projects downtown, especially in conjunction with [Stormwater CIP Projects](#) and the forthcoming Downtown Neighborhood Master Plan.

2.2.9 Water Quality Projects, Programs, and Initiatives

Primary TMDL Target: E. coli bacteria and Sediment

The following program plan will provide the foundation for all water quality-driven activities.

In FY2014-2015, the City created its initial TMDL Bacteria and Sediment Action Plan. The Action Plan is a working document and is amended as new programs are created and data is collected and integrated into our BMPs. This plan outlines goals and the methods to achieve these milestones within a related timeframe. An updated version will be submitted in conjunction with the annual MS4 permit report on October 1 of each calendar year.

Implementation Schedule and Key Milestones:

Watershed Master Plans:

The City has a research agreement with the Virginia Tech Department of Civil and Environmental Engineering to compile data sufficient to develop Roanoke River Tributary Master Plans. These Master Plans will provide a finer level of detail to help the City prioritize the most effective strategies to meet the TMDL WLA requirements at various scales. Specific information will be compiled on watershed characteristics, land use, imperviousness, topography, soils, and current water quality and streambank conditions in each watershed. Capital improvement projects, focused IDDE investigations, water quality monitoring data, and stormdrain maintenance problems will also be mapped to identify locations for installation of new and/or renovation of existing BMPs. Additionally, this data and its analysis will be formative in determining streambank restorations; BMP additions, BMP retrofits and strategic placement of manufactured BMPs to mitigate the impacts of stormwater runoff. Ultimately, the Watershed Master Plans will also facilitate communication with stakeholders in the protection, maintenance and restoration of the watershed.

- FY2014-2015 - The Lick Run Watershed Master Plan was completed December 2015.

- FY2016-2017 - Carvin Creek, Tinker Creek and Glade Creek Watershed Master Plan will be complete December 2016.

- FY2017-2018 - Trout Run

- FY2018 – Peters Creek

Master Plans will be completed for all other watersheds within City limits: Barnhardt Creek, Mud Lick Creek, Murdock Creek, Murray Run, Ore Branch, and the Roanoke River.

Watershed Master Plan Goals, Strategies and Action Items (see Combined Table for additional information)

Goal 1 – Maximize Watershed Resiliency and Sustainability

- A. Restore more natural surface water processes
- B. Revitalize ecosystem health
- C. Augment capacity to endure and recover from short term hazards
- D. Enhance adaptability to long term hazards

Goal 2 – Minimize Watershed Hazard to Public Health, Safety, and Property

- A. Prioritize and construct capital improvement projects that both mitigate neighborhood flood hazards and improve downstream water quality.
- B. Increase Community Rating System (CRS) ratings for progressive floodplain management activities
- C. Delist from the 303(d) report all impairments including bacteria, sediment, Temperature and PCBs and Mercury in Fish

Goal 3 – Connect Citizens, Businesses, Students and other Stakeholders to their Watershed

- A. Provide the community with life-long learning opportunities about their watershed
- B. Engage the community in revitalizing watershed ecosystem health
- C. Coach the community to participate in outdoor recreation and stewardship opportunities within their watershed.

Stream Restorations:

- FY2016, 2017, and 2018 – Lick Run Stream Restoration at Washington Park – The City received \$150,000 in SLAF Grant funds (Stormwater Local Assistance Fund) in 2016. This project is approximately 700' in length with a total budget of \$300,000 (See Combined Table: Goal 1, A-C). A webcam associated with the USGS water monitoring program may be installed as a part of the Washington park stream restoration project (See Combined Table: Goal 3, A).
 - [FY2017 - In progress, the City is currently in the contract negotiation phase of this design-build project.](#)
- FY2016-2017 - [Trevino – Monterey Stream Restoration Project](#) – The City has designed a restoration project in the Tinker Creek Watershed. This is a capital improvement project to reduce neighborhood flooding. The goal is to reduce sedimentation by stabilizing the banks and by restoring proper stream function and energy dissipation along natural sections of this narrow stream. A native plant riparian buffer will be installed on the lower section. A native grass mix planted in Filtrexx logs or other filter sock product will support bank stabilization. The project is approximately 1,940 feet in length. Phase II of this project will include floodplain reconnection for a portion of the stream in this project (Combined Table: Goal 1, C).

- This stream restoration project is almost complete. The project was extended upstream to alleviate some heavily eroded streambank edges that were not part of the original plan.
- FY2017-FY2018+ - SLAF Grants were awarded for three future stream restoration projects: Lick Run at Highland Farm Road with a total budget of \$405,455, a project length of 778' and E. coli impairment; Glade Creek east and west of Gus Nicks with a total budget of \$1,973,400, a project length of 2921' and E. coli impairment; and a tributary of Lick Run near the Roanoke Blacksburg Regional Airport with a total budget of \$681,936, a project length of 1300' and E.coli impairment in Lick Run (See Combined Table: Goal 1, A-C).

Water Quality Monitoring Programs:

USGS – COR – VT Water Monitoring Program:

- FY2016-2021 and beyond – The monitoring station site is located in the Lick Run Watershed adjacent to the greenway below Washington Park near the intersection of 2nd St. NE and Patton Ave. NE. The goal of this monitoring program is characterize streamflow and sediment transport in Lick Run prior to, during, and after BMPs are implemented throughout the watershed. The monitoring objectives include: continual stream levels, water temperature, pH, conductivity, dissolved oxygen and turbidity. Data will also be used to determine annual loads of suspended sediment. All water quality and continuous flow data will be publically available on the USGS National Water Information System Website: <http://waterdata.usgs.gov> (Combined Table: Goal 3, A).
- Additional units in impaired watersheds may be added after corresponding watershed master plans are complete. Other units are dependent on need and cost.
- FY 2017-2018 – The City will continue to build upon the USGS-City-VT monitoring relationship by creating a robust precipitation monitoring network which can provide many benefits to a variety of stakeholders within the city, including stormwater and other utilities, first responders, educational programs, and others. The monitoring network would provide critical data to aid the management and modeling of the stormwater infrastructure and first responders could utilize the real-time monitoring to better allocate resources during extreme precipitation events. The network could also be used as an outreach tool to educate residents and students about precipitation and potential risks of precipitation and flooding. Nine precipitation gauges will be installed in a selected spatial distribution pattern to optimize data capture.

Citizen Science Monitoring Program:

- FY2016 and beyond - The City is in the process of implementing a Citizen Science Benthic Macro-Invertebrate Monitoring Program (Combined Table: Goal 3, A). This program will use the SOP's developed by Save Our Streams (SOS). Monitoring locations will be based on position in the watershed, accessibility, and number of program participants. Standard operating procedures and QA/QC will be used to deliver Level II quality data. The City has purchased 15 monitoring kits and is working with Clean Valley Council to oversee the program. Data will be collected and integrated into an interactive map. Data can be used as an indicator of problem areas where more research, further testing or land-based changes should occur.
- FY2017+ - The Roanoke Riverkeeper Program began in spring 2017. There are currently 16 trained monitors. The QAPP was completed and approved by VA DEQ and a permit was secured through

VDGIF. The City continues to work with Clean Valley Council (CVC) to coordinate the program. An interactive map will be on the CVC website. (Combined Table: Goal 3, A).

Bacteria Monitoring:

- FY2017 and beyond – The City is currently researching and developing an internal bacterial monitoring program. Monitoring will be conducted on a monthly basis. Standard operating procedures and QA/QC will be used to deliver Level II quality data. Data will be used as an indicator of problem areas and further tracking into the watershed and MS4 system could occur.
 - The City’s in-house bacteria monitoring program began in April 2017 and will establish baseline bacteria levels and help to identify and locate bacteria sources found in city streams. Planned program additions may include adding some university/college students to collect samples, starting MS4 wet weather monitoring in known bacteria hotspots, and researching feasibility of moving to Level III quality data.

Ordinance Updates:

FY2017-2018 – Build consensus to:

- Add additional riparian buffer preservation by extending the River and Creeks Overlay to include all applicable areas 50’ on either side of surface water bodies (Combined Table: Goal 1, D).
- FY2017-2018 - Prevent additional perennial stream burial (Combined Table: Goal 1, B)

Stormwater Design Manual Updates:

FY2017-2018 Build consensus to:

- Incentivize infiltration practices (Combined Table: Goal 1, A).
- Require new outfalls to discharge just below the riparian buffer and add diffusers/step pools for erosion reduction (Combined Table: Goal 1, B).
- Use stream simulation method when replacing aging culverts (Combined Table: Goal 2, A).
- Revise construction requirements for storm drain – sanitary sewer crossings to require encasing and minimum cover requirements (Combined Table: Goal 2, C).

Zoning/Building Code Modification:

FY2017-2018 – Build consensus to:

- Allow for innovation green infrastructure/low-impact development (Combined Table: Goal 1, D).
- Allow for green streets right-of-way cross section (Combined Table: Goal 1, D).

Virginia Center for Stormwater Technology Advancement (CSTA)

- TBD - Virginia Tech’s CSTA program may conduct research testing on existing City-owned BMPs to assess how well they are performing. Testing and monitoring will yield adaptive management feedback data on local BMPs that will inform future project BMP design and retrofit choices to optimize efficiency, design, as well as, return on investment.

2.3 PUBLIC EDUCATION AND OUTREACH

2.3.1 Partnership with Clean Valley Council

Primary TMDL Target: All pollutants including E. coli bacteria and Sediment

The City and surrounding localities have contracted with the local non-profit, Clean Valley Council (CVC), to provide events and programming that educate Roanoke Valley citizens about litter prevention, recycling, conservation, and protecting natural resources.

Implementation Schedule and Key Milestones:

- Existing - The CVC currently reaches over 10% of the City's population through education and public events. Through its stream and in-school education programs, the CVC provides environmental literacy to students throughout the Roanoke Valley. Environmental literacy is an important foundation promoting stewardship and an environmental ethic to complement the City's outreach program of engaging and inspiring citizens to make appropriate behavior changes today and create a cultural shift tomorrow.
- FY2016 and beyond - The City is in the process of implementing a Citizen Science Benthic Macro-Invertebrate Monitoring Program (Combined Table: Goal 3, A). This program will use the SOP's developed by Save Our Streams (SOS). Monitoring locations will be based in position in the watershed, accessibility, and number of program participants. Standard operating procedures and QA/QC will be used to deliver Level II quality data. The City has purchased 15 monitoring kits and is working with Clean Valley Council, through an amended contract to oversee the program. Data will be collected and integrated into an interactive map (Combined Table: Goal 3, A). Data can be used as an indicator of problem areas where more research, further testing or land-based changes should occur.
- FY 2017 and beyond - Share watershed master plans with Clean Valley Council to be shared with the public and used for existing school education program enhancement (Combined Table: Goal 3, A).

2.3.2 Erosion/Sediment Brochures

Primary TMDL Target: E. coli bacteria and Sediment

The City is creating highlighting stormwater best management practices for both citizens and contractors. The citizen brochure will target homeowners and the contractor brochure will target: 1. Contractors involved in soil disturbing activities that are under the threshold required to obtain a Virginia Stormwater Management Program (VSMP) permit or generate a Stormwater Pollution Prevention Plan (SWPPP); and 2. Contractors not involved in soil disturbing activities, but who otherwise have a potential to affect water quality via runoff and/or improper materials and waste management. The citizen brochure, as well as other stormwater related educational material, will be available at Stormwater Division presentations, available for mailings, and at the City's permit office.

Implementation Schedule and Key Milestones:

- FY2015-2018 - The Residential Brochure, *Understanding Stormwater Pollution*, completed three rounds of pilot testing with subsequent revisions to maximize understanding and retention of the information.

This brochure was printed and started distribution at events in April 2016. This brochure is added to the water bottles and dispersed in this manner during outreach events.

- FY2015-2018 - *Contractor's Guide: Stormwater Pollution Prevention Requirements* was printed in June 2016. Copies of this brochure are handed out to contractors during the Permitting process in the Planning Department. The City's Building Inspectors will also have them available and can hand them out to contractors in the field, particularly when compliance problems are identified.

2.3.3 Collaboration with External Organizations/Groups

Primary TMDL Target: E. coli bacteria and Sediment

The City is working with various civic organizations to increase audience reach and citizen participation as well as maximize results through increased environmental literacy and collaborative opportunities. The City intends to provide giveaways at these events that are TMDL target specific and relevant to the activity. Example would be pet waste bag dispensers with printed clean water messaging.

Implementation Schedule and Key Milestones:

- FY2015-2016 and beyond -CVC's Recycle Regatta - June 2016 - Stormwater had an outreach booth and actively talked with citizens using the greenway and gave away pet waste bag dispensers to citizens with dogs. Stormwater made a boat out of recycled "rainbarrels" and competed in the Recycled Regatta. The boat sail included a "Scoop the Poop" message.
- FY2015-2018 - Roanoke Valley SPCA Tail Chaser - An estimated 250 race participants received a waste bag holder for their dog's leash so owners are "never" without a bag. Stormwater also had an outreach booth.
- FY2015-2016- CVC/ Longwood University/ Master Gardeners/ Master Naturalists/ Garden Clubs - Train-the-Trainer Rainbarrel workshop - Thirty-four participants were trained and committed to organizing one or two workshops/year of 20 people each = 600-1200 new rainbarrels/year.
 - To date, at least 5 rainbarrel workshops have been held in the Upper Roanoke River Watershed.
- FY2015-2016 and beyond - Roanoke Neighborhood Associations - Watershed and Stormwater *Creating a Clean Water Legacy* presentation for each of the City's 32 neighborhood organizations.
 - 7 presentations were given, including 3 neighborhoods and 8 outreach events were completed.
 - FY2016-2017 - 14 Presentations were given reaching 327 citizens and 9 outreach events reaching approximately 5,239 citizens were completed.

Watershed Academy/Water Resources Institute (Combined Table: Goal 3, A-C):

In order to create a positive change to ultimately protect and repair watersheds, we must engage citizens through active learning and participation; thus increasing social capacity for an environmental culture shift within the Roanoke Valley. This program concept should be a collaborative effort among existing groups like CVC, URRR, RVARC and local governments. Ideally this program would form a new branch of an existing program like CVC or URRR. This program must have a dedicated paid staff member.

The actual instruction would be online through watershed learning modules or actual physical classes similar to the City's Green Academy. This program can educate and "feed" a Citizen Advocacy Group (Watching Over Waters) that can advocate for policy change and support and implement restoration projects. This group would

also run the Citizen Science Water Monitoring Program. Future projects may include PCB Air Quality and Ecosystem Services Valuation.

A program website can serve as an umbrella for watershed plans, watershed fact sheets, and monitoring data. This website can provide current information on events, pollutant issues, green infrastructure, Adopt-A-Stream groups, rainbarrel programs, design your yard online program, adopt annual topics similar to KeepingWatch.org.

- FY2017-2018 – Begin to create some content on the Stormwater Webpage: watershed plans, watershed fact sheets, monitoring data, event calendar, Adopt-A-Stream groups
- FY2017 and beyond – Begin discussion with NGOs on feasibility, interest, barriers, and outcomes for greater program development.

2.3.4 Collaboration with Internal City Departments and Divisions

Primary TMDL Target: E. coli bacteria and Sediment

The City continues to work through what are often conflicting interests to achieve our TMDL WLAs while meeting and managing other pressing economic, social, and environmental needs. Internal partnerships and interdepartmental collaboration is essential to find solutions that benefit all stakeholders.

Implementation Schedule and Key Milestones:

- [FY2017-2018 – Inlet Art Project](#) - Interdepartmental collaboration with Susan Jennings, City Art and Culture Coordinator to commission works of art that would illustrate and/or draw attention to stormwater. This project is underway – 6 pilot project locations have been selected, and art submissions will be collected next. Project should be implemented in spring 2018.
- Future – [Artful Rainwater Design](#) – Interdepartmental collaboration with Susan Jennings, City Art and Culture Coordinator to commission works of art that would illustrate and/or draw attention to stormwater. Grant funding may be available through the National Endowment for the Arts and/or the Virginia Commission of the Arts. Project ideas may include a Rainwater Trail that highlighting underground streams or a water project highlighting Roanoke’s Sister Cities.
- FY2017-2018 – [Updated “Vision” Comprehensive Plan](#) – Interdepartmental collaboration will ensure that the health, resiliency, and sustainability of the City’s watersheds are included as part of the updated “Vision” Comprehensive Plan.
- FY2016 and beyond - Collaboration with the Parks and Recreation Department for Mutt Mitt Station installation and maintenance and annual tree planting projects in selected watersheds (See section 2.2.7 for additional information).
 - [FY2016-2017 – Sixty four new trees were added along the Roanoke River within the River and Creek Overlay District in the fall 2016.](#)
 - [FY2017-2018 – Fifty-five new trees are currently being coordinated and are in the procurement contract phase for installation in the fall 2017.](#)
- [FY2016-2018](#) - Collaboration with the City’s Animal Control Unit to educate and engage dog owners living in the downtown areas.

- FY2016-2017 – Illicit discharge of Grease in CBD – Collaboration among Solid Waste, Stormwater, DRI, Inc., and Office of Environmental Management to determine what actionable steps should be taken as a City to solve this ongoing issue.
 - FY2017-2018 – As outlined in Section 2.1.2, the City will move forward to create outreach materials and update the Solid Waste Ordinance to assist with FOGs and Illicit discharge into stormdrains.

2.3.5 Other Targeted Projects, Programs, and Initiatives

Primary TMDL Target: E. coli bacteria and Sediment

The City plans to implement the following bacteria specific projects, programs, and initiatives to maximize community education, engagement, and inspiration to create change for improved water quality.

Implementation Schedule and Key Milestones:

Pet Waste Campaign Program (Combined Table: Goal 3, B-C):

- FY2015-2016 –
 - Developed, *Here’s the Scoop...Do Your Doody and Clean Up After Your Pet* Brochure which was mailed to roughly 61,000 in the property tax bill and to all registered pet owners downtown.
 - Distributed 100 *Here’s the Scoop...Do Your Doody and Clean Up After Your Pet* Brochures to all city veterinary offices, animal shelters and at several local pet stores for a total of 900 brochures. Follow up phone calls are made to access additional brochure needs.
 - Designed Pet Waste Bag Dispensers with the Keep it Clear logo and “Do Your Doody While You Move Your Booty” which clips on to a dog leash. Roughly 600 of these dispensers were given away at events and along the greenway.
 - Increased Facebook Posts regarding Pet Waste.
- FY2016-2017 –
 - Margie Lucas of the Mill Mountain Garden Club has partnered with Stormwater to produce and install large educational signage on stormwater/pet waste at Carvins Cove, and pending site locations of Highland and Thrasher Dog Park.
 - Forty-six new Mutt Mitt Stations have been identified and are in various stages of installation. Pet waste/water quality educational signs, approximately 12-18” will be added above some Mutt Mitt stations. “Take one for the Road” stickers may be added to stations to encourage use. Mutt Mitt Station locations are available here:
 - Giveaway products available: pet waste bag dispensers, reusable shopping bags, water bottles
 - Develop tattoos or stickers, magnets, and plastic bag recycler with a “take two for the road” message
- FY2017-2018

As outlined in previous documents and sections of this TMDL Action Plan, the City has successfully used the Mill Mountain Garden Club’s grant money to design and create signage for installation above 56 of the 90 existing Mutt Mitt Stations. These signs are currently in the process of being installed. Additionally, the MMGC created yard signs with pet waste messaging for citizens. Stormwater continues to outreach to pet owners with materials referenced in the Program Plan and in the sections above.

- Study feasibility, cost and need for expanding Mutt Mitt Stations into high dog-density neighborhoods, particularly those neighborhoods that have expressed problems.
- Have targeted greenway/neighborhood outreach where staff will give out pet waste bag dispensers and talk with dog owners about stormwater pollution due to pet waste.
 - The City has partnered with the Greenway Ambassador Program to assist with handing out pet waste bag dispensers along the greenways.
- FY2016-2017 and beyond - Septic Clean-Out/Repair and Sewer Connection - The City and other stakeholders will be developing a strategy to address septic repairs/replacement and/or sewer hook-ups. Partnerships for this effort may include local MS4s, Virginia Department of Health, Soil and Water Conservation Districts, and others to identify and target failing septic systems as well as identify and promote funding sources for homeowner resolution.
 - FY2017-2018 - The City has collaborated with the Western Virginia Water Authority to provide assistance for septic system hookups for specific areas with currently failing septic systems.
 - FY2017-2018 - Construction of new sanitary sewer infrastructure in the Overland/Westland Neighborhood within the Mudlick Watershed will provide the ability for sewer connection, alleviating bacterial water contamination from at least two failing septic systems.
 - FY2017-2018 - A septic outreach direct mailer is in the final stages of design and will be direct mailed to known or suspected septic system owners.

2.4 CITY EMPLOYEE TRAINING

2.4.1 MS4 Permit Stormwater Pollution Prevention Training

Primary TMDL Target: Illegal discharge of sediment, chemical pollutants, and bacteria sources

The City's video-based stormwater pollution prevention training educates all employees about IDDE and emphasizes action by instilling the phrase, "If you see something, say something". Additional training focuses on general stormwater BMPs and departmentally relevant material.

Implementation Schedule and Key Milestones:

- FY2018 (next required training given completion of this task in FY2014-2015): The City will increase participant interaction via role-playing theoretical scenarios within departmental groups.
- FY2017-18 Better integration with Roanoke City Public Schools

2.4.2 Stormwater & Environmental Awareness Training for New, Full-Time Employees

Primary TMDL Target: Illegal discharge of sediment, chemical pollutants, and bacterial

The City provides a multi-day New Employee orientation that includes an overview of Federal Laws including: RCRA, CERCLA, SARA, FIFRA, CAA, and CWA. The training describes the purpose of the City's Environmental Sustainability Management System and every employee's legal responsibility and role in compliance. The

training covers reportable quantities, safety features such as “rule of thumb”, and the Anonymous Hotline and Ethics Point website for reporting environmental issues.

Implementation Schedule and Key Milestones:

- Existing – This reoccurring training is held every other month, or as needed, for all new City employees.

2.4.3 Specific Operational and BMP Training

Primary TMDL Target: Sediment, Solid Waste, Petroleum products, and Bacteria

The City focused on high risk operations, mainly at our Public Works Service Center, to create and implement a series of Standard Operating Procedures and related trainings designed to minimize the potential for stormwater pollution and educate employees to respond appropriately in case of a spill or other release. Examples include: Bulk Fuel Delivery, Vehicle & Equipment Fueling, Parking lot sweeping, Hydraulic fitting storage, and more. One related advantage is that these operational BMPs are deployed City-wide as Public Works employees conduct their jobs throughout our community.

Implementation Schedule and Key Milestones:

- Existing – This training is on-going with refreshers on a rotational basis or as dictated by operation and/or equipment changes.

2.4.4 Stormwater Management Certification for Applicable Inspectors

Primary TMDL Target: E. coli Bacteria and Sediment

City Development Inspectors in the Planning Department [as well as City Stormwater Engineers, who conduct post construction BMP inspections on publically-owned stormwater management facilities](#), must become certified as stormwater management inspectors. This course includes best practices and responsibilities of a stormwater inspector during and after construction as well as the Stormwater Management Act, Virginia Stormwater Management Regulations, Construction General Permit Regulation, and the 15 non-proprietary BMPs.

Implementation Schedule and Key Milestones:

- Existing – New Inspectors must become SWM certified within their first year of employment.
- Existing – Inspectors are required to maintain certification by earning 18 CEU credits every 3 years (per Water Guidance Memo # 15-2002)
- TBD – Other City inspectors and/or employees may also be required to obtain SWM certification

2.4.5 E&S Certification for Applicable Inspectors

Primary TMDL Target: Sediment

City Development Inspectors in the Planning Department must become certified as E&S Inspectors. General knowledge areas include: Virginia Erosion and Sediment Control Laws and Regulations, elements of basic erosion and sediment control, plan reading and interpretation, and calculation methods related to specifications of slope, seeding rates, etc.

Implementation Schedule and Key Milestones:

- Existing – New Inspectors must become E&S certified within their first year of employment.
- Existing – Inspectors are required to maintain certification by earning 18 CEU credits every 3 years (per Water Guidance Memo # 15-2002)
- TBD – Other City inspectors and/or employees may also be required to obtain E&S certification

SECTION 3: ACTION PLAN ASSESSMENT AND IMPROVEMENT

3.1 METHOD FOR ACTION PLAN ASSESSMENT

This section attempts to provide a comprehensive list of the City's plans and procedures; however, it is important to note that some plans are developed more fully than others, while some plans are existing and on-going. Further, the City will continue working in coordination with neighboring MS4s and others to develop mutually beneficial performance metrics and analysis procedures that will be used to help us collectively develop and report meaningful, high quality results aimed at supporting delisting decisions. The assessment measures on the following pages will therefore become increasingly refined and clarified in future Action Plan iterations.

The City of Roanoke intends to address the pollutants of concern (POC) through a multi-pronged approach. Initially, an in-stream water quality monitoring approach will be used.

Through our Urban Stormwater Research partnership with Virginia Tech's Civil and Engineering Department, the City will continue to perform biannual benthic macroinvertebrate sampling at six sites along Lick Run. In 2016, a total of eight additional biological monitoring sites will also be added; one in Carvin Creek, six in Tinker Creek, including one at the Lick Run-Tinker Creek confluence, and one in Glade Creek.

Additionally, the Roanoke Riverkeepers, a citizen science benthic macroinvertebrate water monitoring program has been implemented. The goal is to add about 40 monitoring sites throughout the City. Benthic macroinvertebrate sampling will be completed 3 times annually. Other basic monitoring data, like temperature, turbidity, DO, and pH will be collected at designated sites. We are also pleased to include that the Roanoke Riverkeeper monitoring data will be stored and available to City of Roanoke staff, local students, and the general public in an online interactive mapping format that will allow for ease of interpretation and application. Ultimately, this database will include any monitoring results completed by the City, the partnership with VT, and Level II or Level III data through the Citizen Science Program. The City has also implemented bacteria sampling. The Office of Environmental Management will soon make a final decision on the optimal colorimeter or similar device for use during outfall reconnaissance and for illicit discharge investigations as well as using Coliscan bacteria plating upon discovery of suspect discharges.

As we delineate and/or undergo a system data search to find missing drain area calculations, we will also have the capacity to estimate sediment reductions for city-wide stormwater BMPs.

The partnership with USGS for long-term continual monitoring on Lick Run will further assist in watershed characterization and developing an understanding of sediment transport and streamflow. As the City brings all of these pieces together, we can then move towards developing a modeling approach for measuring TMDL AP effectiveness.

Further, our Watershed Master Plans (see the Combined Table) with Goals, Objectives, Action Items and Indicator are integrated into our Action Plans. Completing Action Items outlined in the combined table will serve as additional indicator matrices.

3.2 OVERALL GOALS AND DISCUSSION

The goals of this Action Plan are intended to provide a framework for the City to coordinate its activities, optimize stormwater BMPs and influence behavior change to reduce anthropogenic-source bacteria and sediment in order to meet the City's WLAs. A successful, collaborative effort among the City, other regional localities and adjoining MS4s, academic research, civic groups, and non-profits will be required to restore health to the Upper Roanoke River and all of its tributary watersheds.

The City plans to use a watershed approach to achieve the TMDL WLAs and ultimately delist the Roanoke River and its tributaries. Goals of this approach are as follows:

- Maximize resiliency & sustainability of both natural surface water processes (abiotic hydrology & morphology) and ecosystem health (biotic species habitat & diversity) to ensure both recovery from short term hazards (drought & flood) and adaptability to long term events (climate change.)
- Enrich the community by connecting Citizens to their watershed through education about natural surface water processes and engaging them to protect/restore the aquatic and floodplain habitat, species biodiversity, ecosystem health, and outdoor recreation opportunities in their neighborhood.
- Protect public health and safety through FEMA recognized community floodplain management activities including public information and education, mapping and sustainable development regulations, flood damage reduction, and warning & response.

This watershed ideology will maximize the City’s natural resource assets; protect and/or restore watershed ecosystems; and preserve a high quality of life for Roanoke citizens. Ultimately, we believe that the collaborative approach between the City and its citizens to “Be part of the solution, not the pollution” today will create a “Clean Water Legacy”.

Since the Stormwater Utility is still relatively new, the City is actively collecting data and resources for optimization of its program design, however there remains uncertainty in accurately estimating a timeframe for achieving the bacteria, sediment, and PCB WLAs. As new data is actively being collected through the various types water quality monitoring and during the creation of each tributary Watershed Master Plan we have begun to have enough information to begin targeting a WLA end date of 2072. New data will allow for prioritization and optimization of both design and location of stormwater BMP retrofits and/or new stormwater BMPs.

The table below provides a calculated estimation for installation of all WMP identified WQ projects used in projecting the WLA achievement date:

Budget FY2016-2017	YTD Expenditures FY2016-2017	Admin	CIP	Water Quality	Operations		
	\$8,157,663.00	\$737,260.47	\$4,046,191.64	\$1,695,280.28	\$1,678,931.10	\$4,111,471.36	FY17 Total Non-CIP Exp
	100%	9.0%	49.6%	20.8%	20.6%		
FY18 Estimates	\$8,596,650.00	\$773,698.50	\$4,298,325.00	\$1,762,313.25	\$1,762,313.25		
		9.0%	50.0%	20.5%	20.5%		
9/29/2017 CIP Drainage Projects							
211 Projects	\$139.2M			55.4 Years to complete @ 58.5% FY18 Estimated CIP Expenditures above			
9/29/2017 WMP Projects (4 To Date = Apx 1/3 area of City)							
97 Projects	\$33.1M						
Est 221 Projects	Est \$99.3M			55.7 Years to complete @ 41.5% FY18 Estimated CIP Expenditures above			
9/29/2017 Grand Total CIP Projects = \$238.5M/\$4.3M per year = Apx 55.5 years							

Finally, as part of this Action Plan, a spreadsheet is included that details the City’s prioritization of BMP types, targeted watersheds, and possible funding schedule. Progress and implementation will be reported in the City’s Annual MS4 Report and the Action Plan will be refined as more complete information becomes available.

WMP Action Items - Lick Run and Tinker & Tribs - Proposed restoration strategies appended to Goals, objectives, and indicators for watershed master planning.

Objective	Indicators	Qualitative Benefits	Category Action Items	CRS Series (1)	WMP	Section Ref.	Page #	Capital Cost (3)	FTE Time-Months Est	FTE Cost (14)	Maint Cost	Total Cost	Priority (4)	Timeline	Lead Agency			
Goal 1 - Maximize watershed resiliency and sustainability																		
A. Restore more natural surface water processes (abiotic hydrology, geomorphology, chemistry)	- Long-term rainfall/runoff water balance, - Event rainfall/runoff water balance, - Percent Total Impervious, - Percent Effective Impervious, - Development Standards	↓ flooding, ↓ in-stream erosion, ↓ sediment loads, ↑ biological life	Disconnect impervious surfaces that drain directly to perennial streams by:															
			- disconnection of curb cuts (update Stormwater Design Manual)	420	Lick Run	V.C.1(c)(iv)	129, 134	\$136,000				\$11,000			C1a	FY17-18	SWWQ, SWE, ENG, PLA	
			- disconnection of curb cuts	420	Tinker	5.4.1(b)viii		\$24,000				\$1,000			C2			
			- disconnection of outfalls (update Stormwater Design Manual)	420	Lick Run	V.C.1(b)	126	See 2.A - Cell K86				See 2.A - Cell N86			C1a	FY17-18	SWWQ, SWE, ENG, PLA	
			- disconnection of outfalls using regenerative stormwater conveyances (Cost = 5% of \$13.2M Tinker Creek Stream Restorations)	420	Tinker	5.4.1(c)		\$660,000				\$49,900			C2,W2			
			- riparian buffering (with the WMPs)	420	Lick Run	V.C.1(a)	123	See 1.B - Cells K26-27				See 1.B - Cells N26-27			W1	FY17-18	SWWQ, PLA	
			- riparian buffering	420	Tinker	5.4.1(a)		See 1.B - Cells K28-31				See 1.B - Cells N28-31			W1a			
			- infiltration practices in the upstream watershed (update Stormwater Design Manual)	420	Lick Run	V.C.3(a)	139	See 2.A - Cells K75-77				See 2.A - Cells N75-77			C1b	FY17-18	SWWQ, SWE, ENG, PLA	
			- constructing stormwater BMPs that use infiltration on City-owned parcels	420	Tinker	5.4.3(a)		See 2.A - Cell K78				See 2.A - Cell N78			C1b			
			- constructing stormwater BMPs that use infiltration in the road right-of-way	420	Tinker	5.4.3(b)		See 2.A - Cell K79				See 2.A - Cell N79			C1c			
			On private land, require or incentivize infiltration practices where soils will allow:															
			- On development or redevelopment projects when submitted for review, require estimation of stormwater utility (SWU) fee (update Stormwater Design Manual)	450	Lick Run	V.C.3(b)	140		\$0				\$0			W2	FY17-18	SWWQ, PLA
			- On development or redevelopment projects when submitted for review, require estimation of stormwater utility (SWU) fee	450	Tinker	5.4.3(c)			\$0				\$0			W2		
			- Incorporate this language into next iteration of Stormwater Mgmt. Design Manual.	450	Lick Run	V.C.3(b)	140		\$0		0.5	\$3,500	\$0			W2	FY17-18	SWWQ, SWE, ENG, PLA
- Grant credit to private land owners that live along perennial or ephemeral/intermittent streams for the establishment of high-quality riparian buffer	450	Tinker	5.3.3(a)			\$0		2.0	\$14,000	\$0			W1a					
- Create a larger incentive for private-land stormwater treatment	450	Tinker	5.3.3(c)			\$0		6.0	\$42,000	\$0			W2					
- Work with Roanoke Regional Airport Commission to retrofit existing detention ponds	450	Tinker	5.4.2(c)			\$0		1.0	\$7,000	\$0			W3					
- Work with Roanoke Regional Airport Commission to retrofit existing detention ponds at the Airport to allow for infiltration (in-kind credit for SWU)	450	Lick Run	V.C.2(b)	137		\$0		1.0	\$7,000	\$0			W2	FY17-18	SW - Wetland Soln's.			
B. Revitalize ecosystem health (biotic species habitat and diversity).	- Length and width of riparian buffers, - Length and quality of stream restoration, - Miles of buried stream, - Illicit discharges eliminated	↓ flooding, ↓ in-stream erosion, ↓ sediment loads, ↑ biological life, ↑ aesthetics, ↑ recreation	Preserve sensitive riparian areas through land acquisition/donation and parkland/greenway development:															
			- at and below Evans Spring and through the Evans Spring Neighborhood	420/ 520	Lick Run	V.C.1(a)	123	\$270,000				\$100			W1b		SWWQ, PLA	
			- at the old Countryside Golf Course (Add to River and Creek Overlay)	420/ 520	Lick Run	V.C.1(a)	123	\$200,000				\$6,000			W1a	FY17-18	SWWQ, PLA	
			- At Thrasher Park	420/520	Tinker	5.4.1(a)i		\$19,000				\$2,000			W1a			
			- At Mason Mill Park	420/520	Tinker	5.4.1(a)ii		\$6,000				\$1,000			W1a			
			- At the Ole Monterey Golf Course	420/520	Tinker	5.4.1(a)iii		\$180,000				\$8,000			W3			
			- At the Blue Hills Golf Course	420/520	Tinker	5.4.1(a)iii		\$590,000				\$20,000			W3			
			Construct stream restoration projects at:															
			- Washington Park	420/ 520	Lick Run	V.C.1(c)(i)	130	\$382,000				\$38,000				W3,C3	FYs16-18	SWWQ
			- below Highland Farm Rd.	420/ 520	Lick Run	V.C.1(c)(ii)	131	\$251,000				\$25,000				W2,C2	?	SWWQ
			- 2 nd St. and Patton Ave	420/ 520	Lick Run	V.C.1(c)(iii)	131	\$920,000				\$92,000				W2,C2		SWWQ
			- Tinker Creek at Eastgate Park	420/ 520	Tinker	5.4.1(b)i		\$4,500,000				\$440,000				W2,C2		
			- Tinker Creek south of 13 th St.	420/ 520	Tinker	5.4.1(b)ii		\$1,100,000				\$103,000				W2,C2		
			- Glade Creek west of Gus Nicks Blvd.	420/ 520	Tinker	5.4.1(b)iii		\$2,100,000				\$200,000				W1a,C1a		
			- Glade Creek east of Gus Nicks Blvd.	420/ 520	Tinker	5.4.1(b)iv		\$1,100,000				\$88,000				W1a,C1a		
			- Glade Creek at Vinyard Park (involves coordination with Roanoke County Only)	420/ 520	Tinker	5.4.1(b)v		\$0			1.0	\$7,000	\$0			W1a,C1a		
			- Trib. B, W. Fork of Carvin Creek north of Airport	420/ 520	Tinker	5.4.1(b)vi		\$3,100,000				\$120,000				W2,C2		
			- Tinker Creek north of Columbia St. Bridge	420/ 520	Tinker	5.4.1(b)vii		\$1,300,000				\$47,000				W1b,C2		
			Improve locations where the storm drain system intersects the stream by:															
- Updating stormwater design manual to require that new outfalls discharge just below the riparian buffer where possible to allow for flow through buffer for filtration/infiltration	450	Lick Run	V.C.1(b)			\$0		1.0	\$7,000	\$0			W2	FY17-18	SWWQ, PLA, SWE			
- Assuring that diffusers or step pools are built at the outfall to prevent erosion. (update Stormwater Design Manual)	450	Lick Run	V.C.1(b)			\$0			\$0				C2	FY17-18	SWWQ, PLA, SWE, ENG			
- Prevent burial of additional perennial stream by regulation, and reduce existing stream burial (update Stormwater Design Manual)?	450	Lick Run	V.B.2(a)			\$0		2.0	\$14,000	\$0			W2	FY17-18	SWWQ, PLA			
- Prioritize illicit discharge detection at recommended catchments and outfalls	N/A	Lick Run	V.B.1(a),(b)			\$0			\$0				W1	FY17-18	EM, SWWQ			
Improve the function of the riparian corridor through regulations																		
- Updating outfall requirements in stormwater design manual	450	Tinker	5.3.3(b)			\$0		2.0	\$14,000	\$0			W2					
- Improving the Rivers and Creeks Corridors overlay	450	Tinker				\$0		2.0	\$14,000	\$0			C2					
- Prevent burial of additional perennial stream by regulation, and reduce existing stream burial	450	Tinker				\$0		2.0	\$14,000	\$0			W1a					
Address existing potential illicit discharge issues																		
- Prioritize illicit discharge detection at recommended catchments and outfalls	N/A	Tinker	5.3.2(a), (b), (c)			\$0		1.0	\$7,000	-			W1b					
C. Augment capacity to endure and recover from short term hazards (drought and flood)	- Long-term rainfall/runoff water balance, - Event rainfall/runoff water balance, - Floodplain reconnection volume	↓ flooding, ↑ base-flow in dry channels, ↓ in-stream erosion, ↓ sediment loads, ↑ biological life	Restore more natural hydrologic regime: increase baseflow in streams, and reduce stream flashiness during rain storms by (see Objectives 1.A and 2.A):															
			- disconnect impervious surfaces using riparian buffering and floodplain reconnection (River and Creek Overlay & update Stormwater Design Manual)	450	Lick Run	V.C.1(a),(c)	123, 129								C1a, W1a	FY17-18	SWWQ, PLA	
			- disconnect impervious surfaces using riparian buffering, floodplain reconnection, regenerative stormwater conveyances	450	Tinker	5.4.1(a)-(c)		See 1.B - Cells K28-31 & 36-42				See 1.B - Cells N28-31 & 36-42			C1a, W1a			
- constructing infiltration practices where possible (update Stormwater Design Manual)	450	Lick Run	V.C.3, V.C.1(b)	138, 126	See 1.A - Cell K75-77				See 1.A - Cell N75-77			W2	FY17-18	SWE, ENG, SWWQ-PLA				

			<ul style="list-style-type: none"> constructing infiltration practices where possible 	450	Tinker	5.4.3			See 1.A - Cell K78-79		See 1.A - Cell N78-79				C1b, W1b		
			<ul style="list-style-type: none"> Protect and establish tree canopy in critical areas, create incentive to do so on private land 	450	Tinker	5.3.1		\$281,000			\$29,000				W1a, C1a		
			Construct stream restoration projects that reconnect Lick Run to its floodplain in areas with low flood hazard potential, to reduce downstream flooding (see 1.B for list of projects)	520	Lick Run	V.C.1(c)	129		See 1.A - Cell K33-35		See 1.A - Cell N33-35				W2	FY 2016+	SWWQ
			Construct stream restoration projects that reconnect perennial streams to their floodplain in areas with low flood hazard potential, to reduce downstream flooding (see 1.B for list of projects)	520	Tinker	5.4.1(b)			See 1.A - Cell K36-42		See 1.A - Cell N36-42				W1a,C2		
D. Enhance adaptability to long-term hazards (land development and climate change)	<ul style="list-style-type: none"> Percent Total Impervious, - Percent Effective Impervious, - Development Standards 	<ul style="list-style-type: none"> ↓ flooding, ↑ base-flow in dry channels, ↓ in-stream erosion, ↓ sediment loads, ↑ biological life 	Modify the following ordinances, standards, or codes: (update Stormwater Design Manual)														
			<ul style="list-style-type: none"> zoning ordinances and building code to allow for innovative low-impact development 	430	Lick Run	V.B.2(b)	117	\$0		1.0	\$7,000	\$0			W1a	FY17-18	SWE, SWWQ, PLA
			<ul style="list-style-type: none"> zoning ordinances and building code to allow for innovative low-impact development 	430	Tinker	5.3.3(e)		\$0		1.0	\$7,000	\$0			W1b		
			<ul style="list-style-type: none"> construction standards to allow for green-streets right-of-way cross section 	430	Lick Run	V.B.2(c)	117	\$0		1.0	\$7,000	\$0			W1a	FY17-18	SWE, SWWQ, PLA, TRAN?
			<ul style="list-style-type: none"> construction standards to allow for green-streets right-of-way cross section 	430	Tinker	5.4.3(b)		\$0		2.0	\$14,000	\$0			W1c		
			<ul style="list-style-type: none"> Expand RCC Overlay to include any property partially or wholly within a 50-ft buffer of perennial stream, with undeveloped land in buffer zone 	430	Lick Run	III.B.3	63	\$0		2.0	\$14,000	\$0			W1a	FY17-18	SWWQ
			<ul style="list-style-type: none"> Expand RCC Overlay to include any property partially or wholly within a 50-ft buffer of perennial stream, with undeveloped land in buffer zone 	430	Tinker	5.3.3(b)		\$0		2.0	\$14,000	\$0			W1a		
			Improve City's impervious surface data by performing union of SWU fee data and roadway delineation. Digitize private driveways to the roadway. Archive layer yearly to evaluate imperviousness. See Footnote in Section III.A.2.	440	Lick Run	III.A.2	27	\$0		0.5	\$3,500	1 FTE month			W1	FY17-18?	GIS
			Improve City's impervious surface data by performing union of SWU fee data and roadway delineation. Digitize private driveways to the roadway. Archive layer yearly to evaluate imperviousness. See Footnote 12 in Section 3.1.3(a)	440	Tinker	3.1.3(a)		\$0		1.0	\$7,000	1 F-M			W2		
Objective	Indicators	Qualitative Benefits	Category Action Items	CRS Series (1)	WMP	Section Ref.	Page #	Capital Cost (3)	FTE Time Est	FTE Cost (14)	Maint Cost	Total Cost	Priority (4)	Timeline	Lead Agency		
Goal 2 - Minimize watershed hazard to public health, safety, and property																	
A. Prioritize and construct Capital Improvement Projects that both mitigate neighborhood flood hazards and improve downstream water quality	<ul style="list-style-type: none"> Length and width of riparian buffers, - Length and quality of stream restoration, - Area of wetlands, - Length of stream daylighting, - Virginia Stream Condition Index (VSCI) 	<ul style="list-style-type: none"> ↓ flooding, ↑ base-flow in dry channels, ↓ in-stream erosion, ↓ sediment loads, ↑ biological life 	On public land, construct infiltration practices on City owned property, esp. park land, and in public right-of-way where space and soils will allow at:														
			<ul style="list-style-type: none"> The old Countryside golf course (dependent on future landuse/layout) 	450	Lick Run	V.C.3(a)	139	\$332,000			\$27,000				C1,W1	SWE	
			<ul style="list-style-type: none"> Huff Lane Park 	450	Lick Run	V.C.3(a)	139	\$214,000			\$17,000				C1,W1	SWE	
			<ul style="list-style-type: none"> Right of way 	450	Lick Run	V.C.3(a)	139	\$59,000			\$59,000				C1,W1	SWE	
			<ul style="list-style-type: none"> City-owned parcels 	450	Tinker	5.4.3(a)		\$638,000			\$57,000				C1b,W1b		
			<ul style="list-style-type: none"> Right of way 	450	Tinker	5.4.3(b)		\$242,000			\$10,000				C1c,W1c		
			Retrofit Existing Stormwater Detention Basins to improve storage capacity and add water quality benefits														
			Retrofit the Valley View Basin along I-581 for water quality. There is sediment reduction potential, and possible infiltration. Also has the potential to bring aesthetic value to the area, since it's along the main road to get in and out of the City. Pond retrofit? w/ floating wetlands, tree plantings onsite (Start with Daleton Rd basin.)	450	Lick Run	V.C.2(a)	136	\$588,000			\$112,000				C2,W2	Work in w/ Evan's Spring Plan	SWWQ, SWE
			<ul style="list-style-type: none"> Daleton Blvd. Basin 	450	Tinker	5.4.2(a)		\$600,000			\$19,000				C1a,W1a		
			<ul style="list-style-type: none"> Airport Rd. Basin 	450	Tinker	5.4.2(b)		\$678,000			\$19,000				C2		
			<ul style="list-style-type: none"> Roanoke-Blacksburg Regional Airport Basin B.4 	450	Tinker	5.4.2(c)		\$275,000			\$3,600				C3		
			<ul style="list-style-type: none"> Roanoke-Blacksburg Regional Airport Basin B.5 	450	Tinker	5.4.2(c)		\$100,000			\$1,300				C3		
			Move six existing outfalls in need of repair or replacement to the limit of the riparian buffer (i.e. away from the stream) to allow diffuse flow for filtration and infiltration.	510	Lick Run	V.C.1(b)	126	\$462,000			\$37,000				C3,W3	SWE, SWWQ	
			At proposed stream restoration/riparian buffer sites, remove and replace outfalls using regenerative stormwater conveyance principles to allow diffuse flow for filtration and infiltration.	510	Tinker	5.4.1(c)			See 1.A - Cell K11						C2,W2		
			When aging and failing culverts need to be replaced, use stream simulation method (Section) for sizing new culvert, and replace with culvert suitable for ecosystem connectivity. (update Stormwater Design Manual)	540	Lick Run	V.C.1(d)	135	\$1,400,000			\$100				C3,W3	SWWQ, SWE, PLA	
			When aging and failing culverts need to be replaced, use stream simulation method (Section 4.2.5) for sizing new culvert, and replace with culvert suitable for ecosystem connectivity.	540	Tinker	5.4.1(d)		\$1,300,000			\$0				C2,W3		
B. Increase Community Rating System (CRS) ratings for progressive floodplain management activities	<ul style="list-style-type: none"> CRS Rating, - Annual flood damage 	<ul style="list-style-type: none"> ↓ flooding, ↓ flood insurance cost, ↓ cost of flood repair 	Include Action Items from WMP in CRS recertification, especially in Series 400 - Mapping and Regulations, and 500 - Flood Damage Reduction Activities as the City has the highest potential for improvement in these categories. Relevant CRS Series are noted in this Table.	N/A	Lick Run			\$0		0.5	\$3,500	\$0			C1	FYs17+	SWWQ, PLA, SWE, GIS
			Include Action Items from WMP in CRS recertification, especially in Series 400 - Mapping and Regulations, and 500 - Flood Damage Reduction Activities as the City has the highest potential for improvement in these categories. Relevant CRS Series are noted in this Table.	N/A	Tinker			\$0		0.5	\$3,500	\$0			C1b		
C. Delist from the 303(d) report all impairments including bacteria, sediment, (Temperature, PCBs and Mercury in Fish Tissue)	<ul style="list-style-type: none"> Street sweeping lane miles, - Suspended Solids/Turbidity Monitoring, - VSCI Score, - Number of illicit sanitary sewer disconnects, - Number of illicit discharges eliminated, - Estimated bacteria load reductions from illicit discharges 	<ul style="list-style-type: none"> ↓ sediment loads, ↑ biological life, ↓ bacteria loads 	Use the newly created ArcGIS Online interface to track active construction sites SW or city-wide? and the frequency that they have been inspected. Create a form for inspectors that facilitates the input of information needed at each construction site.	N/A	Lick Run	SW Report: I.C.3(b)	17	\$0		1.0	\$7,000	\$0			M2	PLA, GIS, INSPECTORS	
			Use the ArcGIS Online interface to track active construction sites and the frequency that they have been inspected. Create a form for inspectors that facilitates the input of information needed at each construction site.	N/A	Tinker	Report: Section 2		\$0		2.0	\$14,000	\$0			M2		
			Use the methods in Section V.A.2 with the "stormwater control measure" dataset in the stormwater GIS to estimate the amount of sediment and bacteria removed for each new best management practice	N/A	Lick Run	V.A.2	110	\$0		1.0	\$7,000	0.5 FTE months			W2	GIS, SWE	
			Use the methods in Section 5.2.1 with the "stormwater control measure" dataset in the stormwater GIS to estimate the amount of sediment and bacteria removed for each new best management practice	N/A	Tinker	3.1.6, 5.2.1		\$0		1.0	\$7,000	0.5 F-M			W2		

Objective	Indicators	Qualitative Benefits	Category	CRS Series (1)	WMP	Section Ref.	Page #	Capital Cost (3)	FTE Time Est	FTE Cost (14)	Maint Cost	Total Cost	Priority (4)	Timeline	Lead Agency
			Invest in additional vacuum-assist or regenerative air sweepers, as they remove particulate matter better than mechanical sweepers. Perform street sweeping on private land as equipment and personnel allow. Add regenerative air and vacuum sweepers as necessary/possible	N/A	Lick Run	IV.A	96	\$2,560,000		1 FTE each			M3	FY17-18	SW
			Investigate and map utility crossings in the stream, identify responsible parties for inspection and repair of broken pipes/conduits (e.g. Reach 7 along the Frontage Road). (have updated WVA GIS map of crossings) Set up biennial inspections	N/A	Tinker	5.3.3(d)		\$0		1 FTE/sweeper			M3		
			Investigate and repair utility crossings in and immediately adjacent the stream in coordination with Western Virginia Water Authority	N/A	Lick Run	V.B.1(a)	115	\$0	1.0	\$7,000	\$0		W2		SW Outreach Tech during bacteria monitoring
			Monitor ammonia nitrogen downstream of former Washington Park landfill to assure that leachate does not affect stream water quality	N/A	Tinker	3.2.1(b)		\$0	3.0	\$21,000	\$0		W2		
			Prioritize illicit discharge detection at recommended catchments and outfalls	N/A	Lick Run	V.B.1(c)	115	\$1,000		0.25 FTE months			W3		SWWQ, OEM
			Prioritize illicit discharge detection at recommended catchments and outfalls	N/A	Lick Run	V.B.1(a), V.B.1(b)	114-115	\$0		-			W1	FY17-18	SWWQ, SW Outreach Tech, OEM
			Prioritize illicit discharge detection at recommended catchments and outfalls	N/A	Tinker	5.3.2(a), (b)		\$0		-			W2		
			Address existing potential illicit discharge issues	N/A	Tinker	5.3.2(c)		\$0	1.0	\$7,000	-		W1a		
			Coordinate with the Western Virginia Water Authority for the removal of illicit connections to storm drain system, and removal of septic tanks REPAIR AND INSPECTION	N/A	Lick Run	V.B.1(a)	115	\$0	0.5	\$3,500	0.5 FTE months		W1	FY17-18	SWWQ, Health Department, CVC?
			Coordinate with the Western Virginia Water Authority for the removal of illicit connections to storm drain system, and removal of septic tanks	N/A	Tinker	3.2.1(a), (b)		\$0	0.5	\$3,500	0.5 FTE months		W1b		
			Revise construction requirements for storm drain - sanitary sewer crossings to require encasing and minimum cover requirements (update Stormwater Design Manual)	N/A	Lick Run	V.B.1(d)	116	\$0	1.0	\$7,000	-		W2	FY17-18	PLA, SWWQ
			Revise construction requirements for storm drain - sanitary sewer crossings to require encasing and minimum cover requirements	N/A	Tinker	5.3.2(d)		\$0	1.0	\$7,000	-		W2		
Goal 3 - Connect citizens, businesses, students, and other stakeholders to their watershed															
A. Provide the community with life-long learning opportunities about their watershed (natural processes, ecosystem health, and pollution prevention)	· Community-riparian construction projects, · Citizen monitoring programs, · Public-access water monitoring data	↑ community education, ↑ watershed knowledge base, ↑ aesthetics	Develop a stormwater monitoring program that includes:												
			· The addition of qualified rain gauges (1 gauge per 5 sq.mi. = 9 Citywide @ \$5K each Cap & Maint)	N/A	Tinker	6.1		\$40,000		\$40,000			C1a, W1a		
			· Long-term flow and sediment monitoring of the watershed	N/A	Lick Run	Report I.C.3	118	\$35,000		\$16,000			W1a	FY16-17+	SW
			· Long-term watershed streamflow and sediment monitoring (2 per Watershed = 28 Citywide @ \$55K each Capital & \$50K each USGS Maint)	N/A	Tinker	6.2		\$1,540,000		\$1,400,000			W1b		
			· Biological monitoring	N/A	Lick Run			\$0		\$1,000			W1a	FY17-18+	SWWQ, CVC
			· Monitoring of aquatic insects (i.e. benthic macroinvertebrates - 5 per Watershed X 14 @ \$300/site)	N/A	Tinker	6.3		\$0		\$21,000			W1a		
			· Outfall water quality monitoring	N/A	Lick Run			\$3,900		\$6,000			W1b	FY17-18+	SWWQ, OEM
			· Short-term catchment monitoring at the Roanoke Regional Airport and Valley View Mall confluences with Lick Run	N/A	Lick Run			\$39,000		\$1,000			W2		
			· Short-term catchment-scale monitoring for Daleton & Williamson Rd outfalls (\$55K Cap + \$50K Maint for 3-5 yrs only x 2)	N/A	Tinker	6.4		\$110,000		\$100,000			W2		
			· Targeted monitoring of polychlorinated biphenyls (PCBs) - (\$500 - \$1.5K/2 Samples/Year X 3 Watersheds or GRA funding)	N/A	Tinker	6.5		\$0		\$9,000			W2		
			Apply watershed knowledge to environmental education classes at William Fleming High School, Roanoke Academy of Math and Science, and Round Hill Elementary School. Take field trips to the stream, and use biology data towards learning outcomes. Coordinate this effort with the Clean Valley Council.	N/A	Lick Run	V.B.4	119, 120	\$0	1.0	\$7,000	0.1 FTE		W1		SWWQ, CVC
			Apply watershed knowledge to environmental education classes at Fallon Park and Monterey Elem, Breckenridge Middle, Noel C. Taylor Learning Academy. Take field trips to the stream, and use biology data towards learning outcomes. Coordinate this effort with the Clean Valley Council.	N/A	Tinker	5.3.4		\$0	12.0	\$84,000	1 F-M		W1a		
			Create watershed education classroom at Brown-Robertson Park	N/A	Lick Run	V.B.4	119						W3		
			Create stream education space at Eastgate Park	N/A	Tinker	5.3.4							W3		
			Develop and support citizen monitoring programs in coordination with the Clean Valley Council; assure that monitoring data is easily accessible.	N/A	Lick Run	V.B.3	118	\$0	1.0	\$7,000	0.1 FTE		W2	FY17-18+	SWWQ, RVARC
			Engage the Gainsboro public library as a potential center for watershed education, as it is located near Lick Run. Incorporate hands on, stream-oriented classes in Library education programs Gainsboro Library due to close for renovations	N/A	Lick Run	V.B.4	119	\$0	0.5	\$3,500	0.1 FTE		W2		SWWQ
			Work with City Libraries to create stream and watershed educational programs	N/A	Tinker	5.3.4							W1a		
			Advertise the availability of watershed monitoring data, and incorporate into local educational programs as possible	N/A	Tinker	6		\$0	12.0	\$84,000	1 F-M		W2		
B. Engage the community in revitalizing watershed ecosystem health (BMPs, green infrastructure, and low impact design)	· Contact with key stakeholders, · Continued involvement of key stakeholders	↑ treatment from private BMPs, ↓ illicit dumping	Assure that the general public understands the amount of money that could be saved through their SWU by (1) reducing impervious surface on their property, and (2) disconnecting their impervious surfaces and receiving credits. (newsletter) FY2018 Tree Program	N/A	Lick Run	V.B.3(b)	137	\$0	0.1	\$700	0.1 FTE		W2	FY17-18+	SWWQ
			Assure that the general public understands the amount of money that could be saved through their SWU by (1) reducing impervious surface on their property, and (2) disconnecting their impervious surfaces and receiving credits.	N/A	Tinker	5.4.3(c)		\$0	1.0	\$7,000	1 F-M		W2		
			Investigate and enforce illegal dumping regulations at: (1) Heritage Acres development, (2) Evans Spring neighborhood, (3) Circle-T Trailer Park	N/A	Lick Run	V.B.1(c)	115	\$0	1.0	\$7,000			W2		SWWQ, OEM, CVC, NEIGHBORHOODS, Code Enf.
			Investigate and eliminate (if necessary) potential illicit discharges in the watershed	N/A	Tinker	5.3.2(c)		\$0	1.0	\$7,000			W2		
			Engage commercial property owners in education about proper dumpster care.	N/A	Lick Run	V.B.1(a)	115	\$0	0.5	\$3,500	0.1 FTE		W2		EM, CVC, NEW LANGUAGE IN permits?
C. Coach the community to participate in outdoor recreation and stewardship opportunities within their watershed.	· Pedestrian counts, · Community-riparian construction projects, · Involvement programs	↑ recreation, ↑ community education, ↑ property values	Reconstruct a flood- and erosion-resilient pedestrian bridge at Norris Drive to connect Melrose-Rugby neighborhood to Lick Run Greenway.	N/A	Lick Run	V.B.4	120	\$50,000					C3	Completed 2016	PARKS
			Connect existing Lick Run Greenway to old Countryside golf course, and to adjacent neighborhoods (#20 on greenway list)	N/A	Lick Run	V.B.4	119	See Section					C3	In planning stages	PARKS, SW
			Connect Tinker Creek Greenway to Fallon Park and Monterey Elem. Schools	N/A	Tinker	5.3.4		See Section					C3		

			Establish a restored riparian corridor along 13 th St. from Baldwin Ave. to Mason Mill Rd. to extend Tinker Creek Greenway	N/A	Tinker	5.4.1(b)i, ii	See 1.B - Cells K36-37	See 1.B - Cells N36-37		W2,C2				
			Revitalize Washington and Brown-Robertson Park by tree planting (Family Adopt-A-Tree) and improving controlled pedestrian access, lighting, and recreational activities. Integrate stream restoration with revitalization in Washington Park	N/A	Lick Run	V.B.4, V.C.1(c)	119, 129			C3		SWWQ, PARKS, Tree Stewards, Citizens		
			Establish pocket parks on clusters of vacant land in the Belmont-Fallon Neighborhood	N/A	Tinker	5.3.1		\$300,000	\$5,300	C3				
			Encourage interested private stakeholders such as Roanoke Outside, Trout Unlimited, Orvis, Roanoke Area Paddlers, and the City's Parks and Recreation department to fund or host interactive watershed tours. Roanoke Outside	N/A	Lick Run	V.B.4	119	\$100	0.1 FTE	W3		SW		
			Encourage interested private stakeholders such as Roanoke Outside, Trout Unlimited, Orvis, Roanoke Area Paddlers, and the City's Parks and Recreation department to fund or host interactive watershed tours.	N/A	Tinker	5.3.4		\$100	0.1 FTE	W3				
								Capital Cost (3)	FTE Time-Months Est	FTE Cost (14)	Maint Cost	Total Cost		
								Grand Totals	\$29,347,100	76.1	\$532,700	\$3,242,300		

¹ The CRS Series column refers to the National Flood Insurance Program – Community Rating System Coordinator's Manual (2013) [104]

² Capital costs include land acquisition, materials, labor, and other associated upfront construction costs. Annual costs include operation and maintenance cost. FTE stands for full-time equivalent, see Section V.A.2(b).

³ The Priority column is organized by the type of project: C = Capital Improvement, W = Water Quality (i.e. TMDL Action Plan), and M = Maintenance. Priority is then given where 1a is the highest priority and 3c the lowest.

⁴ Recommendations for assessing the quality of a stream restoration project can be found in Section IV.B.

[1] The CRS Series column refers to the National Flood Insurance Program – Community Rating System Coordinator's Manual (2013) [140]

[2] Capital costs include land acquisition, materials, labor, and other associated upfront construction costs. Annual costs include operation and maintenance cost. F-M stands for full-time equivalent-months, see Section 5.2.2.

[3] The Priority column is organized by the type of project: C = Capital Improvement, W = Water Quality (i.e. TMDL Action Plan), and M = Maintenance. Priority is then given where 1a is the highest priority and 3c the lowest.

[4] Recommendations for assessing the quality of a stream restoration project can be found in Section 4.2.2

[5] The CRS Series column refers to the National Flood Insurance Program – Community Rating System Coordinator's Manual (2013) [140]

[6] Capital costs include land acquisition, materials, labor, and other associated upfront construction costs. Annual costs include operation and maintenance cost. F-M stands for full-time equivalent-months, see Section 5.2.2.

[7] The Priority column is organized by the type of project: C = Capital Improvement, W = Water Quality (i.e. TMDL Action Plan), and M = Maintenance. Priority is then given where 1a is the highest priority and 3c the lowest.

[8] The CRS Series column refers to the National Flood Insurance Program – Community Rating System Coordinator's Manual (2013) [140]

[9] Capital costs include land acquisition, materials, labor, and other associated upfront construction costs. Annual costs include operation and maintenance cost. F-M stands for full-time equivalent-months, see Section 5.2.2.

[10] The Priority column is organized by the type of project: C = Capital Improvement, W = Water Quality (i.e. TMDL Action Plan), and M = Maintenance. Priority is then given where 1a is the highest priority and 3c the lowest.

[11] The CRS Series column refers to the National Flood Insurance Program – Community Rating System Coordinator's Manual (2013) [140]

[12] Capital costs include land acquisition, materials, labor, and other associated upfront construction costs. Annual costs include operation and maintenance cost. F-M stands for full-time equivalent-months, see Section 5.2.2.

[13] The Priority column is organized by the type of project: C = Capital Improvement, W = Water Quality (i.e. TMDL Action Plan), and M = Maintenance. Priority is then given where 1a is the highest priority and 3c the lowest.

(14) The FTE Cost = Paygrade 15 Salary & Benefits/Month X FTE Time Est Column