National Pollutant Discharge Elimination System
Municipal Separate Storm Sewer System
Permit No. 11-DP-3313 MD0068276
Permit Term October 9, 2015 to October 8, 2020

Seventh Annual Report
October 28, 2022

Submitted to:
Stormwater, Dam Safety, and Flood Management Program
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MDOT
MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

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Introduction

The following annual report was prepared by the Maryland Department of Transportation State Highway Administration (MDOT SHA) to demonstrate compliance from July 1, 2021 to June 30, 2022 (a.k.a., fiscal year 2022; referred to hereafter as "FY22") in accordance with conditions in Part V.A.1 of the National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) discharge permit number 11-DP-3313 MD0068276, effective October 9, 2015 and scheduled for expiration on October 8, 2020 (referred to hereafter as the "MS4 Permit"). MDOT SHA submitted its reapplication for MS4 Permit coverage as Attachment B to its fourth, fiscal year 2019 (FY19) MS4 annual report received by the Maryland Department of the Environment (MDE) on October 8, 2019. In correspondence from MDE to MDOT SHA dated November 30, 2020, MDE conveyed that MDOT SHA coverage under the MS4 Permit has been administratively continued, in accordance with the Code of Federal Regulations, until a new MS4 Permit can be issued and that all permit requirements remain in force.

MDOT SHA has submitted, with this FY22 MS4 annual report, five electronic data sets including:

- Geographic Information System (GIS) data (hereafter referred to as the "MS4 Geodatabase – Part 1") in accordance with Part V.A.2 of the MS4 Permit and Version 1.2 of the MDE NPDES MS4 Geodatabase Design and User's Guide distributed to permitted MS4s in May 2017.
- A separate 'annual BMP' geodatabase ("MS4 Geodatabase – Part 2") that contains only an *AltBMPPoly* feature class with records for MDOT SHA implementation of annual/operational inlet cleaning and street sweeping Best Management Practices (BMPs). Records for other restoration BMP types remain in the MS4 geodatabase – Part 1.
- Two data sets not otherwise captured by the MDE MS4 geodatabase design and submitted to demonstrate compliance with conditions in Part IV.C of the MS4 Permit as described in the "Source Identification" section of this FY22 MS4 annual report, including:
    - A supplementary geodatabase containing inventory information for MDOT SHA stormwater infrastructure
    - A supplementary geodatabase containing the inventory of non-permitted industrial sources and associated data for annual visual surveys completed in accordance with Part IV.D.3.b of the MS4 Permit
- A Microsoft Excel workbook containing a comprehensive list of restoration BMPs completed from 2011 to June 30, 2022, separated by contract with associated location, impervious treatment, and cost information provided in accordance with conditions in Part IV.E.5.c of the MS4 Permit.

MDE supplied MDOT SHA comments, dated May 9, 2022, related to the FY21 MS4 annual report and data submittal. MDOT SHA responses addressing the May 9, 2022 MDE comments are submitted in tandem to this FY22 MS4 annual report.

Permit Administration and Legal Authority

The MS4 Permit was administered during FY22 by the MDOT SHA Office of Environmental Design (OED) with Ryan Cole, Water Programs Division Chief, serving as the MS4 Permit Manager and liaison to MDE. In accordance with conditions in Part IV.A of the MS4 Permit, MDOT SHA has provided contact information in the *PermitInfo* table of the MS4 Geodatabase – Part 1 and an updated organizational chart describing staff roles in relation to NPDES stormwater tasks in **Appendix A**.

In accordance with conditions in Part IV.B of the MS4 Permit relative to 40 Code of Federal Regulations 122.26, MDOT SHA maintained adequate legal authority for compliance with all permit conditions during the FY22 reporting period and carried out inspections, surveillance, and monitoring procedures necessary to demonstrate compliance with MS4 Permit conditions. MDOT SHA has provided associated information within **Appendices B and C**.

Status of Implementing the Stormwater Management Program

In the following subsections, MDOT SHA has provided the status of implementing the components of its stormwater management (SWM) program that are established as conditions in the MS4 Permit. Stormwater program components reported in this FY22 MS4 annual report in accordance with conditions in Part V.A.1.a of the MS4 Permit include:

- Source Identification
- Stormwater Management
- Erosion and Sediment Control
- Illicit Discharge Detection and Elimination
- Trash and Litter
- Property Management and Maintenance
- Public Education
- Watershed Assessment
- Restoration Plans
- TMDL Compliance
- Assessment of Controls
- Program Funding

Source Identification

In accordance with conditions in Part IV.C.1 of the MS4 Permit and throughout FY22, the MDOT SHA Office of Highway Development (OHD), Highway Hydraulics Division (HHD) continued to maintain the inventory of MDOT SHA storm drain infrastructure, major outfalls, SWM facilities, and associated drainage areas as described in Section C.1 of the FY19 MS4 annual report. HHD continued to collect missing, and update existing, inventory information during its review of ditch trimming and pipe replacement permits issued to MDOT SHA maintenance forces as described in the "Source Identification" section of the FY21 MS4 annual report.

HHD also continued to update the storm drain system inventory in conjunction with its preventative maintenance inspections for SWM facilities by investigating, and capturing any missing information for, at least one drainage asset connected to each of those facilities. During FY23, HHD intends to expand these investigations to update the inventory for drainage assets that extend beyond that first point of connection to the SWM facility. HHD is also working in FY23 to incorporate 'field walks' during incidental drainage investigations, performed in response to complaints from the public or issues observed in the field by MDOT SHA staff or contractors, to update information for existing storm drain system assets or to capture information for drainage assets that are missing from the inventory.

The new Outfall Inspection tool referenced in the "Source Identification*"* section of the FY21 MS4 annual report, could not be deployed in FY22 due to budgetary constraints; however, MDOT SHA has allocated staff and funding resources in FY23 to deploy the tool in time for scheduled inspections. MDOT SHA has provided the outfall structure information in the *Outfall* and *OutfallDrainageArea* feature classes of the MS4 Geodatabase - Part 1. Information for conveyances and other structures not represented by the MDE MS4 geodatabase design are provided in a supplemental geodatabase submitted with this FY22 MS4 annual report.

In accordance with conditions in Part IV.C.2 of the MS4 Permit, MDOT SHA has identified industrial sites within MDOT SHA right-of-way that have the potential to contribute significant pollutants to MDOT SHA storm drain systems. These include MDOT SHA-owned NPDES 12-SW permitted industrial sites but also non-permitted salt storage areas, parking lots, rest areas, and other highly trafficked or material storage areas as requested by MDE. There are no commercial sites on MDOT SHA properties. MDOT SHA has provided location and other information for NPDES 12-SW permitted industrial sites in the *MunicipalFacilities* feature class of the MS4 Geodatabase – Part 1.

The inventory of non-permitted industrial sites was evaluated in FY22 and numerous sites were identified as closed and no longer in operation, demolished, or not owned and operated by MDOT SHA. Consequently, these were removed from the inventory provided in the supplemental geodatabase submitted with this FY22 MS4 annual report. Also, three communication towers previously reported as non-permitted industrial sites were removed from the inventory because it was determined that those sites do not have potential to contribute significant pollutants to MDOT SHA drain systems and thus do not qualify as industrial sites subject to the conditions in Part IV.C.2 or IV.D.3.b of the MS4 Permit. MDOT SHA does not have any dedicated staff reporting to those locations and there are no significant parking areas to potentially contribute pollutants. Further, since heat is provided to the communication towers via propane gas, there are no petroleum pollution sources to consider. Lastly, there is no waste storage provided at these locations and batteries as well as other potential waste items associated with a site of this nature are stored within the tower's building and out of contact with stormwater. One Park and Ride site built in 2019 was identified as missing from previous reporting and subsequently was added to the inventory for this FY22 MS4 annual report. To facilitate clear communication of these inventory adjustments, MDOT SHA has provided the list of sites removed with their respective reasons for removal as a separate feature class within the supplemental geodatabase submitted with this FY22 MS4 annual report.

During FY22, updates to the inventory of urban BMPs/SWM facilities continued, including many new records added for facilities built since 2018. In many cases, it can take extended time periods for a constructed SWM facility to receive as-built approval which is a prerequisite to its formal incorporation into the MDOT SHA storm drain system inventory. MDOT SHA has provided urban BMP information in the *BMPPOI* feature class and the *BMP* table of the MS4 Geodatabase – Part 1.

As described in Section C.3 of the FY19 MS4 annual report, the MDOT SHA revised baseline analysis, submitted in June 2018, included GIS data for its impervious surfaces. MDE found it acceptable that this information was not resubmitted with the FY19 MS4 annual report and MDOT SHA has similarly excluded it from the FY20 and FY21 MS4 annual reports as well as this, FY22 MS4 annual report. MDOT SHA has provided updates to the *ImperviousSurface* table of the MS4 geodatabase – Part 1.

Monitoring site locations, established to meet conditions described in Part IV.F of the MS4 Permit, were revised as described in Section F.1 the FY19 MS4 annual report. As described in the Assessment of Controls section of the FY20 MS4 annual report, chemical monitoring stations were removed in June 2020. Two new chemical monitoring stations were installed at MDOT SHA's Little Catoctin Creek (LCC) stream restoration site in FY22. The downstream monitoring station was established a short distance downstream of the original location in order to ensure the safety of monitoring professionals performing activities in support of MDOT SHA's monitoring plan for LCC. MDOT SHA has provided information for its monitoring sites in the *MonitoringSite* and *MonitoringDrainageArea* feature classes of the MS4 Geodatabase – Part 1 and changes referenced herein have been noted for applicable records.

Information for MDOT SHA water quality improvement projects completed through the current permit term as well as projects under construction that MDOT SHA expects to complete in State fiscal year 2023 (FY23) and claim for restoration credit is provided in the *RestBMP*, *AltBMPLine*, and *AltBMPPoly* feature classes as well as the *StrRestProtocols* table of the MS4 Geodatabase – Part 1. Information for inlet cleaning and street sweeping annual/operational BMPs is provided in the *AltBMPPoly* feature class of the MS4 Geodatabase – Part 2. In accordance with Part V.A.2.d of the MS4 Permit and applicable guidance provided for the *AltBMPLine* feature class in Version 1.2 of the MDE NPDES MS4 Geodatabase Design and User's Guide and requirements described in Appendix E to the 2014 MDE document, "Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated" (referred to hereafter as "MDE 2014"), MDOT SHA included a Stream Restoration Analysis Report within Appendix G to the FY21 MS4 annual report that showed the work behind calculations for defining pollutant load reductions for stream restoration projects using protocols approved by the Chesapeake Bay Program. No new stream restoration BMPs were constructed in FY22 so information provided for FY21 remains relevant and unchanged.

Stormwater Management

MDOT SHA continues to comply with State and federal laws and regulations regarding SWM as well as MDE permit requirements. MDOT SHA also continues to implement the practices established in the 2000 Maryland Stormwater Design Manual and the MDOT SHA Sediment and

Stormwater Guidelines and Procedures (October 6, 2017) for all projects and remains in compliance with the SWM Act of 2007, including the revised Chapter 5 of the 2000 Maryland Stormwater Design Manual, by implementing environmental site design to the maximum extent practicable for all new and redevelopment projects. During FY22, the SWM program expanded as a result of working in conjunction with the MDOT SHA Asset Management Office (AMO) to finalize the Stormwater Systems Asset Management Plan as an appendix to the Federal Transportation Management Plan submitted to the Federal Highway Administration.

As described in Section D.1.a of the FY19 MS4 annual report, the OHD Plan Review Division (PRD) is the approving authority for both erosion and sediment control (ESC) and SWM for all MDOT SHA projects. PRD continues to submit progress reports to MDE annually in accordance with the July 8th, 2014 Memorandum of Understanding between MDOT SHA and MDE and Authorization Letters. PRD continues to coordinate with MDE to update the PRD Sediment and Stormwater Guidelines and Procedures as necessary. Additional information can be found in the "MDOT SHA Annual Report for Delegation of Sediment and Stormwater Approval Authority" that was submitted to MDE on October 6, 2022.

MDOT SHA maintained SWM and construction inspection information during FY22 utilizing the processes described in Sections D.1.b. and D.1.c of the FY19 MS4 annual report. In accordance with conditions in Part IV.B of the MS4 Permit, a summary of construction inspections, non-compliance findings, and the actions taken by MDOT SHA Districts is referenced in Section 1.11 of, and is provided as electronic data with, the "MDOT SHA Annual Report for Delegation of Sediment and Stormwater Approval Authority" that was submitted to MDE on October 6, 2022. Information for the MDOT SHA SWM program; including required documentation in accordance with conditions in Parts IV.D.1.b, IV.D.1.c, and IV.D.1.d of the MS4 Permit; is provided in the *SWM* table of MS4 Geodatabase – Part 1.

During the FY22 reporting period, MDOT SHA conducted 3,423 preventative maintenance inspections of SWM facilities in accordance with COMAR 26.17.02 and conditions in Part IV.D.1.d of the MS4 Permit. Of these, 3,292 applied standardized inspection processes described in Section D.1.d of the FY19 MS4 annual report. For the remaining 131 accomplished in FY22, HHD piloted a study that utilized Unmanned Aerial Systems (sUAS) to inspect linear SWM facilities. Analysis of the information and photos collected suggests this methodology yields high quality data and provides a significantly increased safety factor for inspection teams by reducing the amount of time spent on the roadway to capture inspections information. Initial results from the pilot program showed an increase of inspection efficiency by as much as 50% for linear SWM facilities. Using data from the pilot study, MDOT SHA generated guidance documents for the use of the sUAS technology to facilitate preventative maintenance inspections in future years. Documentation was a collaborative effort between SWM professionals, drone pilots and spotters, and GIS professionals. These practices will be integrated into the guidance documents for the overall NPDES program during FY23 and FY24 where applicable.

MDOT SHA budget constraints that began in FY21, resultant from the COVID-19 pandemic, continued to have impacts on SWM facility inspection activities during FY22. Despite these challenges, MDOT SHA completed all inspections for facilities that were due for inspection in FY21 and completed a significant number of inspections that were due in FY22. MDOT SHA has allocated funding for the FY23 period to inspect all remaining facilities not inspected during

FY22 as well as 100% of the facilities due for inspection in FY23. In total, 4,767 inspections are anticipated to be completed during the FY23 reporting period. In addition, the FY22 pilot program for inspection of the numerous 2A grass swales included in the inventory using sUAS technology will continue in FY23. The technology may also be used for more complex facilities where access is problematic. MDOT SHA has provided the inspection program information in the *BMPInspections, RestBMPInpsections, AltBMPLineInspections*, and *AltBMPPolyInspections* tables of the MS4 Geodatabase – Part 1.

During FY22, MDOT SHA performed 80 initial inspections of SWM facilities built across 32 different contracts. Initial inspections were performed using processes described in the "Stormwater Management" section of the FY20 and FY21 MS4 annual reports and are reported in the *SWM* table of the MS4 Geodatabase – Part 1. The submittal and review processes for SWM facility as-built certification described in the "Stormwater Management" section of the FY21 MS4 annual report persisted in FY22. During the reporting period, 3 initial inspections were flagged for follow-ups that can include additional inspections or repair, remediation, and/or retrofit/reconstruction activities depending on the findings in those initial inspections. New database and GIS tool upgrades were developed during FY22, including a "SWMFAC Editor Tool" that will improve the efficiency and efficacy of the MDOT SHA processes for as-built certification and tracking the lifecycle of its SWM facilities.

MDOT SHA performed minimal routine maintenance for SWM facilities during FY22 due to continued funding constraints that began in FY20 due to the COVID-19 pandemic. During FY22, HHD leveraged federal grant funding provided by the State Transportation Innovation Council to begin development of an interactive and mapped application for tablets utilized by MDOT SHA maintenance forces that will integrate SWM facility design and inspection records with routine maintenance guidance and activity tracking functions. This application is anticipated to launch by or before FY25. More information and links to MDOT SHA current District-specific guidance can be found online at the following MDOT SHA webpage:

https://www.roads.maryland.gov/mdotsha/pages/Index.aspx?PageId=363

During FY22, no rehabilitation maintenance was completed and consequently, MDOT SHA completed no remediation follow-up inspections during the reporting period. Final acceptance records were submitted to MDOT SHA and are currently under review for the 4 facilities repaired in FY20, as reported in the "Stormwater Management" section of the FY20 MS4 annual report. MDOT SHA anticipates completing remediation follow-up inspections to issue final acceptance for these facilities in FY23.

During the current MS4 Permit term, a total of 51 facilities were remediated by MDOT SHA. A total of 229 SWM facilities still require major maintenance or retrofit. Maintenance work has been prioritized and completion dates are anticipated between June 2023 and June 2026. MDOT SHA has reported 69 'maintenance enforcements' for FY22 in the *SWM* table of the MS4 Geodatabase – Part 1. Captured in this figure are 9 SWM facilities contracted in FY22 and scheduled for repair during FY23 as well as 60 SWM facilities that were assessed and prioritized in FY22 for inclusion in rehabilitation and retrofit designs scheduled for contracting in FY23 and construction by FY24. In accordance with conditions in Part IV.B of the MS4 Permit, MDOT SHA has provided a remediation maintenance schedule (see **Table IV.D.1.d)** in Appendix B along with additional information about MDOT SHA efforts to assess and prioritize rehabilitation of its SWM facilities.

MDOT SHA did not officially abandon any SWM facilities in FY21 or FY22; however, HHD and PRD anticipate they will finalize development of procedures for retiring SWM facilities during FY23. The previously mentioned "SWMFAC Editor Tool" will launch during FY23 and includes an application process for abandonment of SWM facilities. HHD and PRD will review and comment on applications generated by the tool, including the justifications for abandonment tracked within. As SWM facilities are approved for abandonment, PRD will update files and permits associated with the locations wherefor those facilities had previously provided water quality or quantity treatment. Abandonment related documents will be integrated with the tablet application being developed to support routine maintenance operations for SWM facilities.

Erosion and Sediment Control

During the FY22 reporting period, MDOT SHA maintained compliance with Maryland State and federal laws and regulations for ESC as well as MDE requirements for permitting, including compliance with the General Permit for Stormwater Associated with Construction Activity (NPDES-CA) for projects that disturb at least one acre of land. MDOT SHA continued to submit applications for coverage under the NPDES-CA (State discharge permit number GP-14, effective January 1, 2015; expired December 31, 2019), for all qualifying roadway projects as described in Section D.2.d of the FY19 MS4 annual report. During the FY22 reporting period, a total of 26 MDOT SHA construction projects receiving Notice to Proceed (NTP) required coverage under an NPDES-CA permit.

Under allowance granted by the MDE Consent Order issued May 18, 2020, MDOT SHA has elected to continue operating under the terms of the expired NPDES-CA permit until the new permit, CP-20, is issued. To comply, MDOT SHA submitted Declaration of Intents for all active projects that received continued NPDES-CA coverage. CP-20 is anticipated to be issued sometime during calendar year 2022.

In accordance with conditions in Part IV.D.2.b of the MS4 Permit, and in cooperation with the Maryland Transportation Builders and Materials Association , MDOT SHA continued to offer updated ESC training, as described in Section D.2.b of the FY19 MS4 annual report, and issued 274 ESC (a.k.a., "Yellow Card") certifications and 307 re-certifications during the FY22 reporting period. Responsible Personnel Certification training was administered through MDE's online Responsible Personnel Course. More information regarding ESC certification is available at the following MDOT SHA webpage:

https://www.roads.maryland.gov/mdotsha/pages/Index.aspx?PageId=56

In accordance with conditions in Part IV.D.2.c of the MS4 Permit, MDOT SHA has provided the ESC program information in the *ErosionSedimentControl* table and the grading permit program information in the *QuarterlyGradingPermits* feature class and the *QuarterlyGradingPmtInfo* table in the MS4 Geodatabase – Part 1.

Illicit Discharge Detection and Elimination

In accordance with conditions in Part IV.D.3.a of the MS4 Permit, the OED Environmental Compliance Division (ECD) completed the 150 required Illicit Discharge Detection and Elimination (IDDE) field screenings during FY22. Whenever possible in FY22, ECD considered pollution potential and selected outfalls that were located in commercial and industrial areas determined to be "stormwater hotspots" with extra focus on permitted counties where IDDE screenings were less concentrated in previous years. Stormwater pipes 12 inches in diameter and greater were selected throughout Anne Arundel, Carroll, Frederick, and Montgomery Counties.

Additional IDDE investigation and tracking was conducted during FY22 for illicit discharge (ID) sites whose status were reported as "open" in the FY21 MS4 annual report. Citizen reporting or other MDOT SHA contractors working within MDOT SHA right of way (ROW) also identified potential IDs requiring investigation. As part of its overarching program to respond to illegal discharges, dumping, and spills; MDOT SHA coordinated with MDE, surrounding jurisdictions, and property owners during the FY22 reporting period to eliminate IDs and clean up spills and dumping. In accordance with conditions in Parts IV.B, IV.D.3.d, and IV.D.3.e of the MS4 Permit, a summary of outfalls screened and potential IDs with associated jurisdictional contacts/resolution schedules for each is provided in **Tables IV.D.3.a and IV.D.3.d** located in Appendix C. In the MS4 Geodatabase – Part 1, MDOT SHA has provided the IDDE program information in the *IDDE* table.

In accordance with conditions in Part IV.D.3.b of the MS4 Permit, ECD continues to complete multimedia facility inspections at identified industrial areas as well as perform updates to the associated inspection tracking system. During FY22, ECD inspected 32 NPDES 12-SW permitted sites, 20 of which were located within the MS4 permitted areas. A total of 132 stormwater related findings were generated by facility inspections during FY22 and applicable records were uploaded to the MDOT SHA web-based tracking system. Of those findings, 102 were resolved during FY22 whereas 30 findings remain unresolved at the close of the final quarter. Some of the unresolved findings require further communication with maintenance managers and additional tracking. In accordance with Part IV.B of the MS4 Permit, a summary of the most recent quarterly inspection report for each of the NPDES 12-SW permitted sites within the MS4 permitted areas is provided in **Table IV.D.3.b** located in Appendix C.

Also in accordance with conditions in Part IV.D.3.b of the MS4 Permit, ECD and MDOT SHA District maintenance crews collectively performed annual visual surveys at 149 non-permitted industrial sites identified and reported by MDOT SHA per Part IV.C.2 of the MS4 Permit. The date of, and issues identified during, the most recent annual visual survey at non-permitted facilities and the status of issue resolutions is provided in the supplemental geodatabase submitted with this FY22 MS4 annual report.

Trash and Litter

MDOT SHA provided comprehensive descriptions of its 'multi-pronged' trash/litter reduction strategy in the FY18 and FY19 MS4 annual reports. The approach utilizes MDOT SHA employees, contractors, correctional services, the Sponsor-A-Highway (SAH) program and partnerships, as well as labor donated through Adopt-A-Highway (AAH) volunteers. Staffing constraints on trash and litter reduction activities described in the FY21 MS4 annual report and attributed to impacts from the COVID-19 pandemic persisted in FY22. The availability of contractor and SAH staffing remained limited. MDOT SHA crews worked staggered shifts at the beginning of FY22 and access to support from AAH volunteers was very limited. Support from correctional services that started in October 2021 was immediately shutdown for several months and could not resume until March 2022. The Maryland Department of Public Safety and Correctional Services permanently closed its Southern Maryland Pre-Release Unit and Eastern Pre-Release Unit facilities which further reduced the number of crews accessible to less than half the capacity that was available to support MDOT SHA before the pandemic. In contrast, the SAH program has started seeing renewed interest from small businesses.

In accordance with conditions in Part IV.D.4.d of the MS4 Permit, trash/litter removed by MDOT SHA trash reduction strategies during the FY22 reporting period is documented in **Table IV.D.4.d** below. Implementation of the AAH and SAH programs in FY22 resulted in 131 highway miles adopted and 308 miles sponsored. Relative to implementation reported for the FY21 period, this is an increase of 45 and 16 miles respectively for the two programs.

Table IV.D.4.d: Trash and Litter Removed During FY22 by MDOT SHA Trash Reduction Strategies

Jurisdiction	Truckloads	Conversion to Pounds
Anne Arundel	580	276,950
Baltimore	1,893	903,908
Carroll	62	29,605
Cecil	114	54,435
Charles	78	37,245
Frederick	199	95,023
Harford	175	83,563
Howard	368	175,720
Montgomery	473	225,858
Prince George’s	1,080	515,700
Washington	150	71,625
Salisbury	40	19,100
Totals	**5,212**	**2,488,732**

During FY22, MDOT SHA continued to maintain its “Educational Outreach” webpage first described in Section D.4.b of the FY19 MS4 annual report. Content is accessible at the following address:

https://www.roads.maryland.gov/mdotsha/pages/index.aspx?PageId=48

In accordance with conditions in Parts IV.D.4.b and V.A.1.d of the MS4 Permit, additional public education and outreach activities implemented by MDOT SHA during FY22 to reduce littering are incorporated into the summary describing public education programs in **Appendix D**. The MDOT Excellerator program, as described in Section D.4.c of the FY19 MS4 annual report, remains the primary performance management system for tracking the effectiveness of MDOT SHA trash reduction strategies. The most recent biannual report is publicly accessible at the following web address and includes; in charts 9.2D.1, 9.2D.2, and 9.2D.3; an evaluation of quarterly implementation and associated expenditures by MDOT for litter pickup from FY19 through the end of the first FY21 quarter:

https://www.mdot.maryland.gov/tso/pages/Index.aspx?PageId=170

Property Management and Maintenance

During FY22, MDOT SHA continued to monitor the need to update Storm Water Pollution Prevention Plans (SWPPP) and maps following site changes and renovations and continued providing annual SWPPP training to its maintenance personnel. As previously described in the "IDDE" section of this FY22 MS4 annual report, the MDOT SHA maintenance facility staff continued to perform monthly inspections and ECD District Environmental Coordinators continued to perform inspections at all MDOT SHA facilities throughout the FY22 reporting period.

Table IV.D.5.a: Summary of SWPPP Status and Training for MDOT SHA Municipal Facilities

District	Maintenance Facility	12-SW Permit Type	Date of Most Recent SWPPP Update (Month-YR)	Date of Most Recent SWPPP Training (Month-YR)	Number of Individuals Trained
1	Cambridge	General	January-22	October-21	17
	Salisbury	General	December-19	October-21	21
2	Elkton	General	April-19	December-21	33
3	Fairland	General	January-19	October-21	33
	Gaithersburg	General	February-19	September & October-21	28
	Laurel	General	February-19	December-20	32
	Marlboro	General	February-19	September & October-21	31
4	Churchville	General	March-19	June-22	43
	Golden Ring	General	March-19	May-22	28
	Hereford	General	March-19	May-22	18
	Owings Mills	General	March-19	May & June-22	36
5	Annapolis	General	March-19	October-21	36
	Glen Burnie	General	March-19	October-21	26
	La Plata	General	March-19	September-21	28
	Hanover Auto Shop	General	June-20	October-21	6
6	Hagerstown	General	February-20	October-21	33
7	Dayton	General	April-20	May & June-22	30
	Frederick	General	April-20	Septmber-21 & May-22	45
	Thurmont	General	May-20	-	-
	Westminster	General	May-20	September-21	33
				Total	**557**

For each municipal facility within the MS4 permitted areas covered under the NPDES General Discharge Permit (12-SW), MDOT SHA has provided, in **Table IV.D.5.a**, a summary of updates to facility SWPPPs and associated trainings for staff in accordance with conditions in Parts IV.D.5.a and IV.D.5.b.v of the MS4 Permit. As previously reported, the Thurmont facility remains designated as a "satellite" site of the Frederick maintenance facility. During normal operations, no MDOT SHA staff report directly to the Thurmont facility. The Thurmont facility is a 12-SW permitted site and consequently requires an associated SWPPP; however, the staff training is accounted for within the Frederick facility's staff training totals in Table IV.D.5.a below. In the MS4 Geodatabase – Part 1, MDOT SHA has provided information regarding 12-SW permitted facilities in the *MunicipalFacilities* feature class.

Throughout FY22, MDOT SHA continued to clean inlets using vacuum technology as described in Section D.5.b of the FY19 MS4 annual report. MDOT SHA was able to restore funding for some street sweeping activities in FY22 after significant budget reductions in FY21. Information for implementation of inlet cleaning and storm drain vacuuming operations during FY22 is provided in **Table IV.D.5.b** below.

Table IV.D.5.b: Tons Collected in FY22 from Inlet Cleaning and Storm Drain Vacuuming

County	MDOT SHA Maintenance Shop	Total Number of Inlets Cleaned	Tons Collected[1]	Tons Collected from Storm Drain Vacuuming
Anne Arundel	Annapolis	2	0.2	1.6
	Glen Burnie	0	0	0
Baltimore	Golden Ring	92	9.7	0.8
	Hereford	75	7.9	2.1
	Owings Mills	26	2.7	1.2
Carroll	Westminster	98	10.3	3.2
Cecil	Elkton	22	2.3	0
Charles	La Plata	0	0	0
Frederick	Frederick	24	2.5	0
Harford	Churchville	78	8.2	0.6
Howard	Dayton	15	1.6	0.3
Montgomery	Fairland	201	21.1	37.4
	Gaithersburg	4	0.4	4.3
Prince George's	Laurel	1,181	124.0	26.9
	Upper Marlboro	232	24.3	5.8
Washington	Hagerstown	0	0	0
Wicomico[2]	Salisbury	0	0	0
	Totals	**2,050**	**215.2**	**84.2**

[1] Assumes 300 lbs. of wet weight cleaned from each inlet. Calculated wet weight was multiplied by 0.7 to estimate dry weight that was then converted to tons.
[2] The City of Salisbury is a Phase I MS4 jurisdiction, not Wicomico County as a whole.

Most vegetation management on MDOT SHA property is performed by mechanical methods. Herbicides are applied when it is not possible to meet management objectives by mechanical methods alone. MDOT SHA uses herbicides to control noxious weed species identified by the Maryland Department of Agriculture (MDA), invasive weeds, and plants that reduce highway safety and operability. In October and April sessions during FY22, MDOT SHA "ENV 100" classes educated 64 participants and gave them the opportunity to become an MDA-Registered Pesticide Applicator. The MDOT SHA "ENV 200" class, that historically would provide MDA Pesticide Applicator recertification credit, could not be offered by MDOT SHA in FY22 but eligible MDOT SHA staff attended equivalent training provided by MDA. There were 10 participants in MDOT SHA's May 2022 "ENV 210" training for MDA Pesticide Applicator Core and Right of Way tests. MDOT SHA continued to promote reduced use of glyphosate by minimizing use of non-selective herbicides on guardrails. To reduce mowing costs and fuel use, MDOT SHA also promoted use of plant growth regulators (e.g., trinexapac-ethyl and mefluidide) and selective herbicides to preserve desirable vegetation.

To report statewide application of vegetation management chemicals, MDOT SHA uses purchasing records and estimates contractor application usage from contract documents. MDOT SHA applied a greater variety of herbicides in FY22 as a result of efforts to apply glyphosate alternatives. In accordance with conditions in Part IV.D.5 of the MS4 Permit, MDOT SHA has provided its statewide usage during FY22 for herbicide, fertilizer, and deicing chemicals, including percent change for each chemical type relative to amounts reported for the FY21 period, in the *ChemicalApplication* table of the MS4 Geodatabase – Part 1.

MDOT SHA covers disturbed earth slopes with topsoil, a fertilizer blend, seeded turfgrass, and straw to reduce erosion through vegetative establishment and growth. MDOT SHA continued to use slow-release nitrogen and low, or no, phosphorus fertilizers when establishing and maintaining turf, meadows, and other vegetation in FY22. Topsoil was sampled and tested for major and minor plant nutrients. Topsoil producer stockpiles were tested every six months and test results are used to develop Nutrient Management Plans to ensure optimal nutrient levels while avoiding excess fertilizer application.

There is a growing interest in incorporating compost into topsoil on highway slopes and little is known about the performance of these compost-amended topsoil (CAT) blends in such applications. From FY20 through FY22, MDOT SHA sponsored research by the University of Maryland, College Park on geotechnical properties, water infiltration and retention, nutrient availability, and leaching properties for Maryland composts and CAT blends using materials common to MDOT SHA projects. The study completed in FY22, and publication of the results is pending but the researchers provided MDOT SHA their recommendations in late FY22 to inform vegetation management decisions. In consideration of those recommendations, MDOT SHA is evaluating the need for additional studies and has suspended further consideration of compost blankets on slopes due to the risk of nutrient loss. The potential use of compost products as fertilizer applied in lieu of chemical fertilizer products at the time of plant installation, or as re-fertilizing, is also under evaluation.

MDOT SHA continued to test and evaluate new equipment and strategies in an on-going effort to improve the level of service provided to motorists during winter storms while minimizing the impact of its operations on the environment. Minimization practices described in Section D.5.b.iv of the FY19 MS4 annual report continued during the FY22 reporting period. A description of MDOT SHA winter operations and a link to the current version of the MDOT SHA Salt Management Plan, most recently updated in October 2021, is publicly accessible at the following web address:

https://www.roads.maryland.gov/mdotsha/pages/index.aspx?PageId=352

Within the MS4 permitted areas, MDOT SHA applied a total of 102,979 tons of sodium chloride (rock or solar salt) during the 2021-2022 winter season. MDOT SHA uses a metric of pounds of road salt per total lane miles per inch of snow (lbs/lm/inch) in its year-to-year comparisons of road salt usage. For the FY22 reporting period, the value for this metric was 667 lbs/lm/inch which is an increase of 25 lbs/lm/inch relative to the FY21 period.

As described in Section D.5.b.iv of the FY19 MS4 annual report, MDOT SHA continued its "Annual Snow College" training during FY22 in accordance with conditions in Part IV.D.5.b.v of the MS4 Permit. Snow College was implemented statewide in FY22 across all MDOT SHA Districts. FY22 Snow College events trained 80 operators in snow removal and salt management, including new hire and refresher training. MDOT SHA continued administration of supplementary annual maintenance shop winter meetings and hired equipment operator trainings during FY22, with annual outreach estimated at 1,000 State employees and 2,100 hired equipment operators respectively. The scale of outreach for these supplementary trainings is variable year-to-year depending on active contracts, State employee vacancies and new-hires, and equipment acquisitions but the annual variance is estimated to be less than 10% relative to the reported figures.

Public Education

MDOT SHA continued to operate its Customer Care Management System, as described in Section D.6.a of the FY19 MS4 annual report, throughout FY22 for submission of complaints and concerns. In FY22, this system received approximately 23,312 service requests. There were approximately 3,172 service requests regarding littering related issues. These figures indicate a 16- and 8-percent increase respectively to amounts reported in FY21.

During the FY22 reporting period, MDOT SHA maintained its public education webpage, providing links to several interactive maps and educational resources as previously described in the "Trash and Litter" section of this FY22 MS4 annual report. MDOT SHA also participated in the numerous educational opportunities described in Appendix D.

Watershed Assessment

In accordance with conditions in Part IV.E.1 of the MS4 Permit, MDOT SHA continued to reference County watershed assessments to identify specific watershed issues and restoration project opportunities, which is described in detail in Section E.1 of the FY19 MS4 annual report. MDOT SHA is referenced in watershed assessments prepared by Anne Arundel County (*Patapsco Tidal and Bodkin Creek Watershed Assessment*) and Baltimore County (*Bear Creek/Old Road Bay Small Watershed Action Plan*) during FY22 for development of the Non-Tidal Baltimore Harbor watershed sediment implementation plan as discussed in the "TMDL Compliance" section of this FY22 MS4 annual report.

Additionally, throughout the current permit term, MDOT SHA committed resources to advocating for, drafting, negotiating, executing, and amending long-term Memorandums of Understanding/Agreements with 15 different county, State, and federal government agencies in order to facilitate collaborative watershed restoration and monitoring activities. These interagency partnerships have facilitated data exchanges, ROW/easement acquisition, pooled stormwater and restoration monitoring and research, and construction of new restoration SWM, tree planting, outfall stabilization, impervious area removal, and stream restoration BMPs.

Restoration Plans

In accordance with conditions in Part IV.E.2.a of the MS4 Permit, MDOT SHA submitted impervious surface area assessments, as described in Section E.2.a of the FY19 MS4 annual report, and implemented restoration efforts for more than the required 4,621 equivalent acres of impervious surfaces before the end of FY20. Restoration implemented was consistent with the methodology described in the MDE 2014 document and all subsequently provided MDE guidance. In accordance with conditions in Part IV.E.3 of the MS4 Permit, MDOT SHA has provided the cumulative impervious acres restored achieved through FY22 and under the administratively continued permit compliance period in Table IV.E.3 above.

Table IV.E.3: Impervious Acres Restored Achieved During the MS4 Permit Compliance Period

BMP Type	Oct. 21, 2010 to 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	Total
Impervious Surface Elimination to Pervious	0.00	0.00	1.69	0.02	0.11	0.49	0	0	**2.31**
New Stormwater Control Structures	81.79	51.77	33.08	50.94	30.12	0	0	0	**247.70**
Grass Swales	0	9.07	12.01	0.35	0	0	0.89	0	**22.32**
Outfall Stabilization	0	11.92	9.20	169.91	54.24	134.23	472.41	0	**851.91**
Retrofit Existing Stormwater Control Structures	0	90.54	6.33	45.37	48.85	3.02	44.28	0	**238.39**
Stream Restoration	1,158.80	390.60	212.48	6.84	175.70	3,696.26	1,124.86	0	**6,765.54**
Tree Planting	358.84	44.98	7.18	23.48	17.44	23.83	9.24	0	**484.99**
Built BMP Totals	**1,599.43**	**598.88**	**281.97**	**296.91**	**326.46**	**3,857.83**	**1,651.68**	**0**	**8,613.16**
Inlet Cleaning	164*						210.50	119.70	
Street Sweeping	29*						10.90	22.80	
Credit Acquisition	0						0	0	

* Total acres achieved for inlet cleaning and street sweeping annual BMPs is presented here as the average annual implementation through FY20 as finalized in MDE comments dated July 30, 2021

In its comments dated July 30, 2021, MDE confirmed MDOT SHA has completed 8,100 acres of restoration by October 8, 2020, representing 175% achievement of the 4,621 acres restoration required by the end of the current MS4 permit term. In those same comments, MDE stated that MDOT SHA may not claim restoration implemented after the date of permit expiration and instead, must claim restoration completed after October 8, 2020 for the next permit.

MDE also stated that restoration credit must be removed for any 'failed' restoration BMP until proper performance can be verified. In accordance with MDE guidance, MDOT SHA has temporarily removed credits from the summaries presented in Table IV.E.3 and in **Table V.A.1.e** located in **Appendix E** for 409 BMPs where the most recent credit verification inspection was assigned a 'failed' designation or performance could not otherwise be verified by inspection data. MDOT SHA has aligned its credit 'claimed' information in the *GEN_COMMENTS* attribute field of applicable BMP records in the *AltBMPPoly*, *AltBMPLine*, and *RestBMP* features classes and the *StrRestProtocols* associated table of the MS4 Geodatabase – Part 1.

TMDL Compliance

A TMDL for sediment in the Non-Tidal Baltimore Harbor watershed was approved by the United States Environmental Protection Agency (EPA) on January 27, 2022. The Baltimore Harbor sediment TMDL was the only local TMDL issued by MDE and approved by EPA in FY22. In accordance with Part IV.E.2.b of the MS4 Permit, MDOT SHA began development of an individual watershed TMDL implementation plan during FY22 and will submit it for MDE approval by the January 27, 2023 due date. Prior to that submittal, MDOT SHA will advertise the 30-day public comment period in the Baltimore Sun, Washington Post, and on MDOT SHA's website in accordance with conditions in Part IV.E.4.c of the MS4 Permit. MDOT SHA will address all material comments from the public that are received during the public comment period in accordance with conditions in Part IV.E.4.d of the MS4 Permit.

In accordance with conditions in Part IV.E.5 of the MS4 Permit, MDOT SHA has provided the TMDL Assessment Report in Appendix E. MDOT SHA has also provided Bay and local TMDL compliance information in the *CountywideStormwaterWatershedAssessment* and *LocalStormwaterWatershedAssessment* tables of the MS4 Geodatabase – Part 1.

Assessment of Controls

The MDE-approved monitoring plans, developed by MDOT SHA to satisfy conditions in Part IV.F of the MS4 Permit, were appended to the FY16 and FY17 MS4 annual reports. A summary of the MDE-approved monitoring schedules and MDOT SHA progress is provided below in **Table IV.F**. Due to impacts to available resources that began in FY20 and persisted in FY21 as a result of the COVID-19 pandemic, MDOT SHA deferred CHEM 4 and BIO 4 monitoring activities at the LCC stream restoration site until FY22. As reported in the FY21 MS4 annual report, funding was allocated in the FY22 budget to resume CHEM 4 monitoring activities and to complete remaining BIO 4 monitoring activities as soon as practicable, at the start of the summer sampling index period in June 2022. In February 2022, MDOT SHA completed property owner coordination and secured consent to resume monitoring work. That same month, MDOT SHA issued notice to proceed on a new task to re-establish continuous flow gauging stations and to resume chemical monitoring activities necessary complete the CHEM 4 monitoring phase at LCC.

MDOT SHA prepared and submitted plans for upstream and downstream monitoring equipment installation for review by its Office of Structures (OOS) on March 11, 2022. Installation required approval from OOS due to proposed placement on the bridge structure at MD-180. Monitoring equipment was ordered from the manufacturer following OOS approval but, due to supply chain delays resulting from the COVID-19 pandemic, vendors could not deliver the necessary equipment until late May 2022. There were further delays associated with the fabrication of custom-made housing equipment needed to secure and protect the monitoring devices.

Table IV.F: Assessment of Controls Monitoring Schedules and Progress

Monitoring Phase	Proposed Dates	Actual Dates	Construction Phase	Comments
Part IV.F.1 - Watershed Restoration Assessment				
CHEM 1	October 2016 to October 2017	September 2016 to December 2017	Pre-construction	Upstream station installed September 2016 and downstream station installed December 2016. Results and analysis reported in FY17 MS4 annual report.
BIO 1	March 2016	April 2016 to September 2017	Pre-construction	Monitoring performed annually in 2016 and 2017 to establish range for baseline. Results and analysis reported in FY17 MS4 annual report.
PHYS 1	April 2015	September 2017 to February 2018	Pre-construction	Monitoring performed annually in 2017 and 2018 to establish range for baseline. Results and analysis reported in FY17 MS4 annual report.
CHEM 2	October 2017 to October 2018	January 2018 to March 2019	Construction	Monitoring work extended and performed throughout the construction phase. Results and analysis reported in FY18 and FY19 MS4 annual reports.
BIO 2	N/A	N/A	Construction	Activity not to be performed during construction
PHYS 2	N/A	N/A	Construction	Activity not to be performed during construction but supplementary surveys conducted in July/August 2018 to evaluate changes resulting from severe flood event. Results and analysis reported in FY18 MS4 annual report.
CHEM 3	October 2018 to October 2019	April 2019 to April 2020	Post-construction	CHEM 3 completed April 2020; results and analysis reported with FY20 MS4 annual report.
BIO 3	March 2018 to March 2019	April 2019 to April 2020	Post-construction	BIO 3 completed in (spring & summer) 2019. Results and analysis reported with FY20 MS4 annual report.
PHYS 3	March 2018 to March 2019	April 2019 to June 2019	Post-construction	PHYS 3 completed in (spring) 2019. Results and analysis reported with the FY19 MS4 annual report.
CHEM 4	October 2019 to October 2020	April 2020 to June 2020; May 2022 (ongoing)	Post-construction	CHEM 4 partially completed until work stopped in June 2020. CHEM 4 resumed in June 2022 and monitoring will continue through June 2023. FY22 results and analysis reported with FY22 MS4 annual report.
BIO 4	March 2019 to March 2020	April 2020 to June 2020; June 2022	Post-construction	BIO 4 completed in FY22. BIO 4 fish, physical habitat assessment, and supplementary crayfish, mussel, reptile, and amphibian sampling were completed during the summer 2022 sampling index period. Results and analysis reported with FY22 MS4 annual report.
PHYS 4	March 2019 to March 2020	April 2020 to June 2020	Post-construction	PHYS 4 completed in 2020. Results and analysis, including the required hydraulic model, submitted with FY20 MS4 annual report.
Part IV.F.2 - Stormwater Management Assessment				
Year 1	January 2018 to October 2018	May 2018 to June 2018	Pre-construction	Monitoring completed with results and analysis reported in FY18 MS4 annual report.
Year 2	November 2018 to October 2019	July 2018 to June 2019	Pre-construction	Monitoring completed with results and analysis reported in FY19 MS4 annual report.
Year 3	November 2019 to October 2020	July 2019 to June 2020	Pre-construction	Monitoring completed with results and analysis reported in FY20 MS4 annual report.
Year 4	November 2020 to October 2021	Deferred	Post-construction	**Construction delayed until at least 2024**. Post-construction monitoring deferred accordingly.

In the interim, MDOT SHA conducted flow measurement surveys at both the upstream and downstream monitoring locations on May 19, 2022 and June 6, 2022 to begin development of a new stage-discharge relationship for continuous flow monitoring. A baseflow sample was also collected while staff was onsite on June 6, 2022. MDOT SHA performed additional cross section elevation transects on June 16, 2022 to continue development of the stage-discharge relationship.

On June 22, 2022, temperature and depth loggers were installed at upstream and downstream chemical monitoring locations. MDOT SHA sampled a storm event on June 27, 2022. The ISCO 2150 Area Velocity Meter was installed on June 29, 2022 and continuous flow gauging resumed at both monitoring stations and will persist through the completion of the 12-month CHEM 4 monitoring phase period, anticipated to conclude on June 29, 2023. MDOT SHA has allocated funding in FY23 budgets to continue CHEM 4 continuous flow monitoring and storm sampling activities necessary to fulfill all requirements noted in the approved monitoring plan for LCC. MDOT SHA has provided the chemical monitoring data collected in FY22 in the *ChemicalMonitoring* table of the MS4 Geodatabase – Part 1 submitted with this FY22 MS4 annual report. A detailed discussion of chemical monitoring activities and monitoring results can be found in Section 3 of **Appendix F**.

In FY22, MDOT SHA successfully completed the final phase of post-construction biological monitoring (BIO 4) committed in the MDE-approved monitoring plan. MDOT SHA resumed the BIO 4 monitoring phase during the summer 2022 sampling index period and completed all outstanding commitments for fish sampling, physical habitat assessment, and supplementary crayfish, mussel, reptile, and amphibian sampling activities. Results and analysis of BIO 4 monitoring activities are summarized in Section 4 of Appendix F. Fish sampling and habitat assessment data collected in FY22 is reported along with the benthic macroinvertebrate data collected during the spring 2020 sampling index period as a single, combined record representative of BIO 4 in the *BiologicalMonitoring* table of the MS4 Geodatabase – Part 1 submitted with this FY22 MS4 annual report.

As described in Section F.2 of the FY19 MS4 annual report, the construction schedule for the MDOT SHA-owned BMPs referenced in the MDE-approved monitoring plan for SWM Assessment is integrated with, and dependent on, the construction schedule for a Howard County bridge replacement project. The County and MDOT SHA resumed their partnership for construction of the SWM BMPs in conjunction with the County's bridge project in January 2022, and the SWM BMPs are currently at the 90% design milestone and expected to complete design during FY23. Howard County funding capacity for the bridge project in FY23 or beyond remains uncertain. If MDOT SHA cannot secure funding certainty from the County for their bridge project by the end of FY23, MDOT SHA will investigate pathways to construct the necessary SWM BMPs independent of its partnership with the County so that MDOT SHA post-construction monitoring commitments, as described in the approved monitoring plan, can be satisfied.

MDOT SHA has fulfilled its SWM Assessment monitoring obligations by monitoring for at least two full years during the pre-construction period and consequently, did not perform any further pre-construction monitoring activities during FY22. MDOT SHA did not commit to any construction phase monitoring activities in the MDE-approved monitoring plan for SWM

Assessment. Continuous flow measurements were performed throughout the pre-construction period and MDOT SHA evaluated the effects of continuous flow on channel geometry in its previously submitted MS4 annual reports. Hydrologic and/or hydraulic modeling was not performed in the fourth year of the MS4 Permit term, in accordance with conditions in Part IV.F.2.c, because the pre-requisite SWM BMP construction did not initiate during the current MS4 Permit term.

Program Funding

In accordance with conditions in Parts IV.G.1 and V.A.1.c of the MS4 Permit, MDOT SHA has provided program funding information in the *FiscalAnalyses* table of the MS4 Geodatabase – Part 1. **Table V.A.1.c** below contains a supplemental summary of this information.

Table V.A.1.c: MS4 Expenditures for FY22 and Proposed Budget for FY23

Fund	FY22 Expenditures (Millions*)	FY23 Budget (Millions*)
Fund 82 – TMDL Compliance & MS4 Program Management	$13.5	$12.5
Fund 74 – Drainage	$3.7	$10.3
Fund 49 – Industrial	$0.07	$0.35
Operations/ Maintenance	$11.1	$14.5
Totals	**$28.3**	**$37.6**
*Funding numbers are rounded to nearest $0.1 Million with the exception of Fund 49 which is rounded to the nearest $0.01 Million		

Appendix A: NPDES MS4 Program Organizational Chart

- Governor of Maryland
  - Department of Transportation Secretary, James F. Ports, Jr.
    - State Highway Administrator, Timothy E. Smith
      - Chief Counsel
      - State Roads Commission
      - Dep. Administrator for Planning, Engineering, Real Estate & Environment, Maurice Agostino (Acting)
        - Director of Planning & Preliminary Engineering, Scott Pomento
        - Director of Environmental Design, Sonal Ram
          - Dep. Directors, Kevin P. Wilsey, Joseph Vervier
            - Environmental Compliance, Shawn Schmelzer
              - Industrial / IDDE Coordinator
            - Water Programs, Ryan Cole
              - MS4 Program Manager
            - Quality Assurance, Don Hoey
              - Construction Activity Coordinator & Inspections
            - Landscape Programs, Andrew Shoffner
              - TMDL Tree, Pesticide, & Nutrient Management Program
        - Director of Structures, Rod Thornton (Acting)
        - Director of Real Estate, Olu A. Okunola
        - Director of Highway Development, Eric Marabello
          - Dep. Director, Barry Smith
            - Plan Review, Zhihua Kuang (Acting)
          - Dep. Director, Laura Ridler
            - Highway Hydraulics, Dana Havlik
              - Stormwater Asset Management Program, Kiona Leah
            - Innovative Contracting, Sean Campion
      - Operating Officer, Andre Futrell
        - Dep. Administrator for Operations in Hanover, Terri Soos (Acting)
          - Director of Transportation Mobility and Operations, Jason Dicembre
          - Director of Materials Technology, Sejal B. Barot
          - Director of Traffic & Safety, Cedric J. Ward
          - Director of Construction, Stephen Bucy
          - Director of Asset Management, Subrat Mahapatra
          - Director of Maintenance, Michael V. Michalski
            - Dep. Director of Operations, Sandi Sauter
        - District Engineer D-1, James Meredith
        - District Engineer D-2, Kenneth Fender
        - District Engineer D-3, Derek Gunn (Acting)
        - District Engineer D-4, Sutapa Samanta (Acting)
        - District Engineer D-5, Kimberly Tran (Acting)
        - District Engineer D-6, Anthony Crawford
        - District Engineer D-7, Andrew Radcliffe (Acting)
      - Dep. Administrator for Administration, Lisa B. Conners
        - Office of the Attny. Gen. Counsel to the SHA, Kevin Reynolds
        - Director of Communications, Paul Milton
        - Director of Policy & Research, Richard Y. Woo
        - Director of Finance, William J. Bertrand
        - Director of Equal Opportunity, Wanda L. Dade
        - Director of Audits, Lisa Rosenberg (Acting)
        - Director of Procurement and Contract Management, Jada Wright
        - Director of Administration, Michael Lanham
        - Director Of Information Technology, Laurie Goudy
        - DBE Manager of Public Private Partnership, Dwight Barber

MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

[Title] [Name] = Personnel responsible for major NPDES program tasks

Appendix B: Rehabilitation Report for Stormwater Controls

During FY19 and FY20, MDOT SHA began changing its processes for creating rehabilitation work orders (formally known as "remediation work orders") to repair failing SWM facilities. Inspection and CADD standards were created and the process for designing work order plan sets was streamlined. At the end of FY22, HHD reviewed and began planning major updates to its internal guidance documents funded and scheduled for FY23. MDOT SHA will begin requiring designers to add pages to work order plan sets that account for sediment and erosion control, sequences of construction, and documentation of "Rehabilitation Verification" certifications. HHD distributed standard templates for these pages to designers who will update work order plans previously incorporated into contracts cancelled in FY21. The updated guidance documents will also include more detailed information on the "Engineering Assessments" performed after preventative maintenance inspections that inform development of asset maintenance, rehabilitation, and retrofit priorities.

HHD worked during FY22 to formalize asset management procedures in a "Stormwater Systems Asset Management Plan" (SSAMP) that MDOT SHA appended to the Federal Transportation Asset Management Plan it submitted to the Federal Highway Administration to document MDOT SHA commitments and work related to maintaining assets. The SSAMP established a model for risk and criticality analysis that MDOT SHA applied in FY22 to assign a criticality score and then rank its SWM facilities based on the following criteria:

- Asset and Asset Management Risks - asset deterioration, material performance, rehabilitation techniques, failure modes, and data analysis accuracy
- Program or Project Delivery Risks - materials costs, construction and permitting uncertainties, and contractor and resource capacity
- Regulatory Risks - national or regional changes to regulations (typically environmental) that have significant impact on design, maintenance, or capital program practices and priorities
- Public Safety Risks - inherent risks to public safety when given assets are in poor condition
- Funding/Financial Risks - economic issues and trends that may impact State or federal funding sources such as tax revenues, fees, and grants
- Enterprise Risks - systematic corporate and organizational risks such as climate change, operational resiliency, and security

Rankings were used to prioritize SWM facilities for future rehabilitation and retrofit work plans. The SSAMP model for risk and criticality assessment will also be applied to embankment classification for MDOT SHA ponds and dams. During FY23, prioritized facilities will undergo required embankment analysis and resultant data will be tracked in an MDOT SHA database.

In accordance with conditions in Part IV.B of the MS4 Permit, MDOT SHA has provided **Table IV.D.1.d** below that summarizes the current resolution schedule for SWM facilities that require rehabilitation or retrofit. Information provided includes identification of applicable rehabilitation contracts, commitments for dates of completion, and comments on the status of work.

Table IV.D.1.d: MDOT SHA SWM Facilities for Rehabilitation Work Orders

SWM Facility Number	Facility Type	MDE Pass / Fail	Contract	Completion Commitment Date	Rehabilitation Comments
020013	Wet pond	Pass	AA0225274	6/30/2023	Work Order Approved - Funded for construction in FY23. **Per Latest Inspection, BMP is Functioning as Designed**
020026	Wet pond	Fail	XX1725174[a]	9/30/2024	Recommended for Retrofit.
020048	Infiltration basin	Fail	XX1725174[a]	6/30/2026	Work Order Approved, Construction Pending Funding
020052	Infiltration basin	Fail		6/30/2025	
020061	Infiltration basin	Fail		9/30/2025	
020090	Wet extended detention pond	Pass		6/30/2026	**Per Latest Inspection, BMP is Functioning as Designed**
020092	Infiltration trench	Fail	AZ044A11[b]	9/30/2024	In Design and Permitting Process
020093	Infiltration Trench	Pass	XX1725174[a]	6/30/2020	**FY20 Construction Complete**, As-Builts Under Review
020094	Infiltration trench	Fail	XX1725174	6/30/2020	**FY20 Construction Complete**, As-Builts Under Review
020103	Wet pond	Fail	XX1725174[a]	6/30/2025	In Design and Permitting Process
020110	Wet pond	Fail	AA0225174	6/30/2023	Work Order Approved – Funded for Construction in FY23o
020113	Wet pond	Fail		06/30/2026	
020114	Wet pond	Fail	XX1725174[a]	6/30/2025	In Design and Permitting Process
020120	Micropool extended detention pond	Pass		6/30/2024	BMP Added to List in FY22, In Design and Permitting Process

Table IV.D.1.d: MDOT SHA SWM Facilities for Rehabilitation Work Orders

SWM Facility Number	Facility Type	MDE Pass / Fail	Contract	Completion Commitment Date	Rehabilitation Comments
020121	Surface Sand Filter	Pass		6/30/2024	BMP Added to List in FY22, Work Order Approved – Construction Pending Funding
020122	Surface Sand Filter	Pass		6/30/2024	BMP Added to List in FY22, In Design and Permitting Process
020124	Wet pond	Fail	AX9295482[a]	6/30/2023	Work Order Approved – Construction Pending Funding
020167	Dry pond	Fail		9/30/2023	
020177	Dry swale	Fail		9/30/2024	
020231	Infiltration trench	Fail		6/30/2025	
020244	Infiltration trench	Fail	AX3565274[b]	6/30/2024	In Design and Permitting Process
020257	Wet pond	Pass	AX7665D82[b]	6/30/2025	**Per Latest Inspection, BMP is Functioning as Designed**
020258	Infiltration basin	Fail	AA8225174	6/30/2021	**FY20 Construction Complete**, Awaiting As-Builts
020260	Infiltration basin	Fail	AA8225174	6/30/2021	**FY20 Construction Complete**, Awaiting As-Builts
020268	Infiltration basin	Pass	AA8225174	6/30/2021	**FY21 Construction Complete,** Awaiting As-Builts. **Per Latest Inspection, BMP is Functioning as Designed**
020271	Infiltration basin	Fail	AZ044A11[b]	6/30/2024	In Design and Permitting Process
020272	Wet pond	Fail		6/30/2025	
020273	Dry pond	Fail		6/30/2026	
020276	Wet pond	Pass	AX7665D82[b]	6/30/2025	**Per Latest Inspection, BMP is Functioning as Designed**
020298	Wet pond	Pass		6/30/2026	**Per Latest Inspection, BMP is Functioning as Designed**
020308	Infiltration trench	Pass	AZ044A11[b]	6/30/2024	In Design and Permitting Process. **Per Latest Inspection, BMP is Functioning as Designed**

Table IV.D.1.d: MDOT SHA SWM Facilities for Rehabilitation Work Orders

SWM Facility Number	Facility Type	MDE Pass / Fail	Contract	Completion Commitment Date	Rehabilitation Comments
020322	Infiltration trench	Pass	AZ044A11[b]	6/30/2024	In Design and Permitting Process. **Per Latest Inspection, BMP is Functioning as Designed**
020338	Infiltration basin	Fail		9/30/2025	
020339	Infiltration basin	Fail		6/30/2024	
020343	Infiltration trench	Pass		6/30/2024	BMP Added to List in FY22, In Design and Permitting Process
020355	Infiltration trench	Pass		6/30/2024	BMP Added to List in FY22, In Design and Permitting Process
020357	Infiltration trench	Fail	AX9295482[a]	6/30/2023	Work Order Approved – Construction Pending Funding
020358	Infiltration trench	Pass		6/30/2024	BMP Added to List in FY22, In Design and Permitting Process
020363	Infiltration basin	Fail		9/30/2024	
020388	Infiltration basin	Fail		9/30/2024	
020393	Infiltration basin	Fail		6/30/2026	
020394	Infiltration basin	Fail		9/30/2024	
020396	Infiltration basin	Fail	XX1725174[a]	6/30/2023	Work Order Approved – Construction Pending Funding
020399	Infiltration basin	Fail		6/30/2024	
020403	Infiltration trench	Fail	XX1725174[a]	6/30/2023	Work Order Approved – Construction Pending Funding
020406	Dry pond	Fail	XX1725174[a]	6/30/2024	Recommended for Retrofit
020409	Infiltration trench	Fail	AZ044A11[b]	6/30/2024	Recommended for Retrofit
020410	Infiltration trench	Fail	AZ044A11[b]	6/30/2024	Recommended for Retrofit
020429	Infiltration trench	Fail	AX3565274[b]	6/30/2023	In Design and Permitting Process
020440	Infiltration trench	Pass		6/30/2024	BMP Added to List in FY22, In Design and Permitting Process
020480	Wet pond	Fail		6/30/2025	

Table IV.D.1.d: MDOT SHA SWM Facilities for Rehabilitation Work Orders

SWM Facility Number	Facility Type	MDE Pass / Fail	Contract	Completion Commitment Date	Rehabilitation Comments
020484	Infiltration trench	Fail	XX1725174[a]	6/30/2023	Work Order Approved – Construction Pending Funding
020486	Wet pond	Fail	XX1725174[a]	6/30/2023	Work Order Approved – Construction Pending Funding
020489	Infiltration basin	Fail	AZ044A11[b]	9/30/2025	In Design and Permitting Process
020490	Infiltration trench	Fail	AX7665D82[b]	6/30/2019	Rehabilitation Planned for FY24.
020494	Infiltration basin	Fail		6/30/2025	
020500	Infiltration Trench	Pass	XX1725174[a]	6/30/2020	FY20 Construction Complete, As-Builts Under Review
020505	Infiltration Trench	Pass	XX1725174[a]	6/30/2020	FY20 Construction Complete, As-Builts Under Review
020514	Infiltration basin	Fail		6/30/2025	
020516	Infiltration trench	Fail	XX1725174[a]	6/30/2023	Work Order Approved – Construction Pending Funding
020517	Infiltration trench	Fail		6/30/2025	
020520	Infiltration trench	Fail	AZ044A11[b]	6/30/2023	Work Order Approved – Construction Pending Funding
020522	Wet pond	Fail		6/30/2025	
020532	Infiltration trench	Fail		6/30/2025	
020544	Wet pond	Fail		6/30/2025	
020561	Infiltration basin	Fail		6/30/2025	
020565	Infiltration trench	Fail	AX3565274[b]	6/30/2023	In Design and Permitting Process
020584	Wet extended detention pond	Fail		6/30/2025	
020603	Bioretention	Fail		6/30/2025	
020608	Bioretention	Fail		6/30/2025	
020747	Grass Swale	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process
020757	Infiltration basin	Pass	XX1725174[a]	6/30/2023	In Design and Permitting Process. **Per Latest Inspection, BMP is Functioning as Designed**

Table IV.D.1.d: MDOT SHA SWM Facilities for Rehabilitation Work Orders

SWM Facility Number	Facility Type	MDE Pass / Fail	Contract	Completion Commitment Date	Rehabilitation Comments
020760	Infiltration basin	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process
020761	Infiltration basin	Fail		6/30/2025	
020764	Infiltration trench	Pass		6/30/2026	**Per Latest Inspection, BMP is Functioning as Designed**
020774	Infiltration trench	Fail	XX1725174[a]	6/30/2024	In Design and Permitting Process
020782	Infiltration trench	Fail	XX1725174[a]	6/30/2024	In Design and Permitting Process
020787	Infiltration trench	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process
020795	Infiltration trench	Fail	AX3565274[b]	6/30/2024	In Design and Permitting Process
020810	Infiltration trench	Fail		6/30/2025	
020811	Infiltration trench	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process
020817	Surface sand filter	Fail		6/30/2025	
020818	Surface sand filter	Pass	AX7665D82[b]	6/30/2025	**Per Latest Inspection, BMP is Functioning as Designed**
020820	Surface sand filter	Fail		6/30/2025	
020823	Infiltration basin	Pass	AX7665D82[b]	6/30/2024	**Per Latest Inspection, BMP is Functioning as Designed**
020827	Wet pond	Fail	AZ044A11[b]	6/30/2024	Recommended for Retrofit
020845	Infiltration basin	Fail	XX1725174[a]	6/30/2023	In Design and Permitting Process
020850	Infiltration basin	Fail		9/30/2024	
020868	Infiltration trench	Pass		6/30/2024	BMP Added to List in FY22, Work Order Approved – Construction Pending Funding
020875	Infiltration basin	Fail	XX1725174[a]	6/30/2024	In Design and Permitting Process
020880	Infiltration trench	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process
020896	Grass Swale	Fail		6/30/2024	
021012	Micropool extended detention pond	Fail		6/30/2026	
021018	Infiltration basin	Fail		6/30/2026	
021472	Bio-swale	Fail		6/30/2026	
021473	Bio-swale	Fail		6/30/2026	

Table IV.D.1.d: MDOT SHA SWM Facilities for Rehabilitation Work Orders

SWM Facility Number	Facility Type	MDE Pass / Fail	Contract	Completion Commitment Date	Rehabilitation Comments
021796	2A Grass swale	Fail		6/30/2026	
022013	2A Grass swale	Fail		N/A	**BMP Abandoned**
022037	2A Grass swale	Fail		N/A	**BMP Abandoned**
022066	2A Grass swale	Fail		N/A	**BMP Abandoned**
030001	Grass Channel Credit	Fail	AX3565274[b]	6/30/2023	In Design and Permitting Process
030005	Grass swale	Fail	AZ044A11[b]	6/30/2024	In Design and Permitting Process
030011	Wet pond	Fail	AZ044A11[b]	6/30/2024	In Design and Permitting Process
030109	Infiltration Basin	Pass		6/30/2026	**Per Latest Inspection, BMP is Functioning as Designed**
030113	Infiltration trench	Fail		6/30/2025	
030116	Infiltration basin	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process
030124	Infiltration trench	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process
030136	Infiltration basin	Fail		6/30/2024	
030137	Infiltration basin	Fail		9/30/2025	
030175	Dry pond	Fail		6/30/2024	
030183	Infiltration basin	Fail		6/30/2025	
030189	Infiltration basin	Fail		9/30/2024	
030198	Infiltration trench	Fail		6/30/2025	
030200	Infiltration basin	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process
030214	Infiltration basin	Fail		9/30/2024	
030215	Infiltration basin	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process
030220	Infiltration trench	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process
030227	Infiltration trench	Pass		6/30/2024	**Per Latest Inspection, BMP is Functioning as Designed**
030244	Infiltration trench	Pass		6/30/2026	**Per Latest Inspection, BMP is Functioning as Designed**
030245	Infiltration trench	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process
030252	Infiltration trench	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process
030253	Infiltration trench	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process

Table IV.D.1.d: MDOT SHA SWM Facilities for Rehabilitation Work Orders

SWM Facility Number	Facility Type	MDE Pass / Fail	Contract	Completion Commitment Date	Rehabilitation Comments
030256	Infiltration trench	Fail	AX3565274[b]	6/30/2019	Rehabilitation planned for FY24. In Design and Permitting Process.
030269	Dry pond	Fail		6/30/2025	
030274	Infiltration trench	Fail		6/30/2024	
030284	Bioretention	Fail		6/30/2025	
030333	Infiltration trench	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process
030385	Surface sand filter	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process
030505	Micro-Bioretention	Fail		6/30/2025	
060106	Dry pond	Fail		6/30/2025	
070003	Infiltration basin	Fail	AZ044A11[b]	6/30/2025	In Design and Permitting Process
070004	Infiltration basin	Fail	AZ044A11[b]	6/30/2025	In Design and Permitting Process
080007	Wet pond	Fail		6/30/2025	
080019	Infiltration basin	Fail		6/30/2025	
080027	Wet Swale	Fail		6/30/2024	
080028	Wet Swale	Fail		6/30/2024	
080069	Wet pond	Fail		6/30/2024	
080070	Wet pond	Fail		6/30/2024	
080071	Wet pond	Fail		6/30/2024	
080074	Wet pond	Fail		6/30/2025	
082187	Underground detention	Fail		6/30/2026	
100001	Bioretention	Fail		6/30/2026	
100004	Surface sand filter	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process
100012	Infiltration trench	Pass		6/30/2024	**Per Latest Inspection, BMP is Functioning as Designed**
100060	Infiltration basin	Fail	AX7665D82[b]	6/30/2025	In Planning Process
100061	Infiltration basin	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process
100065	Dry pond	Fail	AX9295482[a]	6/30/2023	Work Order Approved - Construction Pending Funding
100099	Wet pond	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process

Table IV.D.1.d: MDOT SHA SWM Facilities for Rehabilitation Work Orders

SWM Facility Number	Facility Type	MDE Pass / Fail	Contract	Completion Commitment Date	Rehabilitation Comments
100126	Grass swale	Fail	AZ044A11[b]	6/30/2023	Work Order Approved – Construction Pending Funding
100129	Wet swale	Fail		6/30/2024	
100143	Dry swale	Fail		6/30/2024	
100310	Bio-swale	Fail		6/30/2026	
100471	Other filtering	Pass		N/A	**Per Latest Inspection, BMP is Functioning as Designed**
120008	Dry pond	Fail	AX7665D82[b]	6/30/2025	In Planning Process
120009	Dry pond	Fail		6/30/2025	
120017	Infiltration trench	Fail	AX3565274[b]	6/30/2023	In Design and Permitting Process
120019	Infiltration trench	Fail		6/30/2025	
120039	Infiltration trench	Fail	HA4285174[b]	9/30/2024	In Design and Permitting Process
120042	Infiltration trench	Fail	HA4285174[b]	9/30/2024	In Design and Permitting Process
120063	Infiltration trench	Fail	AX3565274[b]	6/30/2025	In Design and Permitting Process
120066	Infiltration trench	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process
120095	Infiltration basin	Fail		6/30/2025	
120105	Dry extended detention pond	Fail		9/30/2025	
120106	Infiltration trench	Fail		6/30/2024	
120112	Infiltration trench	Fail	AX3565274[b]	6/30/2023	In Design and Permitting Process
120133	Infiltration basin	Fail		9/30/2025	
120203	Wet extended detention pond	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process
120208	Surface sand filter	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process
120291	Wet pond	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process
122335	2A Grass swale	Pass		6/30/2026	**Per Latest Inspection, BMP is Functioning as Designed**
130013	Dry extended detention pond	Fail		6/30/2025	
130027	Dry extended detention pond	Fail		9/30/2025	
130050	Infiltration basin	Fail		6/30/2025	
130072	Dry extended detention pond	Fail		9/30/2021	Rehabilitation Planned for FY24.

Table IV.D.1.d: MDOT SHA SWM Facilities for Rehabilitation Work Orders

SWM Facility Number	Facility Type	MDE Pass / Fail	Contract	Completion Commitment Date	Rehabilitation Comments
130073	Wet pond	Pass	AX7665282	9/30/2021	Retrofit under construction. **Per Latest Inspection, BMP is Functioning as Designed**
130074	Micropool extended detention pond	Fail	AX9295482[a]	9/30/2024	Recommended for Retrofit
130077	Wet pond	Fail		9/30/2025	
130078	Dry pond	Fail		6/30/2025	
130134	Wet pond	Fail		6/30/2025	
130136	Infiltration trench	Fail		6/30/2026	BMP Failed Post Rehabilitation, Recommended for Retrofit
130167	Infiltration basin	Fail	HO5165274	6/30/2023	Work Order Approved – Funded for Construction in FY23
130175	Infiltration Basin	Pass	HO5165374	06/30/2023	BMP Added to List in FY22, Work Order Approved – Funded for Construction in FY23
130178	Infiltration Basin	Pass	HO5165374	06/30/2023	BMP Added to List in FY22, Work Order Approved – Funded for Construction in FY23
130180	Grass Swale	Fail		6/30/2024	
130204	Infiltration basin	Fail	HO5165174	6/30/2023	Work Order Approved - Funded for Construction in FY23
130206	Wet pond	Fail		9/30/2025	
130208	Infiltration trench	Fail	AX9295482[a]	6/30/2024	Recommended for Retrofit
130210	Wet pond	Fail		6/30/2025	
130220	Dry extended detention pond	Pass		9/30/2025	**Per Latest Inspection, BMP is Functioning as Designed**
130237	Infiltration trench	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process
130251	Surface sand filter	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process
130259	Surface sand filter	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process
130263	Surface sand filter	Fail		6/30/2025	
130267	Dry Pond	Pass	HO5165274	06/30/2023	BMP Added to List in FY22, Work Order Approved – Funded for Construction in FY23

Table IV.D.1.d: MDOT SHA SWM Facilities for Rehabilitation Work Orders

SWM Facility Number	Facility Type	MDE Pass / Fail	Contract	Completion Commitment Date	Rehabilitation Comments
130268	Shallow Wetland	Pass	HO5165274	06/30/2023	BMP Added to List in FY22, Work Order Approved – Funded for Construction in FY23
130271	Dry pond	Fail	AX7665D82[b]	6/30/2025	In Planning Process
130292	Other infiltration	Fail	AX9295482[a]	6/30/2023	Work Order Approved - Construction Pending Funding
130293	Other infiltration	Pass		6/30/2024	BMP Added to List in FY22, Work Order Approved – Construction Pending Funding
130294	Other infiltration	Fail	AX9295482[a]	6/30/2023	Work Order Approved - Construction Pending Funding
130317	Infiltration trench	Fail		6/30/2024	
130319	Infiltration trench	Fail		6/30/2024	
130332	Infiltration trench	Fail		6/30/2024	
130341	Infiltration trench	Fail		6/30/2024	
130366	Infiltration trench	Fail		6/30/2024	BMP Failed Post Rehabilitation, Recommended for Retrofit
130369	Shallow marsh	Fail	AX9295482[a]	6/30/2023	Work Order Approved - Construction Pending Funding
130417	Grass Swale	Fail	HO5165374	6/30/2023	Work Order Approved - Funded for Construction in FY23
130421	Wet pond	Fail		6/30/2025	
130544	Bio-Swale	Pass		6/30/2024	**Per Latest Inspection, BMP is Functioning as Designed**
130629	Bio-Swale	Pass		6/30/2024	**Per Latest Inspection, BMP is Functioning as Designed**
130631	Bio-Swale	Pass		6/30/2024	**Per Latest Inspection, BMP is Functioning as Designed**
130632	Bio-Swale	Pass		6/30/2024	**Per Latest Inspection, BMP is Functioning as Designed**
132056	Micro-Bioretention	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process
150036	Infiltration trench	Pass		6/30/2025	**Per Latest Inspection, BMP is Functioning as Designed**

Table IV.D.1.d: MDOT SHA SWM Facilities for Rehabilitation Work Orders

SWM Facility Number	Facility Type	MDE Pass / Fail	Contract	Completion Commitment Date	Rehabilitation Comments
150066	Dry pond	Fail		6/30/2025	
150079	Infiltration basin	Pass	AZ044A11[b]	6/30/2026	In Design and Permitting Process. **Per Latest Inspection, BMP is Functioning as Designed**
150081	Infiltration basin	Fail		6/30/2025	
150201	Infiltration trench	Fail		6/30/2024	
150217	Infiltration basin	Pass		6/30/2024	**Per Latest Inspection, BMP is Functioning as Designed**
150232	Infiltration trench	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process
150285	Dry pond	Fail		6/30/2025	
150295	Bioretention	Fail	AX3565274[b]	6/30/2023	In Design and Permitting Process
150304	Surface sand filter	Fail		6/30/2025	
150312	Dry extended detention pond	Fail		9/30/2025	
150348	Wet pond	Fail		6/30/2025	
150352	Dry pond	Pass	AZ044A11[b]	6/30/2023	In Design and Permitting Process. **Per Latest Inspection, BMP is Functioning as Designed**
150355	Wet pond	Fail		6/30/2025	
150400	Dry pond	Pass		6/30/2025	**Per Latest Inspection, BMP is Functioning as Designed**
150643	Infiltration trench	Pass	AZ044A11[b]	6/30/2023	In Design and Permitting Process. **Per Latest Inspection, BMP is Functioning as Designed**
150650	Dry pond	Pass	AZ044A11[b]	6/30/2023	In Design and Permitting Process. **Per Latest Inspection, BMP is Functioning as Designed**
150680	Infiltration trench	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process
150706	Infiltration trench	Fail	AX3565274[b]	6/30/2023	In Design and Permitting Process
150749	Other	Fail		6/30/2024	
150750	Other	Fail		6/30/2024	

Table IV.D.1.d: MDOT SHA SWM Facilities for Rehabilitation Work Orders

SWM Facility Number	Facility Type	MDE Pass / Fail	Contract	Completion Commitment Date	Rehabilitation Comments
151370	2A Grass swale	Fail		N/A	**BMP Abandoned**
160012	Infiltration trench	Fail		6/30/2026	
160061	Wet pond	Fail		6/30/2024	
160126	Infiltration trench	Fail		6/30/2026	
160127	Wet extended detention pond	Fail		6/30/2026	
160131	Infiltration trench	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process
160136	Infiltration trench	Fail		6/30/2026	
160151	Infiltration trench	Pass	AZ044A11[b]	6/30/2026	In Design and Permitting Process. **Per Latest Inspection, BMP is Functioning as Designed**
160176	Dry extended detention pond	Fail		6/30/2025	
160181	Infiltration trench	Fail		6/30/2026	
160187	Wet swale	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process
160197	Infiltration trench	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process
160203	Shallow marsh	Fail		6/30/2024	
160211	Infiltration trench	Fail		6/30/2026	
160218	Dry pond	Fail		6/30/2026	
160224	Infiltration trench	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process
160225	Infiltration trench	Fail	AZ044A11[b]	9/30/2023	In Design and Permitting Process
160230	Infiltration trench	Fail	AX3565274[b]	6/30/2023	In Design and Permitting Process
160232	Infiltration trench	Fail	AX3565274[b]	6/30/2023	In Design and Permitting Process
160246	Infiltration trench	Fail		6/30/2026	
160247	Infiltration trench	Fail		6/30/2026	
160250	Infiltration trench	Fail		6/30/2026	
160301	Dry pond	Fail		6/30/2026	
160305	Wet pond	Fail		6/30/2026	
160351	Wet pond	Pass		6/30/2026	**Per Latest Inspection, BMP is Functioning as Designed**
160378	Dry pond	Fail		6/30/2025	

Table IV.D.1.d: MDOT SHA SWM Facilities for Rehabilitation Work Orders

SWM Facility Number	Facility Type	MDE Pass / Fail	Contract	Completion Commitment Date	Rehabilitation Comments
160402	Infiltration trench	Fail		6/30/2026	
160408	Infiltration trench	Fail	AX3565274[b]	6/30/2023	In Design and Permitting Process
160427	Infiltration trench	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process
160429	Infiltration trench	Fail	AZ044A11[b]	6/30/2023	In Design and Permitting Process
160505	Wet pond	Fail	AZ044A11[b]	6/30/2024	In Design and Permitting Process
160662	Wet pond	Fail		6/30/2025	
160732	Wet pond	Fail		6/30/2026	
160747	Wet extended detention pond	Fail	AZ044A11[b]	6/30/2024	In Design and Permitting Process
160806	Wet pond	Fail		6/30/2025	
161953	2A Grass swale	Fail		N/A	**BMP Abandoned**
162131	2A Grass swale	Fail		N/A	**BMP Abandoned**
162242	2A Grass swale	Fail		N/A	**BMP Abandoned**
210003	Dry swale	Fail	XY1695174[a]	6/30/2023	In Design and Permitting Process
210009	Infiltration basin	Fail	XY1695174[a]	6/30/2019	Rehabilitation planned for FY24. In Design and Permitting Process
210233	Dry Pond	Fail	XX1695174[a]	6/30/2025	In Design and Permitting Process
210938	Bio-swale	Fail		6/30/2026	

[a] Refers to a contract that went to construction during FY19 or FY20 that had to be cancelled due to budgetary impacts. These facilities will be prioritized first when resources are allocated for construction.

[b] Refers to a charge number created during FY20 for which work began for design and permitting only. These facilities will be prioritized second when resources are allocated for construction

Appendix C: Illicit Discharge Detection and Elimination Program Summaries

Table IV.D.3.a below summarizes primary field screening efforts for the FY22 reporting period. In the MS4 geodatabase submitted with this FY22 MS4 annual report, MDOT SHA has provided the applicable IDDE program information in the *IDDE* associated table.

Table IV.D.3.a: Primary Field Screening Summary

County	Number of Outfalls Field Screened FY22
Anne Arundel	50
Carroll	54
Frederick	17
Harford	1
Montgomery	42
Totals	164

Table IV.D.3.b below summarizes information from the most recent quarterly facility inspection performed at each of the NPDES 12-SW permitted sites within the MDOT SHA MS4 Permit area. Included in the summary is a description of each issue identified during those inspections and the associated resolutions made by MDOT SHA during the FY22 reporting period.

Table IV.D.3.b: Summary of the Most Recent Quarterly Inspection for NPDES 12-SW Permitted Facilities

Facility Name	Quarter Number and Fiscal Year for Last Inspection	Date of Last Quarterly Inspection	Number of Issues Identified During QTR	Uploaded to Web-based Tracking (Yes or No)	Issue Details	Resolved? (Yes or No)	Comments
Cambridge	2nd QTR 2022	4/11/2022	0	N/A	N/A	N/A	N/A
Salisbury	2nd QTR 2022	4/14/2022	2	Yes	Storm Water/Material Storage- Materials Not Stored Under Cover/Contained – On December 10th, 2021. The District Environmental Coordinator (DEC) notified that the salt dome at Salisbury was not sound and the roof had been mistakenly damaged by onsite personnel. The DEC informed facility management that the salt would need to be relocated or covered. The site Resident Maintenance Engineer informed DEC that the next steps would be determined at a senior level by the District Engineer (DE). The DEC contacted and informed Office of Environmental Design Deputy Director of the issue. Following inspection for safety reasons the DE decided to remove the roof from the dome declaring the salt barn to be an unsafe structure. Since that time bulk salt has not been moved or covered.	No	Coordination of follow ups for this incident and correction of the resulting compliance issue is being administered by senior level management.
	2nd QTR 2022	4/14/2022		Yes	Storm Water/Material Storage- Storage Pile Management Problems – Near the annex building of site there are several mounds of topsoil and unsegregated topsoil that have been disturbed. These mounds are no longer stabilized and pose a stormwater pollution risk. It looks like personnel are dumping loads of concrete mixed with metal and topsoil in between the mounds of stabilized topsoil.	No	No more material being piled, clean up work in ongoing.

Table IV.D.3.b: Summary of the Most Recent Quarterly Inspection for NPDES 12-SW Permitted Facilities

Facility Name	Quarter Number and Fiscal Year for Last Inspection	Date of Last Quarterly Inspection	Number of Issues Identified During QTR	Uploaded to Web-based Tracking (Yes or No)	Issue Details	Resolved? (Yes or No)	Comments
Elkton	2nd QTR 2022	4/14/2022	1	Yes	Storm Water/Materials Storage- Salt Storage Not Appropriate – Sweep all excess salt from the lot and place barriers across the entrance of the salt barn to prevent salt in site run off.	Yes	Salt swept from lot and new berms at building opening.
Fairland	2nd QTR 2022	4/14/2022	1	Yes	Storm Water/Material Storage- Materials Not Stored Under Cover/Contained – In front of the team leader bays there is a pallet with several bags of cold patch that is left outside not under cover.	Yes	Cold patch bags moved indoors and out of contact with stormwater.
Gaithersburg	2nd QTR 2022	5/13/2022	0	N/A	N/A	N/A	N/A
Laurel	2nd QTR 2022	4/20/2022	2	Yes	Storm Water/Material Storage- Materials Not Stored Under Cover/Contained – Outside the maintenance shop near the fuel island has a 3-gallon diesel can, not under cover. At several locations cold patch is sitting outside in contact with stormwater.	Yes	The diesel can and all identified bags of cold patch were moved indoors.
	2nd QTR 2022	4/5/2022		Yes	Storm Water/Material Storage- Storage Pile Management Problems – Sand and cold patch outside the storage area and not pushed back after loading and unloading, outside the roofline of the material structure.	Yes	All erodible materials had been pushed back into their storage areas and no longer outside the roof line of the building.
Upper Marlboro	2nd QTR 2022	5/12/2022	1	Yes	Storm Water/Material Storage- Storage Pile Management Problems – There is a sand mound sitting in front of the sand storage not under cover. There is also a cold patch mound in front of the storage building.	Yes	Sand mound removed and cold patch placed back into storage by facility personnel.

Table IV.D.3.b: Summary of the Most Recent Quarterly Inspection for NPDES 12-SW Permitted Facilities

Facility Name	Quarter Number and Fiscal Year for Last Inspection	Date of Last Quarterly Inspection	Number of Issues Identified During QTR	Uploaded to Web-based Tracking (Yes or No)	Issue Details	Resolved? (Yes or No)	Comments
Golden Ring	2nd QTR 2022	4/28/2022	2	Yes	Storm Water/Material Storage- Fueling Area Not Properly Maintained to Prevent Stormwater Pollution – Accumulated stormwater and fuel mixture in diesel UST fuel spill bucket.	No	Issue remains open as of 6/30/2022.
	2nd QTR 2022	4/24/2022			Storm Water/Materials Storage- Floatable Debris Not Properly Contained – Sand/dirt is in lower lot near phase 2 building. Debris is in stream bed from facility. Culvert pipe is partially clogged with leaves and trash preventing proper functionality. Parking lot needs sweeping.		Issue remains open as of 6/30/2022.
Hereford	2nd QTR 2022	4/6/2022	2	Yes	Storm Water/Material Storage- Materials Not Stored Under Cover/Contained – Cold Patch buckets and bags improperly stored in truck parking area.	Yes	Cold Patch bags disposed of and buckets of usable material moved indoors.
	2nd QTR 2022	4/6/2022			Storm Water/Material Storage- Floatable Debris Not Properly Contained – Soil and debris next to sediment pit and trash identified in swale adjacent to main shop road.		All soil and debris identified were cleaned up by site staff.
Owings Mills	2nd QTR 2022	5/11/2022	1	Yes	Storm Water/Material Storage- Brine Tank and/or Maker – Slow leak at bring tank fitting requires repair.	Yes	Brine leak corrected. Facility continues to monitor.
Churchville	2nd QTR 2022	4/14/2022	0	N/A	N/A	N/A	N/A
Annapolis	2nd QTR 2022	4/14/2022	2	Yes	Storm Water/Material Storage- Storage Pile Management Problems – Sand stockpile not tarped. Sandbags in back of lot are falling apart.	Yes	Sandbags added to pile and sand pile has been tarped to prevent contact with stormwater.
	2nd QTR 2022	4/14/2022		Yes	Storm Water/Material Storage- Salt Storage Not Appropriate – Salt observed outside of designated storage barn.	Yes	Salt swept and pushed back into salt barn by facility personnel.

Table IV.D.3.b: Summary of the Most Recent Quarterly Inspection for NPDES 12-SW Permitted Facilities

Facility Name	Quarter Number and Fiscal Year for Last Inspection	Date of Last Quarterly Inspection	Number of Issues Identified During QTR	Uploaded to Web-based Tracking (Yes or No)	Issue Details	Resolved? (Yes or No)	Comments
Glen Burnie	2nd QTR 2022	4/28/2022	2	Yes	Storm Water/Material Storage- Storage Pile Management Problems – All dirt in stockpile must be fully tarped. Existing tarp is not an adequate size. Lot area behind brine tanks needs sweeping.	No	Issue remains open as of 6/30/2022
	2nd QTR 2022				Storm Water/Material Storage- Fueling Area Not Properly Maintained to Prevent Stormwater Pollution – Mixed fuel and stormwater found in underground fuel tank spill buckets.		Issue remains open of 6/30/2022
Hanover	2nd QTR 2022	4/14/2022	0	N/A	N/A	N/A	N/A
LaPlata	2nd QTR 2022	4/14/2022	0	N/A	N/A	N/A	N/A
Hagerstown	2nd QTR 2022	4/4/2022	0	N/A	N/A	N/A	N/A
Frederick	2nd QTR 2022	4/14/2022	1	Yes	Storm Water/Material Storage- Storage Pile Management Problems – Area in front of aggregate storage bins needs to sweep to clean up dust and fine sediment.	Yes	Mechanical sweeping of area performed.
Thurmont	2nd QTR 2022	4/25/2022	0	N/A	N/A	N/A	N/A
Dayton	2nd QTR 2022	4/14/2022	0	N/A	N/A	N/A	N/A
Westminster	2nd QTR 2022	4/11/2022	0	N/A	N/A	N/A	N/A

Table IV.D.3.d below summarizes the illicit discharges (IDs) that required follow-up investigations during the FY21 and FY22 periods. MDOT SHA performs a follow-up investigation only if dry weather flow is observed during the primary field screening and a subsequent follow-up testing confirms that one or more pollutant parameters were exceeded during both testing events.

Table IV.D.3.d: Illicit Discharges Requiring Further Investigation During Reporting Period

Reference No.	County	MDOT SHA Structure or BMP#	Date of ID	Potential Pollutant	Status
1	Harford	1201804.001	5/26/2021	Detergents & Foam	Closed following FY22 primary screening event, third party investigation, & communication with County.
2	Prince Georges	1601694.001	4/20/2021	Copper	Closed following FY21 investigation & laboratory testing.
3	Prince Georges	1601944.001	4/29/2021	Detergents	Closed following FY21 investigation.
4	Prince Georges	1601989.001	4/28/2021	Copper	Closed following FY21 investigation.
5	Prince Georges	1602000.001	4/28/2021	Copper	Closed following FY21 investigation & laboratory testing.
6	Prince Georges	16020150.001	4/28/2021	Copper	Closed following FY21 investigation & laboratory testing.
7	Prince Georges	1602483.001	5/18/2021	Copper	Closed following FY21 investigation & laboratory testing.
8	Prince Georges	1602499.001	5/19/2021	Copper	Closed following FY21 investigation & laboratory testing.
9	Prince Georges	1602690.001	4/23/2021	pH	Closed following FY21 investigation.
10	Prince Georges	1602700.001	4/23/2021	pH	Closed following FY21 investigation.
11	Prince Georges	1603274.001	4/20/2021	Copper	Closed following FY21 investigation & laboratory testing.
12	Montgomery	1501582.001	6/7/2022	Copper	Investigation initiated in FY22, still underway in FY23. Status remains “open.”

Two potential IDs were reported by citizens and investigated further by MDOT SHA during the FY22 reporting period.

One potential ID was reported to the MDOT SHA Water Programs Division by the Frederick County sustainability and environmental resources division. A citizen reported oil laden runoff observed near a community pool adjacent to Ballenger Creek Pike to County officials. A team of Environmental Specialists from Maryland Environmental Service (MES) responded to the complaint and traveled to the site to investigate the issue. MES inspected 4 nearby MDOT SHA owned inlets, as well as 2 monitoring pipes near the pool. No free oil, oil staining, or odor was found at any of the structures inspected. MES issued a summary report on February 16, 2022, which was submitted to Frederick County officials. Following these actions, the issue was considered to be in “closed” status.

Another potential ID was reported to MDOT SHA by Washington County by the Stormwater Management Coordinator. The County had been receiving reports of periodic wastewater dumping along McAfee Hill Road in Cascade, Maryland. Toilet paper and other debris indicative of municipal wastewater were visible at a stormwater inlet and associated piping along this roadway. MDOT SHA contacted the County for further details. MDOT SHA provided a copy of a dumping and ID flyer to the County, reviewed photographs and findings obtained by the County, cleaned up the debris at grade, and offered to further investigate the issue through field testing. Following these actions and further discussion, the County stormwater management coordinator indicated that County personnel would continue to monitor the inlet. The County requested that MDOT SHA submit additional state stormwater feature mapping to assist with further investigation. Maps were generated by the Office of Environmental Design and submitted to Washington County on March 30, 2022. Following these actions, this issue is considered to be “closed”.

Neither of the potential IDs reported by citizens and forwarded by County officials are detailed further below or included in Table IV.D.3.d because the structures did not yield an ID.

The following updates summarize the jurisdiction contacts/resolution schedule for IDs whose status was designated as “open” or “reopened” in previously submitted MS4 annual reports as well as any FY22 ID’s that required investigation as a result of field screening. Updates below are numbered in alignment with the “Reference No.” field of Table IV.D.3.d above.

1. During FY21 primary screenings, structure #1201804.001, located along Philadelphia Road (Maryland 7) in Harford County, was determined to exceed the established detergent threshold of 1.5 mg/l. Sample field test results also yielded low levels of phenols and chlorine. Inspectors noted visual and olfactory issues indicating the potential presence of sewage at the site. The details of this detected ID were sent to the Harford County health department for correction on June 30, 2021. MDOT SHA ECD followed up via email with the Harford County health department on May 23, 2022, to determine the status of the reported ID and resulting corrective actions. The County health department reported that they had performed a site visit during

November 2021 but "did not observe anything unusual" at the structure. Based upon this information, MDOT SHA considered the ID as remaining in "open" status and added this structure to the queue for FY22 IDDE primary screenings. Primary screening of this site was again performed on June 2, 2022. Dry weather flow was identified and tested for all established IDDE program testing parameters. Low levels of copper and detergents were observed. However, concentrations of these pollutants were well below the established limits. As a best practice, ECD decided to have a third party further investigate the discharge at this site. On June 16, 2022, Environmental Specialists from MES visited the site to further investigate. MES found the structure to be slightly wet, but not actively flowing. They did not observe visual or olfactory issues with the structure or downstream pond. MES generated a written report detailing their findings on July 8, 2022. This report and a summary of testing from FY22 primary screening were sent to the Harford County health department on July 7, 2022. Based on the results of further investigation, this ID is considered "closed" and will not be rescreened in FY23.

2. During FY21 primary screenings, structure #1601694.001; located along Central Avenue near the intersection with Shady Glen Drive in Capital Heights, Maryland; was determined to be an ID. Sample field tests determined that copper concentration in dry weather discharge was 0.66 mg/l. This concentration exceeded the established threshold for that pollutant. At the time of inspection, a strong ammonia and petroleum odor and discoloration was detected by inspectors which originated from the receiving water body. The MDOT SHA structure discharge was not the cause of the observed water quality issues. However, as previously reported, field inspectors contacted the MDE emergency response telephone number and reported the findings on April 20, 2021. Due to budget shortfalls as a result of the COVID-19 pandemic, limited resources were available in FY21 to immediately complete an investigation following the determination of a possible ID. This location investigation was reported as remaining in "open" status during FY21 reporting. A follow up investigation was performed at this location on August 26, 2022. A slow discharge of dry weather flow was observed at structure #1601694.001 during the investigation. Samples were collected, placed on ice, and sent to ALS laboratories for testing. ALS laboratories results determined copper concentrations to be at a non-detectible level. This result was under the 0.21mg/l threshold for copper. Further upstream investigation was performed and multiple upstream inlets were inspected along 55th Avenue and Quincy Street. All inlets were found to be dry and supporting photos were obtained. Following investigation, this structure was determined not to be an ID, was deemed "closed", and was not rescreened during FY22.

3. During FY21 primary screenings, structure #1601944.001; located along Central Avenue in Capital Heights, Maryland; was determined to be an ID. This site is located near to the intersection of Central Avenue and Davey Street just before reaching the District of Columbia. Sample field testing at this site location yielded 1.23 mg/l concentration for detergents which exceeded the threshold established for that pollutant. Due to budget shortfalls as a result of the COVID-19 pandemic, limited resources were available in FY21 to immediately complete an investigation following the determination of a possible ID. This

location investigation remained in “open” status during FY21 reporting. A follow up investigation was performed on August 26, 2022, and the outfall was found not to be discharging. Additionally, trash and debris noted in Watts Branch had been removed from around the outfall by Prince George’s County representatives. Several upstream inlets along Central Avenue were also inspected and found to be dry. Based on site conditions during the follow up investigation, this ID was considered “closed” and was not rescreened during FY22.

4. During FY21 primary screenings, structure #1601989.001; located along Central Avenue in Bowie, Maryland; was determined to be an ID. This site is located near the intersection of Central Avenue and Campus Way. Sample field testing found the concentration of copper to be 0.22 mg/l which just exceeds the established limit of 0.21 mg/l. Due to budget shortfalls as a result of the COVID-19 pandemic, limited resources were available in FY21 to immediately complete an investigation following the determination of a possible ID. This location investigation remained in “open” status during FY21 reporting. A follow up investigation was performed on August 26, 2022. Structure #1601989.001 was found to be dry. No active flow was observed and therefore no further samples could be obtained. Upstream westbound inlets located along Central Avenue were also inspected and found to be dry. Based on site conditions during the follow up investigation, this ID was considered “closed” and was not rescreened during FY22.

5. During FY21 primary screenings, structure #1602000.001; located along Central Avenue in Bowie, Maryland; was determined to be an ID. This site is located near the intersection of Central Avenue and Kettering Drive just west of site #1601989.001. Sample field testing found the concentration of copper to be 0.37 mg/l which exceeds the established limit of 0.21 mg/l. Due to budget shortfalls as a result of the COVID-19 pandemic, limited resources were available in FY21 to immediately complete an investigation following the determination of a possible ID. This location investigation was remained in “open” status during FY21 reporting. A follow up investigation was performed at this location on August 26, 2022. Dry weather flow was observed, and samples were collected, placed on ice, and sent to ALS laboratories for analysis. ALS laboratories testing determined copper concentrations to be at a non-detectible level. This result was under the 0.21 mg/l limit for copper. Therefore, following investigation, the site was not considered to be an ID, was switched to “closed” status, and was not rescreened during FY22.

6. During FY21 primary screenings, structure #1602015.001; located along Central Avenue in Mitchellville, Maryland; was determined to be an ID. This site is located near the intersection of Central Avenue and Michaels Drive. Sample field testing found the concentration of copper to be 1.48 mg/l which exceeds the established limit of 0.21 mg/l. Inspectors also noted that this site flow contained low levels of detergents and chlorine. However, both pollutants did not exceed established limits. Due to budget shortfalls as a result of the COVID-19 pandemic, limited resources were available in FY21 to immediately complete

an investigation following the determination of a possible ID. This location investigation was reported in FY21 as remaining in "open" status. A follow up investigation was performed at this location on August 26, 2021. Dry weather flow was observed, and samples were collected, placed on ice, and sent to ALS laboratories for testing. ALS laboratories testing results determined copper concentrations to be at a non-detectible level. This result was under the 0.21 mg/l limit for copper. Therefore, following investigation, the site was not considered to be an ID, was switched to "closed" status, and was not rescreened during FY22.

7. During FY21 primary screenings, structure #1602483.001; located along Crain Highway in Bowie, Maryland; was determined to be an ID. This site is located near to the intersection of Crain Highway and Excaliber Road. Sample field testing found the concentration of copper to be 0.49 mg/l which exceeds the established limit of 0.21 mg/l. Due to budget shortfalls as a result of the COVID-19 pandemic, limited resources were available in FY21 to immediately complete an investigation following the determination of a possible ID. This location investigation was reported in FY21 as remaining in "open" status. A follow up investigation was performed at this location on August 25, 2021. Dry weather flow was observed, and samples were collected, placed on ice, and sent to ALS laboratories for testing. ALS laboratories results indicated that copper concentrations were at a non-detectible level. This result was under the 0.21 mg/l limit for copper. Therefore, following investigation, the site was not considered to be an ID, was switched to "closed" status, and was not rescreened during FY22.

8. During FY21 primary screenings, structure #1602499.001; located along Crain Highway in Bowie, Maryland; was determined to be an ID. This site is located near to the intersection of Crain Highway and Harbour Way. Sample field testing found the concentration of copper to be 0.93 mg/l which exceeds the established limit of 0.21 mg/l. Inspectors also noted that this site flow contained low levels of detergents and chlorine. However, both pollutants did not exceed established limits. Due to budget shortfalls as a result of the COVID-19 pandemic, limited resources were available in FY21 to immediately complete an investigation following the determination of a possible ID. This location investigation was reported in FY21 as remaining in "open" status. A follow up investigation was performed at this location on August 25, 2021. Flow was observed during the follow up investigation, sampled, and sent for analytical testing. Inspectors determined the dry weather flow source to be an upstream stormwater pond across the roadway. Several inlets along Crain Highway upstream pond were also inspected and determined to be dry. Inspectors collected samples at structure #1602499.001 and obtained a grab sample from the upstream pond. ALS laboratory testing yielded a copper level of 0.063 mg/l at the upstream pond and non-detectable copper concentrations at the structure itself. Both results were under the 0.21 mg/l limit for copper. Therefore, following investigation, this site was not considered to be an ID, was switched to "closed" status, and was not rescreened during FY22.

9. During FY21 primary screenings, structure #1602690.001; located along Croom Road in Upper Marlboro, Maryland; was determined to be an ID. This site is located near to the intersection of Croom Road and Nottingham Road. Sample field testing found a pH value of 6.2 which was outside of the established limit. Due to budget shortfalls as a result of the COVID-19 pandemic, limited resources were available in FY21 to immediately complete an investigation following the determination of a possible ID. This location investigation was reported in FY21 as remaining in “open” status. A follow up investigation was performed at this location on August 25, 2021. Flow was not observed at structure #1602690 or any upstream inlet along Croom Road. Therefore, following investigation, this site was not considered to be an ID, was switched to “closed” status, and was not rescreened during FY22.

10. During FY21 primary screenings, structure #1602700.001; located along Croom Road in Upper Marlboro, Maryland; was determined to be an ID. This site is located near to the intersection of Croom Road and Molly Berry Road. Sample field testing found a pH value of 6.2 which is outside of the established limit. Due to budget shortfalls as a result of the COVID-19 pandemic, limited resources were available in FY21 to immediately complete an investigation following the determination of a possible ID. This location investigation was reported in FY21 as remaining in “open” status.   A follow up investigation was performed at this location on August 25, 2021. A “trickle” of flow was observed by field inspectors during the investigation. No additional visual or olfactory issues were noted. A newly calibrated pH meter was used (Extech model PH220) to test the pH of discharging water. Following multiple collections and testing events, testing yielded pH levels in a range between 6.5 and 6.7 respectively. The immediate upstream inlet was also inspected, photographed, and found not to be flowing. This determination indicates a likely groundwater source of the structure discharge. Based on site conditions during the follow up investigation, this site was not considered to be an ID, was switched to “closed” status, and was not rescreened during FY22.

11. During FY21 primary screenings, structure #1603274.001; located along the ramp to Crain Highway northbound in Bowie, Maryland; was determined to be an ID. This structure discharges into a stormwater pond that can be accessed from 4801 Tesla Drive. Sample field testing found the concentration of copper to be 0.22mg/l which just exceeds the established limit of 0.21 mg/l. Due to budget shortfalls as a result of the COVID-19 pandemic, limited resources were available in FY21 to immediately complete an investigation following the determination of a possible ID. This location investigation was reported in FY21 as remaining in “open” status. A follow up investigation was performed at this location on August 25, 2021. Dry weather flow was observed, and samples were collected, placed on ice, and sent to ALS laboratories for analysis. ALS laboratories testing results determined copper concentrations to be at a non-detectible level. This result was under the 0.21mg/l limit for copper. Therefore, following investigation, this site was not considered to be an ID, was switched to “closed” status, and was not rescreened during FY22

12. During FY22 primary screenings, structure #1501582.001; located along Connecticut Avenue southbound in Kensington, Maryland; was determined to be an ID. This structure discharges into Rock Creek. A significant amount of dry weather flow was found to be discharging from the structure at the time of inspection. Field testing performed on June 2, 2022 determined the concentration of copper to be 0.31 mg/l which exceeded the established limit of 0.21 mg/l. Inspectors intended to return to the site to perform a follow up inspection on June 3, 2022. However, a significant rain event occurred during the early morning hours on June 3, 2022, preventing the required follow up confirmatory inspection. Another initial primary screening occurred on June 7, 2022. Field testing again yielded a copper concentration of 0.23 mg/l which exceeded the established limit. Unfortunately, an unforeseen rain event, again, occurred immediately following primary screening on June 7, 2022. Because two copper limit exceedances had occurred during separate primary inspections, a decision was made to manage this site as an ID. An ID investigation at this location was underway at the end of FY22. Structure #1501582.001 was revisited by MES field inspectors on June 22, 2022. Field staff again found high flow dry weather conditions with copper levels exceeding established program limits at the outfall. State stormwater asset information was gathered and sent to MES staff to facilitate upstream inspection of multiple stormwater collection line segments. MES field inspectors began isolating segments of this large stormwater collection system through structure inspection. MES identified two structures that directly link with the upstream structure in dry flow condition and the downstream structure actively flowing. MDOT SHA is working to schedule a video pipe inspection of the flowing stormwater line. This work was not yet completed as of the date on this FY22 MS4 annual report. This ID investigation is ongoing and remains in “open” status.

Appendix D: Public Education and Outreach Program Report

In accordance with Part V.A.1.d of the MS4 Permit, MDOT SHA provides the following summary describing its public education programs implemented during the FY22 reporting period in accordance with conditions in Parts IV.D.4 and IV.D.6 of the MS4 Permit.

Earth Day

Organization of activities to celebrate Earth Day continued to be impacted by the COVID-19 pandemic during FY22 but alternative electronic education initiatives that began during FY20 persisted. Beginning on April 20, 2022, MDOT disseminated various email newsletters to its workforce of more than 11,000 individuals to promote engagement in Earth Day awareness. An example of these newsletters was titled, “Earth Day 2022: Take Action!”, which is provided below. Subsequent Earth Day 2022 newsletters focused on “Flood Awareness”, “Waste Management and the 3 R’s”, and other pertinent environmental topics.

MDOT MARYLAND DEPARTMENT OF TRANSPORTATION

Earth Day 2022:

Take Action!

Friday, April 22, 2022 is Earth Day!

To encourage environmental stewardship and inspire a call to action, MDOT has developed a voluntary pledge for all MDOT staff in celebration of Earth Day. See below for the link to sign the Pledge.

Pledge to Take Action

This year for Earth Day, we are inviting you to make a pledge to take ACTION in your community. You are invited to commit to take action to enhance the environment by participating in activities such as:

- community organizing,
- cleaning up a stream in your neighborhood,
- planting a garden, or
- other community activities that contribute to improving our natural environment.

With this commitment, we are asking you to capture yourself TAKING ACTION via photos and/or videos that will be shared with our MDOT family. Please send your photos and/or videos to mdotenvironment@mdot.maryland.gov.

We will share these in future environmental communications and in tandem with future Earth Day celebrations. Scan the QR Code below or click on the link to review and sign the pledge.

[Pledge to Take Action! (google.com)]

We hope you had a chance to view some of our Earth Day email blasts.

To ensure you don't miss out on any Earth Day or environmental newsletter emails, make sure to check your Inbox *Other* folder if you have a Focused and Sorted Inbox. Or you can reach out to us at mdotenvironment@mdot.maryland.gov.

Social Media

MDOT SHA leveraged social media platforms Facebook, Twitter, and Instagram in FY22 to promote and encourage participation in MDOT's various environmental education initiatives. Posts included, but were not limited to, information about MDOT SHA's litter clean-ups, flood awareness, and stormwater management efforts. Examples of MDOT SHA FY22 social media posts are provided below.

Keep Maryland Beautiful Grant Program

Maryland Environmental Trust awarded 85 *Keep Maryland Beautiful* (KMB) grants in 2022 to support environmental education, community cleanup, and beautification projects throughout Maryland. Four different grants were offered to help volunteer and nonprofit groups, communities, and land trusts support environmental education projects, litter removal, citizen stewardship, and solve natural resource issues in urban and rural areas. Funding for the KMB grants program is provided by MDOT, Maryland Department of Housing and Community Development, the Forever Maryland Foundation, and Maryland Environmental Trust. MDOT pledged $50,000 a year to the program for five years (starting in FY18) totaling $250,000. More information regarding KMB grants can be found online at:

https://forevermaryland.org/grants-page

Anti-Litter Campaign

MDOT developed an Anti-Litter campaign during FY22 To *Put Litter in Its Place* and help *Keep Maryland Beautiful*, that formally launched in August 2022. MDOT and its Secretary, James Ports, are encouraging people to be responsible about their waste. Reducing the amount of litter on Maryland's roadways and waterways will reduce the cost of keeping the highways clean. This can lead to more money being spent to improve pedestrian and bicyclist facilities, augment transit connections, or undertake critical transportation projects to make the roadways safer and more accessible for all users. More information can be found online at:

https://www.mdot.maryland.gov/tso/pages/Index.aspx?PageId=197

MDOT 'incenTrip' Mobile App

MDOT partnered with the Maryland Transportation Institute at the University of Maryland and the Metropolitan Washington Council of Government's Commuter Connections program during FY22 to develop a mobile application to help reduce the number of single-occupancy vehicles on the road by incentivizing Maryland commuters who utilize alternate modes of transportation when possible. Users can earn points redeemable for cash rewards based on their use of public transportation, carpooling, vanpooling, walking, biking or using alternative work schedules whenever convenient and during rush hour commute. This application will help users avoid traffic, save money, and reduce their carbon footprint among other benefits. IncenTrip is active and ready for download via Google Play and the Apple App Store. More information is available at the following website:

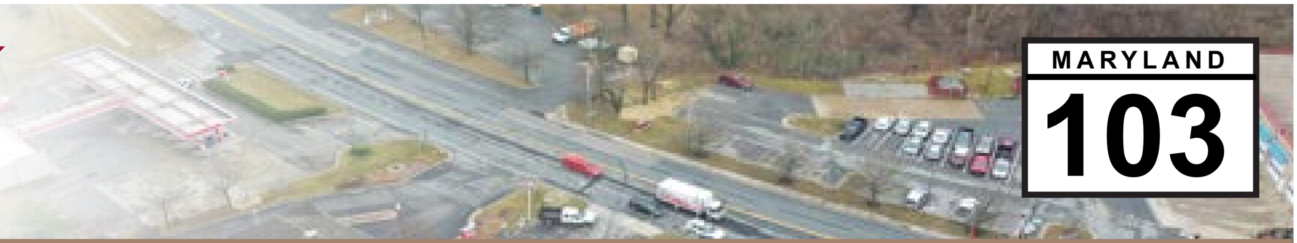
www.mdot.maryland.gov/incenTrip

MDOT
MARYLAND DEPARTMENT OF TRANSPORTATION
incenTrip

Community Outreach

During FY22, MDOT SHA launched numerous projects for goals as varied as improving paths for pedestrians and bicyclists, preventing flooding, and improving stormwater management systems. To inform the public and engage stakeholders during project planning and construction, MDOT SHA reached out to individual communities to prepare them for upcoming work near them and to solicit their feedback. Attached to this Appendix D is one example of the type of community outreach fliers MDOT SHA sent during FY22 for these intents and purposes.

MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION



MARYLAND
103

MD 103 Roadway Widening Project

Roadway Widening Project Begins This Spring

The Maryland Department of Transportation State Highway Administration (MDOT SHA) will begin work to widen MD 103 (Montgomery Road) between US 29 (Old Columbia Pike) and Long Gate Parkway in Ellicott City, Howard County. The project is scheduled to start this spring and be completed in summer 2023.

Project Overview

The roadway-widening project will improve safety and capacity on MD 103. The project will result in an additional lane, providing three lanes on westbound MD 103. These lanes are for dedicated access to northbound US 29 and tie into recently constructed developer improvements. Several other improvements will take place, including:

- Installation of sidewalks and bicycle lanes
- Replacement of curb, gutter, and drainage pipes
- Reconstruction of traffic signals
- Improvements to landscaping and stormwater management

What to Expect During Construction

Currently, there is utility work taking place. The roadway widening construction will begin this spring. MDOT SHA will close one lane in each direction on MD 103 throughout the construction phase. The project will require shoulder and single-lane closures Monday through Friday from 9 a.m. to 3 p.m. There will be no more than one travel lane closed during work hours.

Find Us on the Web

For additional information about the MD 103 Roadway Widening Project, please visit the Project Portal at: **https://bit.ly/MDOTSHA-MD-103-US-29-to-Long-Gate**

You may also use the QR code shown below.

@MDOTSHA
@MDSHA
MarylandStateHighwayAdmin
MDStateHighwayAdmin

Request for Assistance

The Maryland Relay Service can assist teletype users at 7-1-1. Persons requiring translation assistance with this newsletter should send an email to:**shatitleVI@mdot.maryland.gov**

Please indicate the desired language in the subject line.

Chinese:

[illegible] shatitlevi@sha.state.md.us。[illegible] <Chinese>。

Amharic:

[illegible] <Amharic> [illegible]

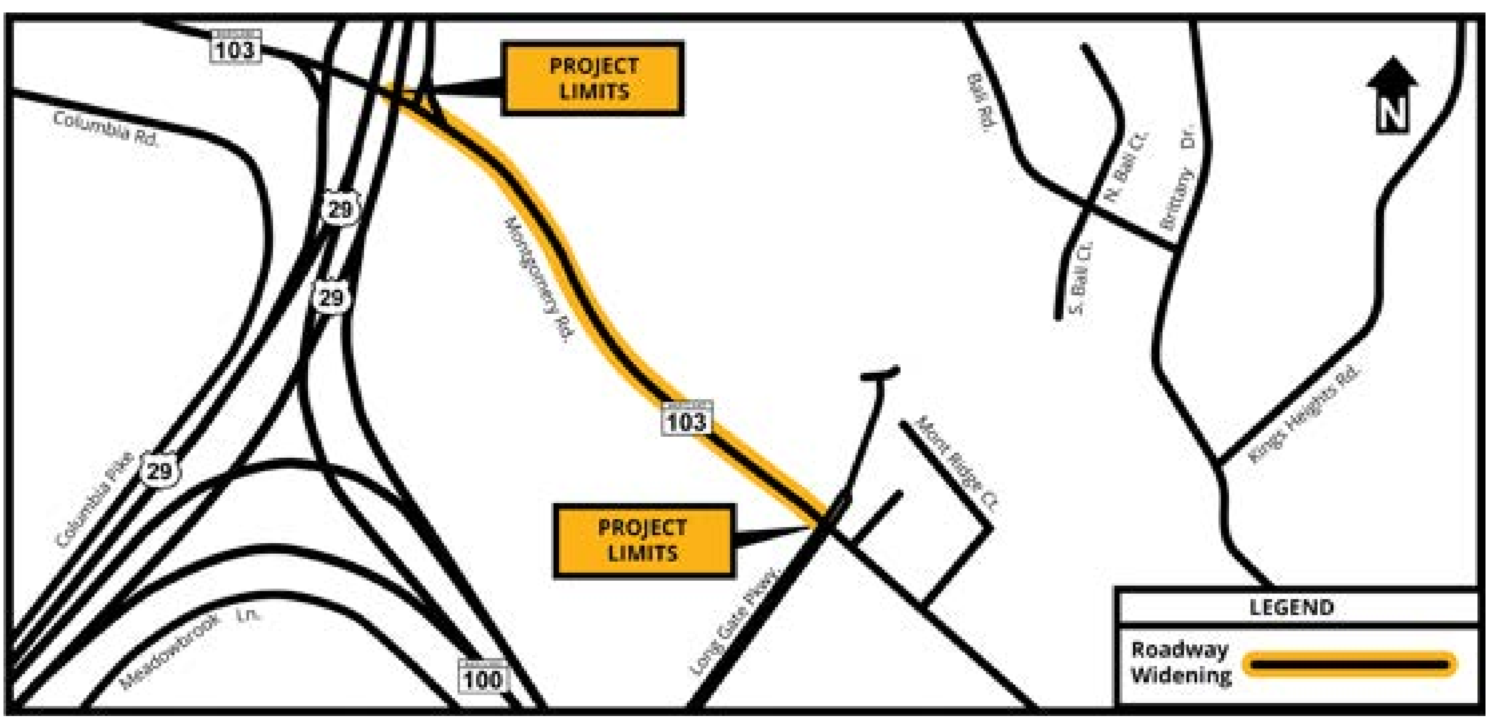
Vietnamese:

[illegible] shatitlevi@sha.state.md.us. [illegible] <Vietnamese> [illegible]

Spanish:

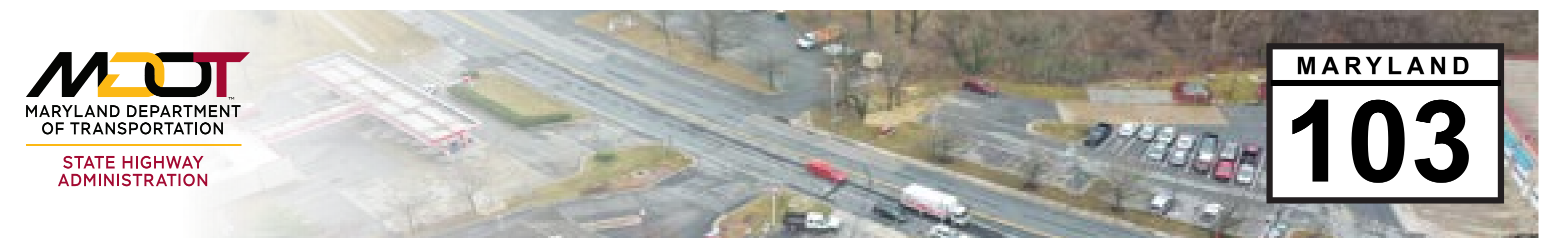
Para recibir este boletín en español, por favor envíe un correo electrónico a: shatitlevi@sha.state.md.us. Por favor indique <Spanish> en el asunto del correo electrónico.

Maryland Relay
Dial 7-1-1



MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

DISTRICT 7 OFFICE
5111 BUCKEYSTOWN PIKE
FREDERICK, MARYLAND 21704



MD 103 Roadway Widening Project

For More Information

For questions about the MD 103 Roadway Widening Project, please contact:

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SEE INSIDE FOR MORE DETAILS!

For additional information about the MD 103 Roadway Widening Project, please visit the Project Portal at:
https://bit.ly/MDOTSHA-MD-103-US-29-to-Long-Gate
You may also use the QR code shown below.

Appendix E: TMDL Assessment Report

MDOT SHA has prepared and is submitting this FY22 TMDL Assessment Report with tables in accordance with conditions in Part IV.E.5 of the MS4 Permit.

It is understood that TMDLs issued during MDOT SHA's current MS4 Permit term apply the MDE 2014 guidance when modeling progress for TMDL wasteload allocation (WLA) obtainment. As such, the nutrient and sediment loads presented here and within applicable reporting tables of the MS4 Geodatabase – Part 1 are modeled using Chesapeake Bay Program (CBP) watershed model (WM) Phase 5.3.2, which is consistent with the loads reported in previous annual report submittals by MDOT during the current MS4 Permit term.

A complete description of the MDOT SHA restoration modeling protocol, used to evaluate whether MDOT SHA restoration plans are effectively working toward achieving compliance with EPA approved TMDLs, was provided as Appendix D to the FY19 MS4 annual report. That protocol was used to develop progress reporting presented in **Table V.A.1.e** below, provided in accordance with conditions in Parts IV.E.5.a, IV.E.5.b, and V.A.1.e of the MS4 Permit. Progress toward attainment of benchmarks and applicable WLAs developed under EPA approved TMDLs is also documented in the *CountywideStormwaterWatershedAssessment* and *LocalStormwaterWatershedAssessment* tables of the MS4 Geodatabase – Part 1 submitted with the FY22 MS4 annual report.

Target and progress load reduction amounts reported by MDOT SHA with this FY22 MS4 annual report comply with guidance provided by MDE in its July 30, 2021 comments that stated credit must be temporarily removed for any 'failed' BMPs until proper performance can be verified. As described in the "Restoration Plans" section of the FY22 MS4 annual report, credit could not be verified for 409 restoration BMPs so they have been temporarily removed from MDOT SHA credit accounting. This, coupled with no new restoration BMPs completing construction in FY22, resulted in MDOT SHA load reduction progress decreasing for many 8-digit watershed TMDLs relative to progress reported in the FY21 MS4 annual report. Given that MDOT SHA modelled load reduction targets are discounted for treatment provided by BMPs that were built prior to the 'baseline year' established for a given 8-digit watershed TMDL, MDOT SHA has also temporarily removed load reduction credit (a.k.a., existing treatment) from its target modeling for 597 SWM facilities and 81 tree planting sites whose functionality could not be verified. For this reason, MDOT SHA load reduction targets increased in FY22 across many 8-digit watershed TMDLs.

MDE stated in its 2022 document, titled "General Guidance for Local TMDL Maximum Daily Load Stormwater Wasteload Allocation Watershed Implementation Plans", that significant uncertainty remains surrounding associated load reductions and source contributions for bacteria and polychlorinated biphenyl (PCB) impairments. Accordingly, MDE it is not requiring progress modeling for bacteria and PCB local TMDLs so MDOT SHA has excluded them from Table V.A.1.e below. MDE published updated guidance documents for developing bacteria and PCB TMDL implementation plans in February and August 2022 respectively. MDOT SHA will coordinate with MDE for steps needed to meet bacteria and PCB TMDLs.

Table V.A.1.e: Progress Toward Attainment of Benchmarks and Applicable WLAs Developed Under EPA Approved TMDLs

Watershed Name	County	Pollutant	Unit	Total Reduction Target*	2025 Interim Target*	FY22 Progress: Reduction Achieved as of 6/30/2022*	FY22 Progress: % Total Reduction	FY22 Progress: % 2025 Interim Target
Chesapeake Bay TMDLs								
MS4 Area Wide	NA	Nitrogen	DEL-lbs/yr	30,170	30,170	31,713	105.1%	105.1%
MS4 Area Wide	NA	Phosphorus	DEL-lbs/yr	10,620	10,620	11,879	111.9%	111.9%
MS4 Area Wide	NA	Sediment	DEL-lbs/yr	9,705,000	9,705,000	10,522,294	108.4%	108.4%
Note: The modeling was conducted for the entire permitted area. MDOT SHA assumed a baseline year of 2011.								
Nutrient and Sediment TMDLs								
Anacostia River - Nontidal	MO	Nitrogen	EOS-lbs/yr	22,610	3,342	3,624	16.0%	108.4%
		Phosphorus	EOS-lbs/yr	1,922	1,922	2,359	122.8%	122.8%
		Sediment	EOS-lbs/yr	503,732	503,732	1,304,194	258.9%	258.9%
Anacostia River – Tidal	MO, PG	Nitrogen	EOS-lbs/yr	4,919	42	79	1.6%	189.1%
		Phosphorus	EOS-lbs/yr	576	17	32	5.5%	186.9%
		Sediment	EOS-lbs/yr	157,967	5,011	9,530	6.0%	190.2%
Antietam Creek	WA	Phosphorus	EOS-lbs/yr	280	124	45	16.1%	36.4%
		Sediment	EOS-lbs/yr	1,017,696	145,339	66,052	6.5%	45.4%
Bynum Run	HA	Sediment	EOS-lbs/yr	26,654	17,705	4,749	17.8%	26.8%
Cabin John Creek	MO	Sediment	EOS-lbs/yr	243,116	74,512	345,562	142.1%	463.8%
Catoctin Creek	FR	Phosphorus	EOS-lbs/yr	155	155	82	53.2%	53.2%
		Sediment	EOS-lbs/yr	603,315	308,204	177,288	29.4%	57.5%
Conococheague Creek	WA	Sediment	EOS-lbs/yr	537,204	63,621	34,222	6.4%	53.8%
Double Pipe Creek	CL, FR	Phosphorus	EOS-lbs/yr	1,051	686	21	2.0%	3.1%
		Sediment	EOS-lbs/yr	458,978	415,290	7,866	1.7%	1.9%
Gwynns Falls	BA	Sediment	EOS-lbs/yr	507,479	53,460	9,095	1.8%	17.0%
Jones Falls	BA	Sediment	EOS-lbs/yr	97,115	97,115	60,916	62.7%	62.7%
Liberty Reservoir	BA, CL	Phosphorus	EOS-lbs/yr	572	113	57	10.0%	50.5%
		Sediment	EOS-lbs/yr	516,390	98,312	46,953	9.1%	47.8%

Table V.A.1.e: Progress Toward Attainment of Benchmarks and Applicable WLAs Developed Under EPA Approved TMDLs

						FY22 Progress		
Watershed Name	**County**	**Pollutant**	**Unit**	**Total Reduction Target***	**2025 Interim Target***	**Reduction Achieved as of 6/30/2022***	**% Total Reduction**	**% 2025 Interim Target**
Little Patuxent River	AA, HO	Sediment	EOS-lbs/yr	600,905	600,905	658,338	109.6%	109.6%
Loch Raven Reservoir	BA, CL, HA	Phosphorus	EOS-lbs/yr	190	190	980	515.8%	515.8%
Lower Gunpowder Falls	BA	Sediment	EOS-lbs/yr	177,831	170,420	227,974	128.2%	133.8%
Lower Monocacy River	CL, FR, MO	Phosphorus	EOS-lbs/yr	1,210	1,210	1,340	110.7%	110.7%
		Sediment	EOS-lbs/yr	1,071,796	413,410	327,173	30.5%	79.1%
Marsh Run	WA	Sediment	EOS-lbs/yr	164,563	29,260	15,506	9.4%	53.0%
Mattawoman Creek	CH, PG	Nitrogen	EOS-lbs/yr	3,034	545	399	13.2%	73.2%
		Phosphorus	EOS-lbs/yr	348	73	31	9.0%	43.0%
Non-Tidal Back River	BA	Nitrogen	EOS-lbs/yr	1,362	552	268	19.7%	48.6%
		Phosphorus	EOS-lbs/yr	134	134	70	52.4%	52.4%
		Sediment	EOS-lbs/yr	258,848	58,238	41,086	15.9%	70.5%
Other West Chesapeake	AA	Sediment	EOS-lbs/yr	19,606	19,606	129	0.7%	0.7%
Patapsco River LN Branch	AA, BA, HO	Sediment	EOS-lbs/yr	507,982	330,329	253,782	50.0%	76.8%
Patuxent River Lower	AA, CH, PG	Sediment	EOS-lbs/yr	28,775	3,177	1,180	4.1%	37.2%
Patuxent River Middle	AA, PG	Sediment	EOS-lbs/yr	65,084	8,068	4,231	6.5%	52.4%
Patuxent River Upper	AA, HO, PG	Sediment	EOS-lbs/yr	43,846	43,846	27,633	63.0%	63.0%
Piscataway Creek	PG	Sediment	EOS-lbs/yr	78,624	60,270	38,033	48.4%	63.1%
Port Tobacco River	CH	Sediment	EOS-lbs/yr	27,716	2,843	2,450	8.8%	86.2%
Potomac River MO County	MO	Sediment	EOS-lbs/yr	338,576	60,591	12,834	3.8%	21.2%
Potomac River WA County	WA	Sediment	EOS-lbs/yr	204,383	55,562	52,158	25.5%	93.9%
Prettyboy Reservoir	BA, CL	Phosphorus	EOS-lbs/yr	19	19	396	2,111.3%	2,111.3%
Rock Creek	MO	Phosphorus	EOS-lbs/yr	359	359	1,008	280.9%	280.9%
		Sediment	EOS-lbs/yr	678,086	654,889	662,886	97.8%	101.2%
Rocky Gorge Reservoir	HO, MO, PG	Phosphorus	EOS-lbs/yr	53	16	9	16.7%	55.1%

Table V.A.1.e: Progress Toward Attainment of Benchmarks and Applicable WLAs Developed Under EPA Approved TMDLs

Watershed Name	County	Pollutant	Unit	Total Reduction Target*	2025 Interim Target*	FY22 Progress: Reduction Achieved as of 6/30/2022*	FY22 Progress: % Total Reduction	FY22 Progress: % 2025 Interim Target
Seneca Creek	MO	Sediment	EOS-lbs/yr	666,082	377,461	277,148	41.6%	73.4%
South River	AA	Sediment	EOS-lbs/yr	71,904	71,904	194,566	270.6%	270.6%
Swan Creek	HA	Sediment	EOS-lbs/yr	7,932	7,932	387	4.9%	4.9%
Triadelphia Reservoir (Brighton Dam)	HO, MO	Phosphorus	EOS-lbs/yr	52	52	1	2.2%	2.2%
Upper Monocacy River	CL, FR	Phosphorus	EOS-lbs/yr	58	58	112	193.1%	193.1%
		Sediment	EOS-lbs/yr	440,752	65,776	69,069	15.7%	105.0%
West River	AA	Sediment	EOS-lbs/yr	13,375	256	74	0.6%	29.0%
Trash TMDLs								
Anacostia River MO County	MO	Trash	lbs/yr	6,044	4,764	586	9.7%	12.3%
Anacostia River PG County	PG	Trash	lbs/yr	14,134	10,344	5,855	41.4%	56.6%
Patapsco - Gwynns Falls	BA	Trash & Debris	lbs/yr	2,300	2,300	433	18.8%	18.8%
Patapsco - Jones Falls	BA	Trash & Debris	lbs/yr	1,419	1,419	403	28.4%	28.4%

* "Total Reduction Target", "2025 Interim Target", and "Reduction Achieved" values have been updated to account for credit removed due to BMPs failing or missing their most recent triennial inspection

Note: For the Trash WLA MDOT SHA is required to continue practicing trash removal activities that are captured in the baseline and remove 100% of the WLA set in the TMDL documents. It is estimated that approximately 5 lbs. of trash is removed from an inlet during cleaning based on a literature review of inlet cleaning characterization studies and physically viewing MDOT SHA inlet cleaning operations.

MDE is requiring jurisdictions to remodel all baseline loads and restoration progress for nutrient and sediment TMDL implementation plans using the CBP WM Phase 6 and the MDE-developed TMDL Implementation Progress and Planning (TIPP) Tool. Following MDE issuance of the new MS4 Permit, MDOT SHA plans to complete its required remodeling efforts and submit adjusted load reduction targets and progress with the first annual report of the new MS4 Permit term. MDOT SHA intends to use the remodeled restoration needs to inform planning efforts in FY23 and FY24 for implementation of new restoration BMPs in the subsequent years so that established benchmarks and 'end date' targets for pollutant load reductions can be achieved.

MDOT SHA adaptively manages its Coordinated TMDL Implementation Plan through prompt review and incorporation of new regulatory guidance and progress modeling tools, rigorous tracking of restoration needs by watershed, and continuous investigation for new opportunities to implement effective BMPs and to collaborate with private and public sector partners. The plan is accessible online at the following web address:

https://roads.maryland.gov/mdotsha/pages/index.aspx?PageId=336

During FY22, MDOT SHA expended $66,000 on local TMDL coordination and adaptive management activities, including planning work needed to programmatically incorporate new MDE guidance documents issued for TMDL implementation plans, the new MDE TIPP tool and MS4 geodatabase schema for reporting, and the CBP WM Phase 6. MDOT SHA also reviewed the new MS4 Permits issued to other MS4 jurisdictions during FY22 against current practices by the MDOT SHA TMDL compliance program to identify adjustments that may be needed to satisfy TMDL compliance conditions anticipated for MDOT SHA's new MS4 Permit.

To advance MDOT SHA's Coordinated TMDL Implementation Plan, MDOT SHA expended $77,000 in FY22 to develop a Request for Proposals (RFP) to private industry contractors to construct new restoration BMPs necessary to meet its WLAs established for Total Nitrogen (TN), Total Phosphorus (TP), and Total Suspended Sediment (TSS) TMDLs with 2025 and 2030 end dates. MDOT SHA also expended $35,000 in FY22 advancing contractor design of a 26-acre tree planting site that will provide pollutant load reductions to the Catoctin Creek watershed (HUC: 02140305).

In FY22, MDOT SHA resumed partnership commitments with the Maryland Department of Natural Resources, Howard County, the City of Rockville, and the United States Fish and Wildlife Service that had been deferred at the end of FY20 due to the COVID-19 pandemic and associated impacts to MDOT SHA funding sources. Through these partnerships, MDOT SHA advanced design efforts for 6 new stormwater management BMPs and 4 new stream restoration BMPs that will provide pollutant load reductions for the Little Patuxent River (HUC: 02131105), Patuxent River Upper (HUC: 02131104), and Potomac River Montgomery County (HUC: 02140202) local TMDL watersheds. MDOT SHA intends to compile information for 'proposed' BMPs described herein during FY23 for reporting in the MS4 Geodatabase it submits with the FY23 MS4 annual report.

Table IV.E.5.d: TMDL Compliance Funding Levels

Fiscal Year	Funding Level (Millions)
2023	$12.5
2024	$13.5
2025	$20.6
2026	$34.9
2027	$35.1
2028	$38.5
Total 2023 - 2028	**$155.1**

In accordance with conditions in Part IV.E.5.c, a Microsoft Excel workbook containing a summary table and comprehensive list of restoration BMPs completed from 2011 to October 8, 2021; separated by contract and including associated location, impervious treatment, and cost information; is submitted electronically with this FY22 MS4 annual report. **Table IV.E.5.d** is provided in accordance with conditions in Part IV.E.5.d of the MS4 Permit and shows the anticipated levels of capital funding for TMDL Compliance activities by MDOT SHA through

State fiscal year 2028. This information is publicly accessible in the MDOT *Draft Consolidated Transportation Program* for fiscal years 2023 to 2028, published on September 1, 2022 at the following web address:

https://mdot.maryland.gov/tso/Pages/Index.aspx?PageId=27

Appendix F: Little Catoctin Creek Watershed Monitoring Implementation Document

MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

October 2022

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1 Introduction

The Maryland Department of Transportation State Highway Administration (MDOT SHA) Water Programs Division (WPD) has completed a stream restoration project on Little Catoctin Creek (LCC). The restoration extents originate at MDOT SHA bridge structure number 10081 along MD 180 (Jefferson Pike) and continues downstream approximately 3,100 LF of the existing channel. The floodplain restoration project consisted of stabilization and relocation of approximately 3,000 linear feet of Little Catoctin Creek, south of MD-180. The goals of the stream and floodplain restoration were to restore impaired vital ecosystems, and return hydrology, geomorphic, and hydraulic stream functions back to pre-development conditions within the 100-year floodplain. Construction of the Little Catoctin Creek stream restoration project was completed in April 2019.

MDOT SHA is in the process of monitoring the physical, chemical, and biological features of the project stream for five years: This report documents the findings from the fourth year of monitoring per the NPDES/MS4 Assessment of Controls for Stream Restoration of Little Catoctin Creek at U.S. 340. The following sections of this yearly report include activities for physical, chemical, and biological monitoring activities performed between March 2022 and June 2022.

2 Study Area

The Little Catoctin Creek watershed occupies 17.72 square miles (11,340.3 acres) in the southwestern corner of Frederick County in the Blue Ridge physiographic province. It flows 8.5 stream-miles southeast from its headwaters on the eastern side of South Mountain to the mouth east of the town of Brunswick and drains directly into the Potomac River. Land use in the watershed is primarily agricultural. Approximately 20 percent of the watershed draining to the study reach is forested. Impervious surface comprises less than 3 percent of the watershed (SHA 2016).

The study area is located north of the town of Rosemont between US-340 at the upstream end and Petersville Road (MD-79) at the downstream end. Within the study area, Little Catoctin Creek flows through active and old pasture. Prior to restoration, much of the riparian area (especially in reaches adjacent to MD-180) contained few trees – leaving much of the stream open to direct sunlight. Stream banks within the open pasture were steep and heavily eroded. Riffle and run habitats within the creek were predominantly cobble and gravel. Heavy deposits of fine silt and sand were found in pools and depositional areas.

3 Chemical Monitoring

Chemical monitoring of Little Catoctin Creek was performed per the chemical monitoring methodology specified in the NPDES/MS4 Assessment of Controls monitoring plan for the following monitoring efforts:

- Pre-construction phase (CHEM 1): January 3, 2017 to January 31, 2018
- Construction phase (CHEM 2): February 1, 2018 to April 15, 2019
- Post-construction phase Year 1 (CHEM 3): April 16, 2019 to April 30, 2020
- Post-construction phase Year 2 (CHEM 4): May 1, 2022 to June 30, 2022 (ongoing)

Discharge, velocity, continuous water quality measurements, and discrete water quality sample analyses made during these efforts are available through the U.S. Geological Survey's National Water Information Service (NWIS) online at: https://www.waterqualitydata.us/.

In February of 2022, EA Engineering, Science and Technology, Inc., PBC (EA) received notice to proceed from the Maryland Department of Transportation State Highway Administration (SHA) for monitoring activities in the Little Catoctin Creek, including re-establishing monitoring stations that had been removed in June 2020 during the COVID-19 pandemic. Due to manufacturer supply chain issues, the ISCO and HOBO monitoring equipment orders were delayed approximately 8 weeks from the order date, which resulted in limited recording of continuous velocity and discharge data at the upstream and downstream chemical monitoring stations during the FY22 reporting period. During the time between when EA received Notice to Proceed from MDOT SHA and waiting to receive the shipment of the continuous monitoring equipment, EA performed a cross section elevation survey and two velocity surveys at the upstream and downstream chemical monitoring stations. In June of 2022, while waiting for the ISCO monitoring equipment to arrive, HOBO KIT-D-U20-1 temperature and depth loggers were installed at both chemical monitoring locations. A baseflow sample was collected on June 6, 2022. On June 27, 2022, EA collected six discrete storm event subsamples; however, it should be noted that the storm tracked over the National Weather Service Emmitsburg MD weather station and did not track over the Hagerstown Airport weather station. It is possible that an event may be labeled as being a “storm” although precipitation did not occur at the weather station – isolated summer thunderstorms may have impacted only the LCC basin but did not impact the weather station. Since continuous monitoring equipment was not installed for this storm event the existing stage discharge relationship was utilized to calculate velocity and discharge for this event. Additionally, there was no observed response in stream discharge over the course of this storm event. Future storm events will rely on the area-velocity meter installed at the upstream chemical monitoring station to calculate discharge. The ISCO 2150 area-velocity meter was installed on June 29, 2022 and began collecting continuous velocity data in 5-minute intervals.

In June of 2022, EA began collecting continuous discharge, velocity, depth, and discrete water quality sample data at the chemical monitoring stations. The monitoring efforts through June 30, 2022 were conducted as part of the FY22 post-construction phase Year 2 (CHEM 4) first quarter chemical and flow monitoring activity, to evaluate post-construction conditions. EA collected samples for one storm event and one baseflow event during the FY22 reporting period. Figure 1 shows Little Catoctin Creek and the locations of the two USGS stream gages used for monitoring.

Figure 1. Chemical Monitoring Locations

Figure 2. Upstream chemical monitoring station (01636845)

Figure 3. Re-located downstream monitoring station (01636846)

Figure 4. FY22 relocated downstream station (Site ID 01636846) on Little Catoctin Creek near Rosemont, MD. The photo shows the HOBO logger and stream gage.

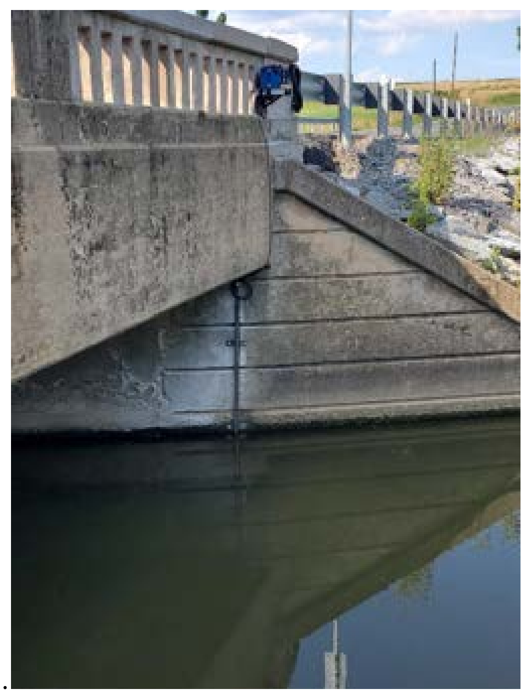

Figure 5. FY22 upstream station (Site ID01636845) on Little Catoctin Creek near Rosemont, MD. The photo shows the ISCO velocity and area flow module.

3.1 Surface Water Stage/Discharge/Velocity

In September 2016, U.S. Geological Survey established Site 01636845 (Figure 1, Little Catoctin Creek Near Rosemont, MD; upstream). This station was equipped with a radar level sensor and acoustic doppler velocity meter (ADVM) for measuring stage and velocity, respectively. In the pre-construction and construction phases of the study, 82 discrete discharge measurements were made for the purpose of calibrating these instruments, covering a range of 0.49 cubic feet per second (ft3/s) to 307 ft3/s. These measurements establish the relation between stage-velocity and discharge. Thirty-six manual calibration measurements were made between July 1, 2018 – June 30, 2019, which includes the period when the gage was decommissioned following the historic flood in 2018 and again at the start of the stream reconstruction work (January 18, 2019 – May 23, 2019). The gage was rebuilt using a radar water-level measuring system mounted aside the Rte. 180 Bridge and began operating in April 2019. Since then, 39 additional discharge measurements were made through July 2020 to recalibrate the stage-discharge relation. Because of the construction of the pond directly downstream of the bridge, the ADVM equipment could not be reinstalled at the upstream station, so water velocity entering at the upstream station (the pond) is not available for the post-construction during this period. The USGS station was removed in June 2020. However, in June 2022, EA installed new monitoring equipment on the Jefferson Pike Route 180 bridge and re-established the upstream chemical monitoring station 01636845 (Figure 2).

In December 2016, U.S. Geological Survey established the downstream site 01636846 (Little Catoctin Creek at Rosemont, MD). This site was instrumented with an ADVM to measure stream velocity. In September 2017, a bubbler-style gage unit was installed at this site to record stage needed for the computing discharge. Historic observations can be found at:

https://waterdata.usgs.gov/nwis/inventory/?site_no=01636846&agency_cd=USGS

Discharge at the downstream station was deemed necessary because of the possibility that construction would enhance groundwater flow into the stream through the channel bottom. In addition, numerous springs and seeps were observed along the banks of the Little Catoctin Creek that likely contribute to the stream flow. Measurement of volumetric discharge concurrently at both the upstream and downstream stations allow quantification of the changes through the reach, and changes that may be attributed to the restoration effort. Methods used in this work follow USGS procedures in USGS Techniques of Water-Resources Investigations (Book 3, Chapter A8) available at https://pubs.usgs.gov/tm/tm3-a7/tm3a7.pdf and https://pubs.usgs.gov/twri/twri3a8/.

During the study, 284 and 261 discrete discharge measurements were made at the upstream and downstream sites, respectively, ranging from 0.54 ft3/s to 824 ft3/s at the upstream site, and 0.49 to 2,100 ft3/s at the downstream site. The difference in ranges due to the disruption the upstream station caused by the 2018 flood. These discrete measurements help ensure the accuracy of the continuous discharge measurements required for evaluating the rehabilitation.

In June of 2022, with guidance from SHA, EA proposed and established an alternate downstream chemical monitoring station (Figure 3) due to safety and accessibility concerns of collecting storm samples via wading into the stream at the original downstream monitoring station. A HOBO KIT-D-U20-1 logger and stream gage are installed at the new downstream chemical monitoring station (Figure 4). This alternate downstream chemical monitoring station is located downstream of the previous station at coordinates Northing 185568.226199999 and Easting 346207.164300002 (Maryland North American Datum 1983 (NAD 83)).

In June 2022, EA began collecting continuous velocity and flow data in 15-minute intervals with an ISCO 2150 area velocity flow module mounted to the Jefferson Pike Route 180 bridge at the upstream chemical monitoring station 01636845 (Figure 5). EA also began collecting continuous temperature and depth data in five-minute intervals using HOBO KIT-D-U20-1 loggers installed at the upstream 01636845 and downstream 01636846 chemical monitoring stations beginning in June 2022. Pre- and post-restoration historic observations can be found online at:

https://nwis.waterdata.usgs.gov/md/nwis/uv/?site_no=01636845

As part of continued post-construction monitoring, EA conducted stream velocity surveys and stream geomorphic surveys at both the upstream and downstream stations on May 19, 2022 and June 16, 2022. Stream discharge was determined from the velocity survey and continuous depth/velocity data and compared to the pre-construction USGS rating curves (Figure 6 and Figure 7). The USGS shift-adjusted rating curves are shown to not reflect current stream hydrodynamics, so a new controlled rating curve was fit to the paired stage-discharge data using the following equation:

$$Q = a \times (WSE - e)^b$$

Where:

Q = discharge in ft3/s,

WSE = water surface elevation in NAVD88 feet,

e = ineffective flow elevation in NAVD88 feet, and

a and b = rating curve coefficients.

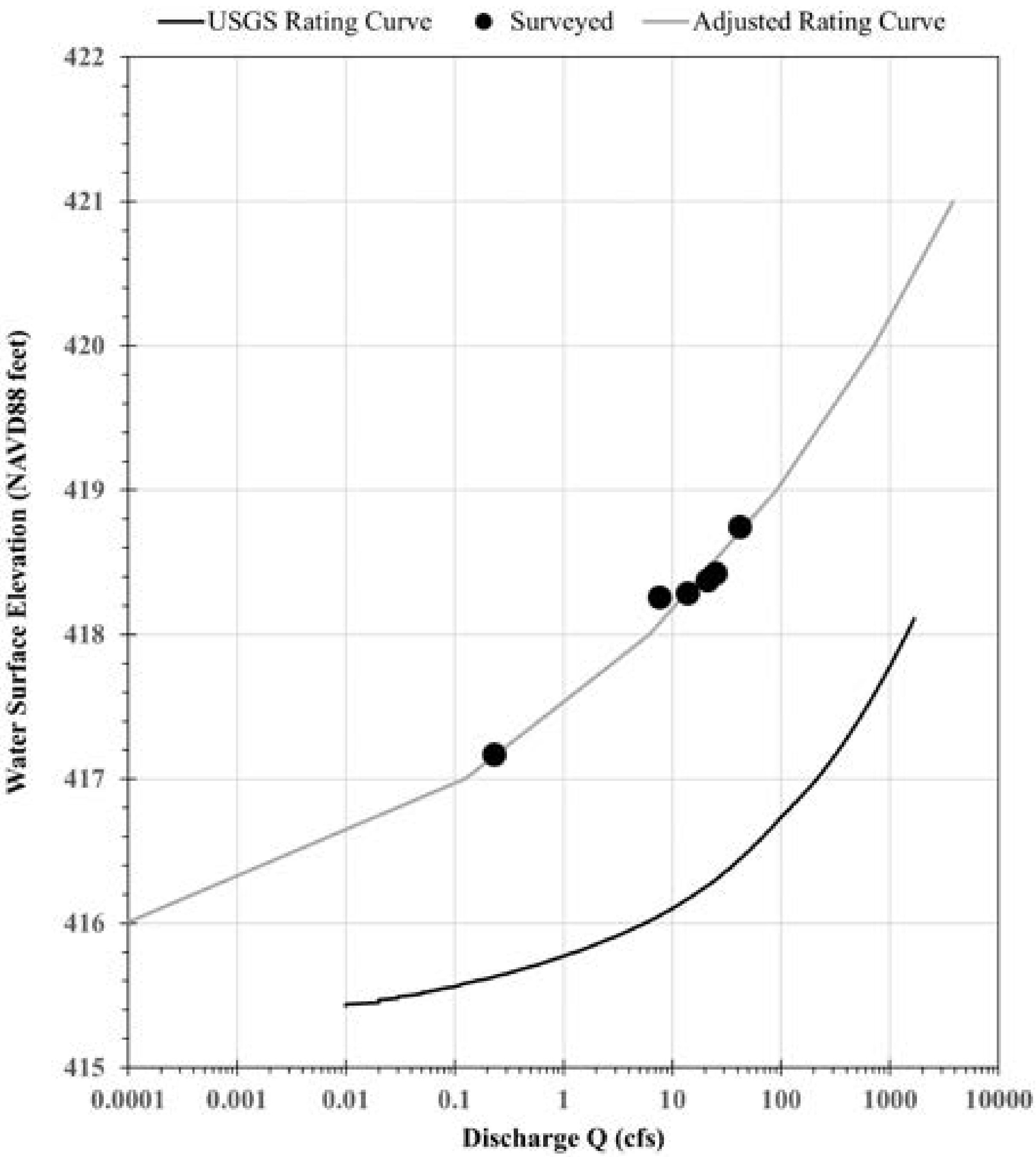

Figure 6. Upstream station (Site 01636845) rating curve

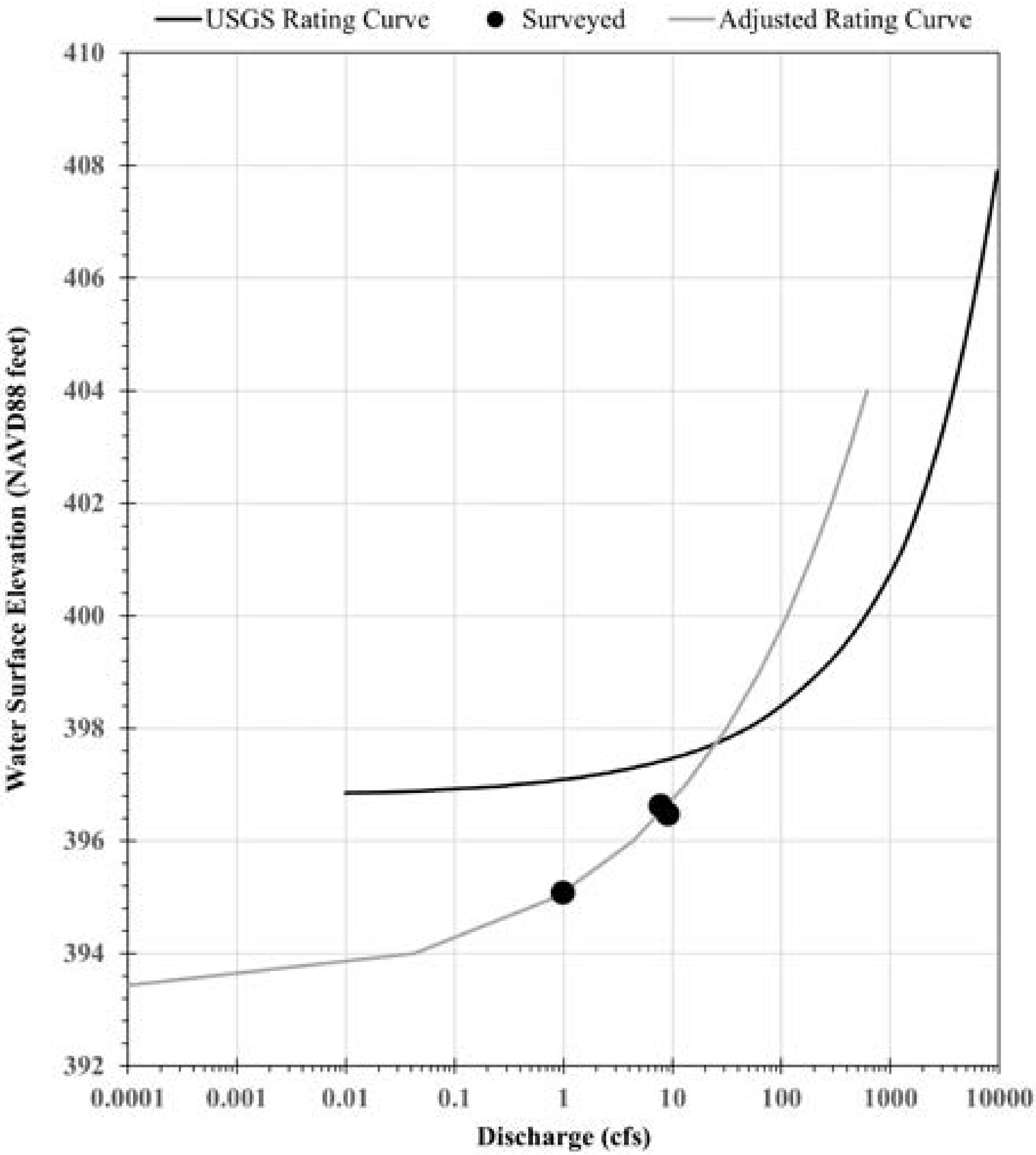

Figure 7. Downstream station (Site 01636846) rating curve

3.1.1 Summary of Discharge and Velocity Data

The continuous discharge and water velocity data were downloaded, tabulated, and inspected for completeness, where completeness is defined as the percent of time when measurements were recorded compared to the total time of gage operation. Completeness is an important consideration when attempting to compare hydrologic and chemical parameters among time periods. For example, extended periods of missing data will greatly hinder the ability to compare volumes and loadings among pre- and post-construction periods. Data loss is the result of equipment failures, icing, or other unforeseen incidents such as major floods. Another factor is the percentage of data “approved” by the USGS for use. Hydrologic data collected by the USGS undergoes a rigorous review process before becoming “approved”, with data classified as “provisional” being subject to change upon USGS review.

A summary of the continuous hydrologic data is presented in Table 3-1. This data are divided into four intervals as follows:

1. Entire study period (January 3, 2017 – June 30, 2020)
2. Pre-construction period from the initiation of sampling (January 3, 2017) until construction started on January 31, 2018
3. Construction period from February 1 2018 to April 15, 2019; and
4. Post-construction period from April 16, 2019 to June 30, 2020 when the study was suspended.

As previously discussed, the gaging equipment at the upstream station was removed for 126 days (beginning on January 18, 2019) because of the floodplain restoration work. The gage was reinstalled and began operating again at the end of the construction work. This explains the low percentage of the discharge record in Table 3-1 for the construction period.

As was the case in the pre- and construction phases, discharge and gage heights during the post-construction phase are higher at the downstream station than in the upstream station – indicating the Catoctin Creek study is a gaining reach. Median discharges for post- construction are 2.86 ft3/s (maximum of 842 ft3/s) upstream and 3.53 ft3/s (maximum 918 ft3/s) downstream. The difference in medians between upstream and downstream (downstream minus upstream = 0.67 ft3/s) can be interpreted as the yearly groundwater input to the stream over this period. A smaller difference, 0.14 ft3/s, existed between the medians of the upstream and downstream stations during the pre-construction period.

Comparing discharge measured concurrently at the upstream and downstream stations indicates that discharge increases by approximately 15% through the stream reach (8% difference for the pre-construction phase, and 21% for the post construction phase). Any “missing” discharge values, such as occurred at the upstream station during the construction period, can be estimated as being roughly 80% of the discharge measured downstream.

Velocity data for the two stations in the post-construction period of the study are still under evaluation by USGS surface water technicians; and the raw data were not fully available at the time this report was being produced. As shown in Table 3-1, only about 11% of the possible velocity measurements for the post-construction period were available for inspection at the time this report was prepared, and as mentioned previously, velocity data were only obtained at the downstream station. Velocities in this reduced data set ranged from 0.001 to 7.34 ft/s with a median of 0.235 ft/s. Until the velocity data are fully processed and approved, it is not possible to evaluate the effects the restoration work had on the water velocity through the reach.

Recording of continuous velocity and discharge data for the FY22 reporting period was initiated on June 29, 2022. Due to the limited amount of data recorded during the FY22 reporting period continuous velocity and discharge data will be processed and reported in the next annual report.

Table 3-2 is a summary of precipitation data for the site during the project study. The rain gage at the site began operation on 2/25/18, so precipitation data were not available the pre-construction monitoring period. The precipitation record is sporadic through the construction and post-construction period due to problems with the rain collection equipment. To maintain consistency, the precipitation record from the Hagerstown Regional Airport, retrieved from NOAA website (https://www.ncdc.noaa.gov/data-access) was used to calculate precipitation totals and intensities for the sampled storm events. As is evident in this table, total precipitation varied considerably during the pre-, construction, and post construction periods. During FY20, 32.25 inches of precipitation fell over the 367 days (start and end dates inclusive) in the year. During the construction period, several very large storms occurred, including the 100-year record storm, resulting in over 2 times more precipitation than was measured in the pre- and post-construction periods. Roughly 1.5 inches more precipitation fell in the post-construction interval than in the pre-construction. During FY22, EA retrieved precipitation data from the National Weather Service NOAA online weather data web site (https://www.weather.gov/wrh/climate?wfo=lwx) from the Emmitsburg MD weather station. The Emmitsburg weather station recorded precipitation data for the 27 June storm event sample. Due to the quick changes in the paths of isolated summer thunderstorms that impact the LCC basin, the NWS weather station which recorded the most representative rainfall data compared to what was observed on site during storm events were chosen for rainfall data. For example, the Emmitsburg weather station recorded rain fall data for the 27 June storm sample and the Hagerstown Regional Airport which recorded precipitation due to the course of the storm. Precipitation for the FY22 reporting period was recorded for the months of May and June totaling 10.51 inches of rainfall over 61 days.

Table 3-1. Summary statistics of discharge, water velocity, and precipitation recorded at the upstream (1636845) and downstream (1636846) stations on Little Catoctin Creek, Md
[ft, feet; ft3/s, cubic feet per second; ft/s, feet per second; in, inches; min, minutes; --, not available]

	Gage height (ft)	Discharge (ft^3/s)	[2]Velocity (ft/s)	[1]Precipitation (in. per 5 min.)
UPSTREAM (1636845)				
Pre-construction 1/3/17 – 2/1/18				
% of data available	98	92	97	na
% of data "Approved"	100	100	0	na
Maximum	5.59	454	2.92	na
Minimum	0.16	0.36	0.0	na
Median	1.12	1.74	0.10	na
Construction 2/2/18 – 4/15/19				
% of data available	70	97	23	54
% of data "Approved"	100	100	0	100
Maximum	8.96	9050	7.28	0.30
Minimum	0.88	1.08	0.00	0.00
Median	1.75	5.78	0.20	<0.01
Post-construction 4/16/19 to 6/30/20				
% of data available	78	87	na	86
% of data "Approved"	44	49	na	100
Maximum	4.51	842	na	0.48
Minimum	1.93	0.32	na	0.00
Median	2.58	2.86	na	<0.01

[1] Statistics are for precipitation recorded at the upstream USGS station, which began operation on 2/25/18. Precipitation amounts are collected at 5-minute intervals.

[2] Post-construction data for velocity measured at the downstream station are still be processed and were not available at the time this report was being prepared. The velocity measuring equipment was removed at the upstream site in April 2019 after construction on the pond was started.

Table 3-1. Summary statistics of discharge, water velocity and precipitation data recorded at the upstream (1636845) and downstream (1636846) stations on Little Catoctin Creek, Md. – Continued.
[ft, feet; ft^3/s, cubic feet per second; ft/s, feet per second; in, inches; min, minutes; --, not available]

	Gage height (ft)	Discharge (ft^3/s)	[2]Velocity (ft/s)
DOWNSTREAM (1636846)			
Pre-construction 1/3/17 – 2/1/18			
% of data available	35	95	97
% of data “Approved	100	100	68
Maximum	5.03	562	2.92
Minimum	1.32	0.38	-0.23
Median	1.44	1.88	0.11
Construction 2/1/18 – 4/15/19			
% of data available	99	98	26
% of data “Approved	99	98	0
Maximum	12.1	9,630	7.28
Minimum	1.22	0.33	-0.64
Median	1.65	6.95	0.20
Post-construction 4/16/19 to 6/30/20			
% of data available	98	98	11
% of data “Approved	45	45	0
Maximum	4.82	918	7.34
Minimum	1.32	0.46	0.001
Median	1.40	3.53	0.235

[1] Statistics are for precipitation recorded at the upstream USGS station, which began operation on 2/25/18. Precipitation amounts are collected at 5-minute intervals.

[2] Post-construction data for velocity measured at the downstream station are still be processed and were not available at the time this report was being prepared. The velocity measuring equipment was removed at the upstream site in April 2019 after construction on the pond was started.

Table 3-2. Summary of monthly precipitation at Hagerstown Regional Airport during the pre-construction, construction, and post construction phases of the study.

Table 3.2 Pre-construction 1/3/18 to 2/1/18		Construction 2/2/18 to 7/15/19		Post construction 4/16/19 to 6/1/20		[1]FY22 5/1/22 to 6/30/22	
Month and year	Total ppt. inches	Month and year	Total ppt. inches	Month and year	Total ppt. inches	Month and year	Total ppt. inches
Jan-17	2.75	Feb-18	3.88	Apr-19	3.14	May-22	7.22
Feb-17	1.35	Mar-18	1.96	May-19	5.73	Jun-22	3.34
Mar-17	2.83	Apr-18	4.12	Jun-19	2.12		
Apr-17	2.37	May-18	4.64	Jul-19	4.37		
May-17	5.32	Jun-18	4.97	Aug-19	2.4		
Jun-17	2.74	Jul-18	5.96	Sep-19	0.48		
Jul-17	5.35	Aug-18	6.24	Oct-19	5.25		
Aug-17	2.9	Sep-18	9.31	Nov-19	0.8		
Sep-17	1.45	Oct-18	1.63	Dec-19	3.05		
Oct-17	3.54	Nov-18	2.46	Jan-20	2.75		
Nov-17	1.62	Dec-18	4.87	Feb-20	1.71		
Dec-17	0.81	Jan-19	3.43	Mar-20	2.57		
Jan-18	2.62	Feb-19	2.97	Apr-20	4.53		
		Mar-19	4.21	May-20	1.55		
		4/16/2019 end	0.99				
Total precipitation	35.65		61.64		40.45		10.56
Total days	395		438		413		61

[1] FY22 data retrieved from NOAA Emmitsburg weather station.

3.2 Continuous Water Quality

In November and December 2016, multiparameter water quality sondes (YSI EXO-2) were installed at site 01636845 and 01636846, respectively. These sondes measure temperature, specific conductivity, pH, and turbidity at 5-minute intervals. The sondes have been operational since installation and historic data are available on the NWIS website listed above. As mentioned previously, due to the restoration activities, the upstream data sonde was removed 1/18/19 and returned to operation on 4/9/19. The sondes were permanently removed on June 30, 2020 when the USGS sampling stations were dismantled.

3.2.1 Summary of Available Continuous Water Quality Data

The continuous water-quality data measured using the data sondes were retrieved from NWIS, inspected for completeness, and tabulated. Short periods of missing data were replaced using the average of the measurement at the beginning and end of each missing interval. Temperature, specific conductance, pH, and turbidity data are summarized in Table 3-2. In FY22, discrete water quality measurements were performed in-situ during sampling events and are included in Attachment A of this report.

Several characteristics are noteworthy in these summary data:

1. pH – the elevated pH values, above 8.0 and even 9.0 standard units, in the FY20 data set remain marked as "provisional" data and thus are subject to change upon review. However, pH's>9.0 are found in the pre-construction, construction, and post-construction continuous record. The presence of pH's >8.0 at both the upstream and downstream stations, occurring in all construction periods, supports that elevated pH's are real and not the result of instrument artifacts.

   1.1 In all construction periods, pH's >8.0 occur between May and October at both the upstream and downstream stations. pH's above 8.0 were not found in any of the chemical samples collected during the study (discussed below).

   1.2 pH's >8.0 occur when specific conductance ranges from approximately 200-370 µS/cm. At both the upstream and downstream stations, SC's over 2,000 µS/cm were measured at both stations. There does not appear to be a clear relation between elevated pH's and SC.

2. Temperature – Water temperatures in excess of 90oF have been measured in the stream at both stations. However, these elevated temperatures occur during <1% of the total time covered by each of the project phases. Temperatures exceeding 80oF occur during less than 5% of the time covered in each construction interval. Higher temperatures occur during the summer months and correlate with low gage heights and discharges.

3. Turbidity – Turbidity correlates with discharge and water velocity (where data are available), as expected – during storms high discharges increases the mass of sediment transported in the stream. Median turbidity values show that in both the pre- and post-construction periods, higher turbidity was measured at the upstream station compared with the downstream station. Very high turbidity was measured at both the upstream and downstream stations during the construction period, however, the downstream station had a higher median turbidity. It should be noted that the median turbidities are very low for natural waters; the best indicator for the effect of the construction activity would be the number of peaks in turbidity at the downstream station not associated with rain events.

Table 3-3. Summary statistics of continuous water quality data recorded at the upstream (1636845) and downstream (1636846) stations on Little Catoctin Creek, Md
[FNU, formazin nephelometric units; µS/cm, micro-siemens per centimeter; F, degrees Fahrenheit]

	Turbidity (FNU)	Specific conductance (µS/cm)	Water temperature (°F)	[3]pH (standard Units)
UPSTREAM (1636845)				
All Data 1/3/17 to 6/30/19				
% of data available[1]	87	89	86	90
% of data "Approved"[2]	87	87	92	88
Maximum	2,260	2,470	91.8	9.4
Minimum	0.8	54	31.6	5.3
Median	6.1	322	56.8	7.3
Pre-construction 1/3/17 – 2/1/18				
% of data available	82	84	86	84
Maximum	2,010	1,980	80.4	8.8
Minimum	1.3	135	31.6	6.9
Median	6.1	349	53.9	7.3
Construction 2/1/18 – 4/15/19				
% of data available	67	69	67	70
Maximum	2,260	2,470	87.8	9.4
Minimum	0.8	54	32.0	5.3
Median	5.1	295	54.7	7.4
Post-construction 4/16/19 to 6/31/20				
% of data available	94	98	98	94
% of data "Approved"[2]	82	83	83	82
Maximum	2,220	879	91.8	9.5[3]
Minimum	1.2	61	32.0	6.9
Median	6.5	283	59.0	7.5

1. Percent of data available is equal to the total number of recorded measurements divided by the total number of possible measurements in time period, time 100. Measurements were made at 5-minute intervals.
2. Percent of data approved is equal to the total number of recorded measurements that are stamped "Approved" divided by the total number of measurements made, times 100.
3. The very high pH values were reported in data still labeled as "provisional" and are subject to change.

*Table 3.2. Summary statistics of continuous water quality data recorded at the upstream (**1636845**) and downstream (**1636846**) stations on Little Catoctin Creek, Md. – Continued.*
[FNU, formazin nephelometric units; µS/cm, micro-siemens per centimeter; F, degrees Fahrenheit]

	Turbidity (FNU)	Specific conductance (µS/cm)	Water temperature (ºF)	pH (stnd. Units)
DOWNSTREAM (1636846)				
All Data 1/3/17 to 6/30/19				
% of data available[1]	89	88	90	87
% of data "Approved"[2]	99	99	89	99
Maximum	270	2,070	94.6	9.8[3]
Minimum	1.3	47	31.6	6.8
Median	5.1	325	57.2	7.4
Pre-construction 1/3/17 – 2/1/18				
% of data available	78	76	80	78
Maximum	2,040	1,300	86.5	9.4
Minimum	1.3	51	31.6	7.1
Median	4.0	361	56.3	7.4
Construction 2/1/18 – 4/15/19				
% of data available	99	98	100	95
Maximum	2,170	2,070	88.7	9.8[3]
Minimum	1.3	47	31.8	6.8
Median	6.0	300	51.4	7.4
Post-construction 4/16/19 to 6/30/20				
% of data available	96	99	99	97
% of data "Approved"[2]	100	100	100	100
Maximum	2,170	643	94.6	9.6
Minimum	1.1	99	32.2	7.0
Median	5.5	296	59.9	7.5

1. Percent of data available is equal to the total number of recorded measurements divided by the total number of possible measurements in time period, time 100. Measurements were made at 5-minute intervals.
2. Percent of data approved is equal to the total number of recorded measurements that are stamped "Approved" divided by the total number of measurements made, times 100.
3. The very high pH values were reported in data still labeled as "provisional" and are subject to change.

3.3 Discrete Water Quality

The goals of the water-quality sampling are: (1) to fulfill monitoring requirements outlined in the NPDES/MS4 assessment of controls permit; (2) to facilitate calculation of nutrient and sediment loads or yields; and (3) to document the changes in loads of sediment and nutrients caused by the floodplain restoration. Water-quality sampling was also used to verify cross-channel homogeneity in suspended sediment (SS) and dissolved species, and to provide data for generating relationships between turbidity and suspended-sediment concentration (SSC).

During storm events, samples are collected during the rise, peak, and falling stages of the hydrograph. These three samples, termed sub-samples, are weighted using the stream discharge at the time of sampling, and then summed to determine the mean concentration for the event, termed EMC:

$$\text{EMC} = \sum_{1}^{n} \left(\frac{\text{Qt}}{\text{QTotal}}\right) * \text{Ct}$$

Where:

EMC is the event mean concentration

Qt is the instantaneous discharge at the time (t) of sub-sample was collected

QTotal is the sum of the instantaneous discharges at times the sub-samples were collected

Ct is the concentration of component measured in sub-sample collected at time t

n is the number of sub-samples collected (2 to 5)

During most storm events, three sub-samples were obtained at each station; however, on some occasions, fewer sub-samples were obtained because of equipment failure or other unavoidable conditions. A few events multiple sub-samples, up to 5, were collected to provide replicate data needed to evaluate variability and precision. When available, replicate samples were included in the calculation of EMC.

Sub-samples were collected either manually by wading or by using automatic samplers. When the stream was wadable (during low-flow and sometimes during the falling stage), composite samples were prepared from 10 vertically depth-integrated grab samples obtained at equally spaced intervals across the stream. These grab samples are composited in a plastic churn, mixed, and sub-sampled for the various analytic protocols. During storm events when wading is not possible (typically the rising and cresting stages), the autosamplers are used to collect discrete samples for nutrient and sediment (either suspended-sediment concentration SSC, or total suspended solids (TSS) and bacteriological constituents. In contrast to wading, automatic samplers collect a sample from a point in the stream. Total petroleum hydrocarbon (TPH) samples were always collected manually (whenever possible), resulting in fewer sub-samples for this constituent.

Over the course of the study, the autosamplers were calibrated by making cross-sectional measurements of turbidity and specific conductance (SC) while the autosampler was collecting point samples for SSC, conductivity, and turbidity. Cross-channel turbidity is used to evaluate the distribution of suspended materials across the channel, while SC is used to evaluate the cross-channel mixing of dissolved constituents by turbulence. SSC can be related to turbidity (and possibly also to discharge), thereby allowing the continuous turbidity record to be used as a surrogate of SSC. The data collected to date show the stream is well mixed with respect to suspended and dissolved materials, and therefore, samples collected by autosamplers are comparable to those collected manually and are considered to accurately represent conditions in the stream. Calibration sampling was re-initiated at this station after sampling equipment was re-installed in April 2019.

Samples collected during times of low-flow are used to represent baseflow chemistry - these may not represent “baseflow” in the strict hydrologic sense; that is, baseflow being the groundwater contribution of the channel flow. Baseflow sampling was conducted only if precipitation had not occurred within 7 days prior to sampling and the stage was low and steady. As discussed below, baseflow discharge ranged from 0.60 to 1.63 ft3/s, with higher values generally in winter months and during the construction period.

Samples for analysis of constituents that make up TPH were collected manually as grab samples (during both storm and baseflow) and were not composited across the stream. TPH samples are collected using a stainless-steel weighted sampler that holds multiple VOC vials. Because samples for TPH were collected manually, some storm events are represented by only 1 or 2 sub-samples (because of non-wadable conditions). During storms, samples for bacteriological analysis were collected into sterilized plastic bottles by the autosamplers.

Table 3-4 summarizes the number of storm and baseflow events, and the discrete sub-samples collected for nutrients, bacteriological, and TPH constituents. In total, 61 events were sampled at the upstream site, and 64 at the downstream site. Baseflow was sampled 14 times at the upstream site and 17 times at the downstream station. A total of 166 sub-samples were collected at the upstream station for chemical analysis, 72% were obtained using an autosampler. At the downstream site, of the 158 sub-samples collected for chemical analysis, 71% were obtained using the autosampler. A total of 327 samples have been collected at the upstream and 309 at the downstream for SSC; fewer samples were collected for TSS (161 and 154, respectively). Bacteriological samples were collected during all of the storms, totaling 163 and 159 samples at the upstream and downstream stations, respectively. TPH sub-samples totaled 110 and 105 at the upstream and downstream stations, respectively. As mentioned earlier, fewer samples for TPH constituents were collected because of the need to use manual collection methods. As shown in table 3.4, the number of samples for which EMCs were calculated was identical (20) in the pre- and post-construction period. Almost two-times as many samples for SSC were collected in the pre- than in the post-construction phase, which is due to the calibration of the autosamplers.

Upon completion of analyses, results are uploaded into the U.S. Geological Survey's NWIS and are made available at https://water.usgs.gov/owq/data.html#USGS. In addition to the storm and baseflow events, a variety of field and equipment blanks were prepared and analyzed for quality assurance purposes. These data can also be available from the USGS-Md Water Science Center.

In June of FY22, EA resumed collecting baseflow and storm event samples at the upstream and downstream chemical monitoring stations. One baseflow event and one storm event were sampled during this time period. Three discrete sub-samples were collected during the storm event at each chemical monitoring station. Discrete storm samples were collected manually by wading into the stream during the rising, peak, and falling stages of the hydrograph. In total, eight discrete sub-samples were analyzed at Eurofins Lancaster Laboratories, Inc. in Leola PA, for Biochemical Oxygen Demand, Total Kjeldahl Nitrogen, Nitrate plus Nitrite, Total Suspended Solids, Total Petroleum Hydrocarbons, Total Lead, Total Copper, Total Zinc, Total Phosphorus and Hardness. Eight discrete sub-samples for E. Coli were analyzed at Fountain Valley Analytical Lab located in Westminster, MD. Laboratory analytical reports are included in Attachment A.

Table 3-4. Summary of samples collected at the upstream (1636845) and downstream (1636846) stations on Little Catoctin Creek, Md.

	Total number of samples for EMC calculation	Number of sample sets collected during storms (2 or 3 sub-samples)	Number of sample sets collected during baseflow (1 sample)	Number of sub-samples collected for chemical analyses	Number of sub-samples collected for SSC	Number of sub-samples collected for TSS	Number of sub-samples collected for bacteria	Number of sub-samples collected for TPH
UPSTREAM 1636845								
All samples 1/3/17 to 6/30/22	61	50	14	166	327	161	163	110
Samples collected in FY22	1	1	1	4	NA	4	4	4
Samples collected during preconstruction 1/23/17 to 1/31/18	20	14	7	52	127	49	50	39
Samples collected during construction 2/1/18 to 4/15/19	21	18	4	56	147	54	54	40
Samples collected during post-construction 4/16/19 to 6/30/22	20	18	3	58	53	58	59	31
DOWNSTREAM 1636846								
All samples 1/3/17 to 6/30/22	64	48	17	158	309	154	159	105
Samples collected in FY22	1	1	1	4	NA	4	4	4
Samples collected during preconstruction 1/23/17 to 1/31/18	19	11	8	46	115	43	46	37
Samples collected during construction 2/1/18 to 4/15/19	24	19	5	55	144	54	56	39
Samples collected during post-construction 4/16/19 to 6/30/22	21	18	4	57	50	57	57	29

3.4 Conditions During Sampled Storm and Baseflow Events

The discharge and precipitation during each event were tabulated and inspected for completeness. To calculate the total discharge for an event, the volume of water passing the gage during each 5-minute interval between measurement was calculated and then summed for the period of interest:

$$Q_{\text{total}} = \sum_{start}^{finish} \Delta t * Qt * K$$

Where
Qt is the total volume of water in liters
Δt is the time step between measurements, typically 5 minutes
Qt is the instantaneous discharge measured at time t
K is a constant to change ft3/s to liters/minute (1699)

It is important to standardize the time over which discharge volumes were calculated for an event. Summation of discharge started at 0:00 on the day when the stream gage height first responded to precipitation and continued to 23:55 on the day the gage height returned to (or near) pre-storm heights. For some events, precipitation occurred again after sampling was completed but before the stage returned to its original pre-storm level. In these cases, the volume summation was ended at the time when the lowest post-storm gage height was reached. Volumes for baseflow samples were calculated for the 24-hours (0:00 to 23:55) of the sampling date, which results in volumes in units of L/day.

As mentioned above, the precipitation record at the upstream site was sporadic, so it was necessary to use precipitation data collected at the Frederick Airport. Data are recorded at the airport station every time 0.01-in of rain was collected. In FY22, EA retrieved precipitation data from the NWS Emmitsburg weather station. Rainfall amount and intensity was determined by summing the precipitation volume that occurred over the defined interval of the event. Intensity was then calculated by dividing the total precipitation by the minutes between the times when the first and the final precipitation were recorded. Storm events were tracked by the EA project manager via forecasting by the National Weather Service. During storm event sampling, EA personnel arrived on-site prior the start of precipitation and remained on-site until the end of precipitation. Stream stages were estimated by visual observations of the stream gages on-site, and precipitation was measured via on-site rain gages during storm events. The precipitation record at the site was sporadic, so it was necessary to use precipitation data collected at the Emmitsburg, MD weather station.

A summary of the conditions at LCC during the storm and baseflow events is provided in Table 3-5 and includes the date the first sample of the event was collected, the phase of the study (pre-construction, construction, and post-construction), whether upstream or downstream samples were collected, the rainfall amount and intensity, the maximum discharge reached at the upper sampling station, and the total volumes of water passing the two stations. Because the precipitation data listed in this table is from the Hagerstown Regional Airport or Emmitsburg National Weather Service station, it is possible that an event may be labeled as being a “storm” although precipitation did not occur at the weather station – isolated summer thunderstorms may have impacted only the LCC basin but did not hit the weather stations.

To evaluate how the sampling effort represented the flow regimes that occur in LCC, discharge recorded at the upstream station at the time each sub-sample was collected was compared with the percentile rankings of discharge in the river for the period October 1, 2016, through June 30, 2022 (Table 3-6). The percentile discharges at the downstream station (not shown) are slightly greater than those at the upstream station, again indicating this is a gaining reach of the stream. The largest number of sub-samples were collected during times when the discharge was at or above the 99th percentile (>75.7 ft3/s) – the highest flow, followed by samples collected at moderate flows (4.64-8.89 ft3/s). Thus, the sampling effort produced data that provides a good representation of the water-quality during moderate and high flow regimes. Almost equal numbers of samples were collected in the pre- and post-construction phases when discharge was very low, in the 10th percentile range <1.33 ft3/s.

3.5 Event Mean Concentrations

Event Mean Concentrations (EMCs) for all samples collected in this study (January 3, 2017 through June 30, 2022) are summarized in Table 3-7. With the exception of TPH, the EMCs values presented in this table are calculated with "non-detect" concentration in a sub-sample replaced with the corresponding MDL concentration. For the TPH, the EMC values were calculated with 'non-detected' values replaced with a null concentration (not considered in the EMC calculation). Samples with TPH reported as "nd" indicates that all components of TPH were below their respective MDLs. EMCs for the sampled events are presented in Table 3-8.

The following points summarize and help understand how EMCs were calculated.

1. Concentrations of all compounds except TPH in sub-samples that were reported as less-than the method detection level (MDL) were replaced with the MDL for the purpose of calculating EMCs. Few sub-samples had inorganic species reported below their MDL; only BOD, zinc and total suspended solids (TSS) had multiple analyses reported below the MDLs. Because MDL values were used, any load calculated using these EMCs should be considered to be estimated maximum loads.

2. Event mean concentrations were also calculated by replacing non-detected (below MDL) concentrations with 0. These EMCs are not discussed in this report, and any load calculated with these EMCs should be considered a minimum.

3. Total Kjeldahl nitrogen was calculated as the sum of the dissolved organic nitrogen and dissolved ammonia.

4. The Total Kjeldahl Nitrogen result from the June 6, 2022 baseflow sample produced a result of 200 mg/L which is approximately 50 times higher than TKN results from previous studies. EA requested that the analytical laboratory verify this result and rerun the analysis. Unfortunately, no additional sample remained after the initial analysis and this value could not be verified. Due to these circumstances this result is suspected to be attributed to laboratory error due to a miscalculation of the dilution factor. EA recommended SHA remove this result from the data set.

5. Because EMCs were calculated as sums of sub-sample concentrations weighted by discharge, some EMCs are below the MDL for the constituent. This occurred in only a few cases and are noted in tables.

6. TPH. Several analytic methods are available for measuring TPH in water samples; different methods may produce different TPH depending on the analytes included in the method. In this work, five organic compounds were summed to obtain a TPH value, these compounds are: toluene (before 9/2018 MDL = 0.05 µg/L; then increased to 0.20 ug/L); benzene (MDL=0.026 µg/L); ethylbenzene (MDL=0.036 µg/L); o-xylene (MDL=0.032 µg/L); and methyl tert-butyl ether (MTBE, MDL = 0.1). Note the detection levels for toluene changed over the study. Because the TPH is calculated by summing various constituent compounds, the MDL for TPH cannot be lower

than the highest MDL for any one constituent – in this case, the MDL for TPH is set by the toluene MDL of 0.1 or 0.2 ug/L (depending upon date of sample).

However, if one component was found at a quantifiable concentration (that is, above its individual MDL) in only 1 of the sub-samples collected for a storm, and was below the toluene MDL, then the TPH_EMC0 concentration was reported as the quantifiable concentration. In other words, the toluene concentration is considered to actually be 0. When the TPH_EMC0 value was calculated and no individual component of the TPH was found quantifiable in any sub-sample, then the concentration is reported as 0 with the MDL for toluene of 0.1 or 0.2 ug/L used for TPH. It should be noted that although an EMC is provided for TPH (set by the MDL of toluene), in most sub- samples none of the TPH constituents were found in a quantifiable concentration; there is no evidence that TPH was present in the stream water during these events.

A few noteworthy observations can be made regarding TPH in the LCC samples from either the upstream of downstream sampling stations.

A. In FY20 samples, compounds that comprise TPH were found at quantifiable concentrations in only 3 sub-samples at the upstream station, that being for benzene (0.01 ug/L sampled on 10/7/19 and 0.02 ug/L sampled on 10/22/19 and 0.02 for the sample collected on 11/24/19). For FY20 samples from the downstream station, quantifiable concentrations were found in three samples: 0.02 ug/L for benzene in the sample from 10/22/19; 0.02 ug/L for benzene in the sample from 10/30/19; and 0.02 ug/L for xylene in the 4/30/20 sample.

B. Prior to FY20, quantifiable concentrations of organic constituents in the sub-samples were found in samples collected on 1/23/17 (both stations), 3/1/17 (upstream), 3/31/17 (both), 4/6/17 (both), 5/5/17 (both), 5/25/17 (both), 6/19/17 (both), 7/6/17 (both), 2/7/18 (upstream), 2/11/18 (both), 3/23/18 (both), 4/6/18 (upstream), 12/15/18 (both) and 3/21/19 (both).

C. Toluene was the only compound detected prior to 3/21/18, after which date only benzene was detected (samples collected on 3/23/18, 12/15/18, and 3/21/19).

D. The highest quantifiable TPH concentration was 0.95 µg/L in one sub-sample collected at the upstream station during the 3/1/17 event, which produced an EMC of 0.49 µg/L for this event.

E. At the downstream station the highest TPH concentration was 0.17 µg/L for a subsample collected during the 1/23/17 event (producing an EMC of 0.16 µg/L).

F. There appears to be no seasonal relation in the presence of the toluene or benzene, as “hits” were observed in samples collected during both winter and summer, and “hits” were observed in both upstream and downstream samples.

G. It should be noted that any quantifiable concentration was very-much lower than would be expected if “free-product” such as gasoline or diesel fuel were in the creek. While the data might be interpreted to indicate that petroleum is occasionally present in the stream, it is more likely these “hits” are random low-level contamination introduced either from sampling equipment or laboratory equipment.

H. In FY22, TPH data were analyzed using EPA method 1664A, which has a higher detection limit. Therefore, current TPH data may not be directly comparable to previous TPH data.

Table 3-5. Summary of precipitation, maximum discharge reached, and total discharge during sampled events. upstream (1636845) and downstream (1636846) stations on Little Catoctin Creek, Md.
[in, inches; in/hr, inches per hour; ft3/s, cubic feet per second; L, liters]

Date	Stream status	Sample collected downstream?	Sample collected upstream?	Event type	Precipitation amount (in)	Rainfall intensity (in/hr)	**UPSTREAM** maximum discharge reached (ft3/s)	**UPSTREAM** total volume (L)	**DOWNSTREAM** total volume (L)	**Percent difference between downstream and upstream**
1/3/17	Pre	N	Y	Storm	0.06	0.011	84.9	8.403E+07	9.191E+07	9.0
1/23/17	Pre	Y	Y	Storm	0.09	0.009	198	1.420E+08	1.552E+08	8.9
2/23/17	Pre	Y	Y	Base	0	--	1.85	4.430E+06	4.844E+06	8.9
3/1/17	Pre	Y	Y	Storm	0.19	0.095	7.53	1.419E+07	1.552E+07	9.0
3/31/17	Pre	Y	Y	Storm	0.08	0.137	73.7	6.365E+07	6.962E+07	9.0
4/6/17	Pre	Y	Y	Storm	0.00	--	181	1.350E+08	1.475E+08	8.8
5/5/17	Pre	Y	Y	Storm	1.23	0.049	90.9	6.587E+07	7.205E+07	9.0
5/25/17	Pre	Y	Y	Storm	1.15	0.052	123	1.383E+08	1.512E+08	8.9
6/19/17	Pre	Y	Y	Storm	0.00	--	22.0	1.439E+07	1.574E+07	9.0
7/6/17	Pre	Y	Y	Storm	0.30	0.033	303	1.117E+08	1.222E+08	9.0
8/7/17	Pre	Y	Y	Base[1]	0.00	--	2.07	7.257E+06	7.902E+06	8.5
8/24/17	Pre	Y	Y	Base	0	--	0.79	1.682E+06	1.781E+06	5.7
9/26/17	Pre	Y	Y	Base	0	--	0.60	1.371E+06	1.225E+06	-11
10/9/17	Pre	Y	Y	Storm	0.73	0.090	7.7	8.743E+06	1.294E+07	39
10/24/17	Pre	Y	Y	storm	0.45	0.064	4.99	7.490E+06	9.203E+06	21
10/29/17	Pre	Y	Y	Storm	0.46	0.060	122	9.983E+07	9.641E+07	-3.5
11/29/17	Pre	Y	Y	Base	0	--	1.11	2.635E+06	2.981E+06	12
12/20/17	Pre	Y	N	Base	0	--	0.91	2.101E+06	2.871E+06	31
12/24/17	Pre	N	Y	Base	0	--	2.6	4.095E+06	5.124E+06	22
1/12/18	Pre	Y	Y	Storm	1.16	0.048	454	1.748E+08	2.359E+08	30
1/26/18	Pre	Y	Y	Base	0	--	2.5	5.735E+06	6.087E+06	6.0

Note: Light shaded dates represent storm or baseflow events when only 1 station was sampled

[1] On 8/7/17 0.02-in of precipitation was recorded at Frederick Airport.

*Table 3-5. Summary of precipitation, maximum discharge reached, and total discharge during sampled events. upstream (**1636845**) and downstream (**1636846**) stations on Little Catoctin Creek, Md.—Continued*
[in, inches; in/hr, inches per hour; ft3/s, cubic feet per second; L, liters]

Date	Stream status	Sample collected downstream?	Sample collected upstream?	Event type	Precipitation amount (in)	Rainfall intensity (in/hr)	**UPSTREAM** maximum discharge reached (ft3/s)	**UPSTREAM** total volume (L)	**DOWNSTREAM** total volume (L)	**Percent difference between downstream and upstream**
2/7/18	Const.	Y	Y	Storm	0.03	0.040	88.5	7.209E+07	8.542E+07	17
2/11/18	Const.	Y	Y	Storm	0.52	0.047	48.3	6.619E+07	7.914E+07	18
2/23/18	Const.	Y	Y	Storm	0.17	0.039	26.0	9.864E+07	9.660E+07	-2.1
3/1/18	Const.	Y	N	Storm	0.53	0.169	19.6	2.806E+07	1.312E+08	130
3/23/18	Const.	Y	Y	Base	0	--	12.0	2.502E+07	3.025E+07	19
4/15/18	Const.	Y	Y	Storm	2.69	0.336	235	2.392E+08	2.555E+08	6.6
4/27/18	Const.	Y	Y	Storm	0.34	0.132	7.51	1.157E+07	1.402E+07	19
5/6/18	Const.	N	Y	Base	0.28	0.070	5.99	1.651E+07	2.799E+07	52
5/13/18	Const.	Y	Y	Storm[2]	7.7	0.052	9,050	2.623E+09	3.192E+09	20
5/22/18	Const.	Y	Y	Storm	0	--	397	1.180E+08	1.208E+08	2.3
Samples collected and analyzed after 2018 report submittal										
6/2/18	Const.	Y	N	Storm	1.4	0.030	1,820	3.351E+08	3.912E+08	15
6/20/18	Const.	Y	N	Storm	0.01	0.002	62.2	2.146E+07	2.790E+07	26
7/16/18	Const.	Y	Y	Base	0	--	1.86	4.068E+06	5.038E+06	21
8/21/18	Const.	Y	N	Storm	0.98	0.363	327	9.671E+07	1.191E+08	21
9/9/18	Const.	N	Y	Storm	1.55	0.049	471	4.279E+08	4.932E+08	14
9/17/18	Const.	Y	Y	Storm	0.36	0.360	410	1.399E+08	1.616E+08	14
10/26/18	Const.	Y	Y	Storm	0.63	0.067	32.8	6.899E+07	8.426E+07	20

Note: Light shaded dates represent storm or baseflow events when only 1 station was sampled

[1] Rainfall between 5/13/18 @7:15am on 5/13/18 and 10:45 am on 5/19/18 (147.75 hours) totaled 7.7-inches, however, this precipitation occurred in 7 distinct intervals. The maximum precipitation was 1.9 inches that occurred over 8 minutes at 0:55 am on 5/16/18.

*Table 3-5. Summary of precipitation, maximum discharge reached, and total discharge during sampled events. upstream (**1636845**) and downstream (**1636846**) stations on Little Catoctin Creek, Md.--Continued*
[in, inches; in/hr, inches per hour; ft3/s, cubic feet per second; L, liters]

Date	Stream status	Sample collected downstream?	Sample collected upstream?	Event type	Precipitation amount (in)	Rainfall intensity (in/hr)	**UPSTREAM** maximum discharge reached (ft^3/s)	**UPSTREAM** total volume (L)	**DOWNSTREAM** total volume (L)	**Percent difference between downstream and upstream**
11/9/18	Const.	Y	Y	Storm	0	--	94.4	7.334E+07	8.221E+07	11
11/29/18	Const.	Y	Y	Base	0	--	6.3	1.486E+07	1.876E+07	23
12/15/18	Const.	Y	Y	Storm	1.24	0.037	308	3.823E+08	4.644E+08	19
12/20/18	Const.	Y	Y	Storm	0.48	0.051	81.5	7.403E+07	8.169E+07	9.8
2/3/19	Const.	Y	Y	Base	0	--	9.1	3.36E+07	3.951E+07	15
2/6/19	Const.	Y	Y	Storm	0	--	8.8	3.54E+07	4.168E+07	15
2/11/19	Const.	Y	Y	Storm	0.45	0.014	168	1.77E+08	2.088E+08	15
2/21/19	Const.	Y	Y	Storm	0.03	0.007	53.5	7.08E+07	8.335E+07	15
3/21/19	Const.	Y	Y	Storm	0.24	0.012	739	5.32E+08	6.257E+08	15

Note: Light shaded dates represent storm or baseflow events when only 1 station was sampled

Volumes shaded in dark gray were estimated as 85% of the discharge measured at downstream station. The upstream gaging equipment was not operational during this period due to the construction activity.

*Table 3-5. Summary of precipitation, maximum discharge reached, and total discharge during sampled events. upstream (**1636845**) and downstream (**1636846**) stations on Little Catoctin Creek, Md.--Continued*

[in, inches; in/hr, inches per hour; ft^3/s, cubic feet per second; L, liters]

Date	Stream status	Sample collected downstream?	Sample collected upstream?	Event type	Precipitation amount (in)	Rainfall intensity (in/hr)	**UPSTREAM** maximum discharge reached (ft^3/s)	**UPSTREAM** total volume (L)	**DOWNSTREAM** total volume (L)	**Percent difference upstream to downstream**
4/19/19	Post	Y	Y	Storm	0.82	0.154	41.5	5.445E+07	5.954E+07	8.9
4/26/19	Post	Y	Y	Storm	0.3	0.039	7.28	4.768E+07	5.218E+07	9.0
5/23/19	Post	Y	Y	Storm	0	--	38.6	3.879E+07	4.685E+07	19
5/30/19	Post	Y	Y	Base	0	--	4.43	9.970E+06	1.122E+07	12
6/13/19	Post	Y	Y	Storm	0.800	0.069	35.7	3.491E+07	4.692E+07	29
6/27/19	Post	Y	Y	Base	0.75	0.900	16.0	9.105E+06	1.166E+07	25
6/29/19	Post	Y	Y	Storm	0.07	0.030	6.11	1.834E+07	2.243E+07	20
7/31/2019	Post	Y	Y	Base	0.00	0.000	1.58	3.649E+06	4.236E+06	15
8/18/2019	Post	Y	Y	Storm	1.07	1.834	30.7	1.814E+07	1.917E+07	5.5
9/30/2019	Post	Y	Y	Storm	0.22	0.115	0.94	3.333E+06	3.927E+06	16
10/7/2019	Post	Y	Y	Storm	0.19	0.019	3.23	7.516E+06	9.642E+06	25
10/22/2019	Post	Y	Y	Storm	0.34	0.047	5.13	8.385E+06	1.190E+07	35
10/30/2019	Post	Y	Y	Storm	0.27	0.030	206	1.227E+08	1.996E+08	48
11/24/2019	Post	Y	Y	Storm	0.50	0.058	5.69	1.638E+07	1.975E+07	19
1/25/2020	Post	Y	Y	Storm	1.08	0.139	369	1.463E+08	1.782E+08	20
2/6/2020	Post	Y	Y	Storm	0.55	0.079	289	2.231E+08	2.928E+08	27
3/13/2020	Post	Y	Y	Storm	0.21	0.079	704	4.130E+07	4.686E+07	13
4/13/2020	Post	Y	Y	Storm	0.68	0.073	31.9	3.769E+07	4.493E+07	18
4/24/2020	Post	Y	Y	Storm	0.29	0.040	21.7	6.585E+07	7.921E+07	18
4/30/2020	Post	Y	Y	Storm	0.21	0.011	302	2.493E+08	3.433E+08	32
6/7/2022	Post	Y	Y	Base	0	--	5.20	--	--	38.8
6/27/2022	Post	Y	Y	Storm	0.06	0.015	0.629	1.018E+06	1.079E+06	5.8

Note: Light shaded dates represent storm or baseflow events when only 1 station was sampled

Dark shaded volumes at upstream station were estimated from discharge measured at downstream station

Table 3-6. Number of sub-samples collected at the upper station (1636845) under different flow-regimes and construction phases on Little Catoctin Creek, Md from 2016-2022.
[ft3/s; cubic feet per second]

Percentile range	Upstream station discharge 10/1/16 to 6/30/22 (ft^3/s)	Discharge range (ft^3/s)	Pre-Construction Number of subsamples [1] collected at upstream station during indicated flow range during pre-construction phase	Construction Number of subsamples [1] collected at upstream station during indicated flow range during construction phase	Post-Construction Number of subsamples [1] collected at upstream station during indicated flow range during post-construction phase
99	75.7	>75.7	51	56	54
95	8.89	8.89--75.7	8	12	2
75	4.64	4.64--8.89	20	30	16
50	2.44	2.44--4.64	3	11	15
25	1.33	1.33--2.44	9	2	11
10	0.81	0.81--1.33	7	1	5
		0--0.81	1	0	4

[1.] Storm events when 2-3 subsamples were collected, or baseflow events when 1 sub-sample was collected.

Table 3-7. Summary of event mean concentrations calculated for upstream (1636845) and downstream (1636846) stations on Little Catoctin Creek, Md. Concentrations were calculated after replacing non-detected values with the minimum detection level.
[EMC, event mean concentration; kg/L, kilograms per liter; mg/L, milligrams per liter; µg/L, micrograms per liter; MPN, most probable number; MDL, method detection level]

	Average [1] temperature C	Average pH (stnd. Units)	BOD-5 (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Nitrite + Nitrate (mg/L)	Total phosphorous (mg/L)	Suspended sediment (mg/L)	TSS (mg/L)	Total copper (µg/L)
UPSTREAM									
Count	61	59	54	62	62	62	58	61	60
Maximum	81	7.9	39.8	3.63	5.10	3.435	1,828	1,460	52.2
Minimum	33.8	7.1	0.01	0.06	0.37	0.048	3	5	0.7
Median	53.5	7.4	7.9	0.93	2.78	0.434	53	48	7.4
# of EMCs below MDL	0	0	2	2	0	0	0	13	0
DOWNSTREAM									
Count	63	63	56	64	64	64	61	63	63
Maximum	77.6	8.8	41.3	4.01	4.91	3.459	1376	1197	48.3
Minimum	34.7	6.7	0.8	0.01	0.03	0.033	1	15	0.30
Median	56.4	7.5	5.5	0.76	2.60	0.314	46	40	7.6
# of EMCs below MDL	0	0	1	3	0	0	0	16	0

	Total lead (µg/L)	Total zinc (µg/L)	Hardness (mg/L)	*Enterococcus* (MPN)	*E. coli* (MPN)	[2,6]TPH (µg/L)
UPSTREAM						
Count	60	58	60	59	60	18
Maximum	32.3	124	133.3	1,000,000	16,500,000	1700
Minimum	0.07	2	37	51	1,100	0.01
Median	1.10	11	86	1,920	207,000	0.09
# of EMCs below MDL	0	7	0	0	0	52
DOWNSTREAM						
Count	62	61	63	63	64	15
Maximum	288	107	133	1,710,000	5,180,000	1633
Minimum	0.05	1	29	21	819	0.01
Median	1.07	8	90	23,700	79,900	0.05
# of EMCs below MDL	0	13	0	0	0	43

1. Summary statistics for all constituents except TPH were calculated after replacing non-detected concentrations with respective MDLs.
2. EMC's for TPH were calculated with non-quantifiable measurements (below MDL) replaced with null values.
3. FY22 results for TPH analyzed by EPA method 1664A.

Table 3-8. Summary of event mean concentrations calculated for upstream (1636845) and downstream (1636846) stations on Little Catoctin Creek, Md. Concentrations were calculated after replacing non-detected values with the minimum detection level.
[kg/L, kilograms per liter; mg/L, milligrams per liter; µg/L, micrograms per liter; MDL, method detection level; MPN, most probable number; -- not measured or data not yet received]

UPSTREAM (1636845)

Event date	Stream condition	Average temperature (ºF)	Average pH (stnd. units)	BOD-5 (mg/L)	Total Kjeldahl nitrogen (mg/L)	Nitrite + Nitrate (mg/L)	Total phosphorous (mg/L)
MDL	--	--	--	2	0.5	0.04	0.05
Pre-Construction Samples							
1/3/17	Storm	43	7.6	--	1.8	1.88	1.43
1/23/17	Storm	38	7.4	18	1.3	1.18	3.08
2/23/17	Baseflow	54	7.5	2.0	0.49	4.38	0.048
3/1/17	Storm	55	7.4	13	0.78	2.91	0.590
3/31/17	Storm	48	7.5	12	2.6	1.81	2.18
4/6/17	Storm	54	7.4	18	1.7	0.92	2.40
5/5/17	Storm	62	7.3	15	2.5	2.02	1.38
5/25/17	Storm	70	7.2	11	1.9	3.14	1.83
6/19/17	Storm	75	7.3	40	1.8	2.09	1.24
7/6/17	Storm	75	7.1	8.0	2.0	3.43	1.63
8/7/17	Baseflow	69	7.1	26	3.0	3.36	0.558
8/24/17	Baseflow	70	7.5	1.2	0.38	3.30	0.098
9/26/17	Baseflow	73	7.6	--	0.26	2.36	0.102
10/9/17	Storm	71	7.2	30	1.2	2.13	0.990
10/24/17	Storm	63	7.2	--	3.6	2.57	1.28
10/29/17	Storm	51	7.4	29	1.7	2.89	3.44
11/29/17	Baseflow	46	7.6	1.7	0.22	4.41	0.050
12/24/17	Baseflow	43	7.4	--	1.0	3.55	0.212
1/12/18	Storm	42	7.3	0.4	1.78	3.10	2.43
1/26/18	Baseflow	37	7.3	2.5	0.73	5.10	0.067

Notes: The EMCs presented here for all species except TPH were calculated by replacing 'non-detects" with respective MDL.

EMC for TPH were calculated by replacing non-detected values with null (0) concentration. Values reported as nd (not detected) indicates that all components of TPH were below their respective MDL

Shaded values had one or more sub-samples with a concentration reported below the MDL.

*Table 3-8. Summary of event mean concentrations calculated for upstream (**1636845**) and downstream (**1636846**) stations on Little Catoctin Creek, Md. Concentrations were calculated after replacing non-detected values with the minimum detection level.--Continued*
[kg/L, kilograms per liter; mg/L, milligrams per liter; µg/L, micrograms per liter; MDL, method detection level; MPN, most probable number; -- not measured or data not yet received]

UPSTREAM (1636845)							
Event date	Stream condition	Average temperature (°F)	Average pH (stnd. units)	BOD-5 (mg/L)	Total Kjeldahl nitrogen (mg/L)	Nitrite + Nitrate (mg/L)	Total phosphorous (mg/L)
MDL	--	--	--	2	0.5	0.04	0.05
Construction samples							
2/7/18	Storm	33	7.3	--	1.0	2.37	0.594
2/11/18	Storm	38	7.4	--	1.4	3.06	0.759
2/23/18	Storm	47	7.4	--	0.95	3.07	0.339
3/23/18	Baseflow	41	7.6	6.4	0.40	4.35	0.095
4/15/18	Storm	48	7.1	4.6	1.5	1.65	1.42
4/27/18	Storm	55	7.4	8.6	0.82	2.84	0.170
5/6/18	Baseflow	60	7.5	--	2.1	2.69	0.434
5/14/18	Storm	65	7.3	3.1	1.47	2.25	2.59
5/22/18	Storm	71	7.3	11	1.5	1.45	1.25
7/16/18	Baseflow	81	7.8	2.3	0.11	3.75	0.085
9/9/18	Storm	65	7.0	6.5	0.74	0.66	1.21
9/17/18	Storm	71	7.4	6.7	0.86	2.62	0.497
10/26/18	Storm	50	7.5	7.9	0.93	2.84	0.521
11/9/18	Storm	48	7.2	--	0.68	2.04	0.733
11/29/18	Baseflow	40	7.4	2.7	0.51	4.96	0.051
12/15/18	Storm	43	7.5	23	1.8	1.60	2.18
12/20/18	Storm	45	7.4	9.6	0.86	2.56	0.345
2/3/19	Baseflow	40	7.3	22	0.72	4.62	0.096
2/6/19	Storm	45	7.4	3.7	0.47	3.90	0.070
2/11/19	Storm	35	7.4	7.0	0.63	1.71	0.881
2/21/19	Storm	43	7.4	6.9	0.78	2.82	0.390
3/21/19	Storm	44	7.3	15	1.4	1.96	2.86

Notes: The EMCs presented here for all species except TPH were calculated by replacing 'non-detects" with respective MDL.

EMC for TPH were calculated by replacing non-detected values with null (0) concentration. Values reported as nd (not detected) indicates that all components of TPH were below their respective MDL

Shaded values had one or more sub-samples with a concentration reported below the MDL.

*Table 3-8. Summary of event mean concentrations calculated for upstream (**1636845**) and downstream (**1636846**) stations on Little Catoctin Creek, Md. Concentrations were calculated after replacing non-detected values with the minimum detection level.--Continued*

[kg/L, kilograms per liter; mg/L, milligrams per liter; µg/L, micrograms per liter; MDL, method detection level; MPN, most probable number; -- not measured or data not yet received]

UPSTREAM (1636845)

Event date	Stream condition	Average temperature (ºF)	Average pH (stnd. units)	BOD-5 (mg/L)	Total Kjeldahl nitrogen (mg/L)	Nitrite + Nitrate (mg/L)	Total phosphorous (mg/L)
MDL	--	--	--	2	0.5	0.04	0.05
Post construction samples							
4/19/2019	Storm	62	7.5	2.4	0.56	1.50	0.156
4/26/2019	Storm	64	7.5	12	0.93	3.08	0.182
5/23/2019	Storm	70	7.6	13	0.72	3.20	0.522
5/30/2019	Baseflow	75	7.6	1.6	0.56	3.62	0.085
6/13/2019	Storm	66	7.7	5.4	0.73	2.95	0.178
6/27/2019	Baseflow	74	7.7	2.7	0.43	3.41	0.109
6/29/2019	Storm	78	7.5	8.0	0.06	2.82	0.240
7/31/2019	Baseflow	75	7.8	2.9	0.46	3.53	0.104
8/18/2019	Storm	75	7.3	19	1.28	2.49	1.595
9/30/2019	Storm	69	7.6	1.5	0.42	2.59	0.104
10/7/2019	Storm	63	7.5	8.5	0.79	2.78	0.396
10/22/2019	Storm	58	7.5	5.6	0.62	2.34	0.263
10/30/2019	Storm	60	7.4	13	1.74	2.00	0.463
11/24/2019	Storm	43	7.5	12	1.30	3.25	0.412
1/25/2020	Storm	40	7.6	7.2	0.88	1.10	2.111
2/6/2020	Storm	43	7.5	6.0	2.38	0.98	0.389
3/13/2020	Storm	53	7.5	3.8	0.69	3.61	0.085
4/13/2020	Storm	56	7.5	6.3	1.00	1.72	0.416
4/24/2020	Storm	52	7.4	13	0.98	2.08	0.280
4/30/2020	Storm	57	7.2	15	1.05	0.37	1.330
6/6/2022	Baseflow	66	7.3	2.0	*	2.7	0.093
6/27/2022	Storm	73	7.7	2.0	1.18	2.02	0.196

Notes: The EMCs presented here for all species except TPH were calculated by replacing 'non-detects" with respective MDL.

EMC for TPH were calculated by replacing non-detected values with null (0) concentration. Values reported as nd (not detected) indicates that all components of TPH were below their respective MDL.

Red highlighted values were flagged by USGS for failing laboratory QA/QC checks and are likely biased high.

Shaded values had one or more sub-samples with a concentration reported below the MDL.

*TKN result was suspected to be laboratory dilution error and subsequently removed from the data set.

*Table 3-8. Summary of event mean concentrations calculated for upstream (**1636845**) and downstream (**1636846**) stations on Little Catoctin Creek, Md. Concentrations were calculated after replacing non-detected values with the minimum detection level.--Continued*

[kg/L, kilograms per liter; mg/L, milligrams per liter; µg/L, micrograms per liter; MDL, method detection level; MPN, most probable number; -- not measured or data not yet received]

UPSTREAM (1636845)						
Event date	Stream condition	Suspended sediment (mg/L)	Total suspended solids (mg/L)	Total copper (µg/L)	Total lead (µg/L)	Total zinc (µg/L)
MDL	--	0.5	1	0.36	0.071	4
Pre-construction samples						
1/3/17	Storm	264	217	15	5.1	30
1/23/17	Storm	1,250	1,250	35	25	109
2/23/17	Baseflow	4	15	0.9	0.07	2
3/1/17	Storm	102	77	4.8	2.4	17
3/31/17	Storm	583	497	20	11	54
4/6/17	Storm	833	618	26	17	78
5/5/17	Storm	202	162	12	3.7	21
5/25/17	Storm	402	381	29	8.3	46
6/19/17	Storm	147	141	9.6	4.1	32
7/6/17	Storm	396	354	19	7.6	37
8/7/17	Baseflow	15	16	3.1	0.31	7.0
8/24/17	Baseflow	5	15	1.3	0.09	2.0
9/26/17	Baseflow	6	15	1.5	0.19	2.0
10/9/17	Storm	57	43	5.8	0.78	11
10/24/17	Storm	29	31	6.2	0.57	12
10/29/17	Storm	723	525	26	13	85
11/29/17	Baseflow	1	15	1.2	0.07	2.0
12/24/17	Baseflow	12	15	3.8	0.29	4.0
1/12/18	Storm	861	660	26.4	13.0	77
1/26/18	Baseflow	4	15	0.8	0.12	2.0

Notes: The EMCs presented here for all species except TPH were calculated by replacing ‘non-detects” with respective MDL.

EMC for TPH were calculated by replacing non-detected values with null (0) concentration. Values reported as nd (not detected) indicates that all components of TPH were below their respective MDL

Shaded values had one or more sub-samples with a concentration reported below the MDL.

*Table 3-8. Summary of event mean concentrations calculated for upstream (**1636845**) and downstream (**1636846**) stations on Little Catoctin Creek, Md. Concentrations were calculated after replacing non-detected values with the minimum detection level.--Continued*

[kg/L, kilograms per liter; mg/L, milligrams per liter; µg/L, micrograms per liter; MDL, method detection level; MPN, most probable number; -- not measured or data not yet received]

UPSTREAM (1636845)						
Event date	Stream condition	Suspended sediment (mg/L)	Total suspended solids (mg/L)	Total copper (µg/L)	Total lead (µg/L)	Total zinc (µg/L)
MDL	--	1	1	0.36	0.071	4
Construction samples						
2/7/18	Storm	132	100	7.4	2.4	12
2/11/18	Storm	141	128	8.2	3.4	17
2/23/18	Storm	38	25	--	--	--
3/23/18	Baseflow	3	15	1.3	0.08	2.0
4/15/18	Storm	440	328	8.5	2.3	13
4/27/18	Storm	16	16	2.1	0.37	5.4
5/6/18	Baseflow	21	15	4.1	0.32	10
5/22/18	Storm	351	356	11	8.2	31
7/16/18	Baseflow	7	15	1.1	0.12	2.0
9/9/18	Storm	59	318	13	6.7	29
9/17/18	Storm	80	83	6.7	1.8	10
10/26/18	Storm	50	56	5.2	1.1	8.1
11/9/18	Storm	146	116	6.4	3.0	17
11/29/18	Baseflow	4	15	0.7	0.10	2.0
12/15/18	Storm	942	616	34	18	82
12/20/18	Storm	62	50	10	1.4	11
2/3/19	Baseflow	7	--	--	--	--
2/6/19	Storm	6	15	2.4	0.18	2.7
2/11/19	Storm	539	467	14	11	42
2/21/19	Storm	159	138	5.3	3.0	19
3/21/19	Storm	1,440	1,300	41	29	120

Notes: The EMCs presented here for all species except TPH were calculated by replacing ‘non-detects” with respective MDL.

EMC for TPH were calculated by replacing non-detected values with null (0) concentration. Values reported as nd (not detected) indicates that all components of TPH were below their respective MDL

Shaded values had one or more sub-samples with a concentration reported below the MDL.

*Table 3-8. Summary of event mean concentrations calculated for upstream (**1636845**) and downstream (**1636846**) stations on Little Catoctin Creek, Md. Concentrations were calculated after replacing non-detected values with the minimum detection level.--Continued*
[kg/L, kilograms per liter; mg/L, milligrams per liter; µg/L, micrograms per liter; MDL, method detection level; MPN, most probable number; -- not measured or data not yet received]

UPSTREAM (1636845)

Event date	Stream condition	Suspended sediment (mg/L)	Total suspended solids (mg/L)	Total copper (µg/L)	Total lead (µg/L)	Total zinc (µg/L)
MDL	--	1	1	0.36	0.071	4
Post-construction Samples						
4/19/2019	Storm	7	32	7.6	1.10	7
4/26/2019	Storm	19	16	1.7	0.48	5
5/23/2019	Storm	113	133	10.8	3.33	20
5/30/2019	Baseflow	11	15	1.3	0.27	3
6/13/2019	Storm	20	21	2.3	0.51	4
6/27/2019	Baseflow	10	15	1.3	0.24	2
6/29/2019	Storm	8	46	7.4	1.09	9
7/31/2019	Baseflow	6	15	1.4	0.15	2
8/18/2019	Storm	446	415	22.7	9.68	57
9/30/2019	Storm	10	16	3.9	0.27	3
10/7/2019	Storm	28	31	12.7	0.78	9
10/22/2019	Storm	29	30	5.4	0.76	6
10/30/2019	Storm	15	15	16.3	0.46	8
11/24/2019	Storm	25	19	6.6	0.60	8
1/25/2020	Storm	1,850	1,480	52.8	32.6	126
2/6/2020	Storm	55	53	17.0	1.52	14
3/13/2020	Storm	13	15	12.2	0.31	5
4/13/2020	Storm	66	65	15.2	1.63	12
4/24/2020	Storm	29	23	11.2	0.80	9
4/30/2020	Storm	962	877	25.9	18.5	76
6/6/2022	Baseflow	--	3	0.7	0.1	4
6/27/2022	Storm	--	5.09	1.29	0.54	4.8

Notes: The EMCs presented here for all species except TPH were calculated by replacing 'non-detects" with respective MDL.

EMC for TPH were calculated by replacing non-detected values with null (0) concentration. Values reported as nd (not detected) indicates that all components of TPH were below their respective MDL

Shaded values had one or more sub-samples with a concentration reported below the MDL.

*Table 3-8. Summary of event mean concentrations calculated for upstream (**1636845**) and downstream (**1636846**) stations on Little Catoctin Creek, Md. Concentrations were calculated after replacing non-detected values with the minimum detection level.--Continued*

[kg/L, kilograms per liter; mg/L, milligrams per liter; µg/L, micrograms per liter; MDL, method detection level; MPN, most probable number; -- not measured or data not yet received]

UPSTREAM (1636845)					
Event date	Stream condition	Hardness (mg/L)	*Enterococcus* (MPN)	*E. coli* (MPN)	TPH (µg/L)
MDL	--	15	--	--	1500
Pre-construction samples					
1/3/17	Storm	73	23,500	207,000	0.04
1/23/17	Storm	52	43,400	230,000	0.14
2/23/17	Baseflow	106	1,300	1,900	nd
3/1/17	Storm	107	45,000	120,000	0.49
3/31/17	Storm	62	37,400	203,000	0.15
4/6/17	Storm	50	62,200	231,000	0.15
5/5/17	Storm	73	155,000	240,000	0.09
5/25/17	Storm	64	175,000	2,240,000	0.10
6/19/17	Storm	91	192,000	1,630,000	0.11
7/6/17	Storm	48	105,000	4,180,000	0.12
8/7/17	Baseflow	127	26,000	240,000	nd
8/24/17	Baseflow	129	2,400	31,000	nd
9/26/17	Baseflow	128	1,300	31,000	nd
10/9/17	Storm	109	1,000,000	2,400,000	0.22
10/24/17	Storm	114	274,000	6,510,000	nd
10/29/17	Storm	70	712,000	16,500,000	nd
11/29/17	Baseflow	107	930	14,000	nd
12/24/17	Baseflow	95	--	--	nd
1/12/18	Storm	60	19,200	240,000	nd
1/26/18	Baseflow	110	63	2,900	nd

Notes: The EMCs presented here for all species except TPH were calculated by replacing 'non-detects" with respective MDL.

EMC for TPH were calculated by replacing non-detected values with null (0) concentration. Values reported as nd (not detected) indicates that all components of TPH were below their respective MDL

Shaded values had one or more sub-samples with a concentration reported below the MDL.

*Table 3-8. Summary of event mean concentrations calculated for upstream (**1636845**) and downstream (**1636846**) stations on Little Catoctin Creek, Md. Concentrations were calculated after replacing non-detected values with the minimum detection level.--Continued*
[kg/L, kilograms per liter; mg/L, milligrams per liter; µg/L, micrograms per liter; MDL, method detection level; MPN, most probable number; -- not measured or data not yet received]

		UPSTREAM (1636845)			
Event date	Stream condition	Hardness (mg/L)	*Enterococcus* (MPN)	*E. coli* (MPN)	[1]TPH (µg/L)
MDL	--	15	--	--	1500
		Construction samples			
2/7/18	Storm	59	2,200	69,800	0.09
2/11/18	Storm	81	2,600	194,000	0.01
2/23/18	Storm	--	--	--	nd
3/23/18	Baseflow	122	350	3,000	0.01
4/15/18	Storm	49	22,800	188,000	nd
4/27/18	Storm	88	8,820	54,800	nd
5/6/18	Baseflow	102	33,000	170,000	nd
5/22/18	Storm	50	65,700	2,290,000	nd
7/16/18	Baseflow	99	1,400	17,000	nd
9/9/18	Storm	38	42,500	2,330,000	nd
9/17/18	Storm	95	97,900	2,370,000	nd
10/26/18	Storm	89	55,400	2,210,000	nd
11/9/18	Storm	73	38,000	702,000	nd
11/29/18	Baseflow	88	580	3,100	nd
12/15/18	Storm	54	26,700	601,000	0.01
12/20/18	Storm	74	7,930	130,000	nd
2/3/19	Baseflow	--	51	1,100	nd
2/6/19	Storm	86	338	8,820	nd
2/11/19	Storm	49	1,930	24,900	nd
2/21/19	Storm	91	2,900	10,200	nd
3/21/19	Storm	48	17,400	665,400	0.01

Notes: The EMCs presented here for all species except TPH were calculated by replacing ‘non-detects” with respective MDL.

EMC for TPH were calculated by replacing non-detected values with null (0) concentration. Values reported as nd (not detected) indicates that all components of TPH were below their respective MDL

Shaded values had one or more sub-samples with a concentration reported below the MDL.

*Table 3-8. Summary of event mean concentrations calculated for upstream (**1636845**) and downstream (**1636846**) stations on Little Catoctin Creek, Md. Concentrations were calculated after replacing non-detected values with the minimum detection level.--Continued*

[kg/L, kilograms per liter; mg/L, milligrams per liter; µg/L, micrograms per liter; MDL, method detection level; MPN, most probable number; -- not measured or data not yet received]

UPSTREAM (1636845)					
Event date	Stream condition	Hardness (mg/L)	*Enterococcus* (MPN)	*E. coli* (MPN)	TPH (µg/L)
MDL	--	15	--	--	1500
Post- construction samples					
4/19/2019	Storm	80	14,200	680,000	nd
4/26/2019	Storm	86	47,200	98,800	nd
5/23/2019	Storm	81	83,700	576,000	nd
5/30/2019	Baseflow	105	5,200	19,000	nd
6/13/2019	Storm	90	17,200	240,000	nd
6/27/2019	Baseflow	96	1,400	19,000	nd
6/29/2019	Storm	96	8,520	313,000	nd
7/31/2019	Baseflow	105	860	28,000	nd
8/18/2019	Storm	70	128,000	240,000	nd
9/30/2019	Storm	118	3,860	54,800	nd
10/7/2019	Storm	107	47,400	240,000	0.02
10/22/2019	Storm	104	46,800	214,000	0.01
10/30/2019	Storm	113	239,000	1,400,000	nd
11/24/2019	Storm	103	16,300	178,000	nd
1/25/2020	Storm	48	9,740	230,000	nd
2/6/2020	Storm	77	12,200	53,700	nd
3/13/2020	Storm	89	6,400	11,500	nd
4/13/2020	Storm	71	52,800	206,000	nd
4/24/2020	Storm	80	19,100	125,000	nd
4/30/2020	Storm	37	72,100	226,000	nd
6/6/2022	Baseflow	110	--	3,255	nd
6/27/2022	Storm	126	--	14,507	600

Notes: The EMCs presented here for all species except TPH were calculated by replacing 'non-detects" with respective MDL.

EMC for TPH were calculated by replacing non-detected values with null (0) concentration. Values reported as nd (not detected) indicates that all components of TPH were below their respective MDL

Shaded values had one or more sub-samples with a concentration reported below the MDL.

*Table 3-8. Summary of event mean concentrations calculated for upstream (**1636845**) and downstream (**1636846**) stations on Little Catoctin Creek, Md. Concentrations were calculated after replacing non-detected values with the minimum detection level.--Continued*
[kg/L, kilograms per liter; mg/L, milligrams per liter; µg/L, micrograms per liter; MDL, method detection level; MPN, most probable number; -- not measured or data not yet received]

DOWNSTREAM (1636846)							
Event date	Stream condition	Average temperature (ºF)	pH (standard units)	BOD-5 (mg/L)	Total Kjeldahl nitrogen (mg/L)	Nitrite + Nitrate (mg/L)	Total phosphorous (mg/L)
MDL	--	--	--	2	0.5	0.04	0.05
Pre-construction samples							
1/23/17	Storm	40	7.5	5.4	1.34	1.3	3.459
2/23/17	Baseflow	51	7.6	1.1	0.12	4.2	0.046
3/1/17	Storm	54	7.6	1.9	0.48	3.0	0.138
3/31/17	Storm	47	7.4	9.2	3.09	1.8	2.126
4/6/17	Storm	55	7.5	22	1.45	1.3	3.057
5/5/17	Storm	57	7.2	18	2.40	2.1	1.738
5/25/17	Storm	58	7.4	11	1.91	2.4	1.573
6/19/17	Storm	76	7.3	27	1.42	1.9	1.120
7/6/17	Storm	73	7.2	7.9	1.72	3.2	1.663
8/7/17	Baseflow	69	7.4	1.0	0.40	3.1	0.093
8/24/17	Baseflow	73	7.5	1.0	0.38	2.7	0.102
9/26/17	Baseflow	70	7.5	1.0	0.46	2.1	0.081
10/9/17	Storm	71	7.3	9.0	0.73	2.0	0.546
10/24/17	Storm	63	7.4	0.0	0.45	1.2	0.216
10/29/17	Storm	52	7.3	41	1.65	2.5	2.075
11/29/17	Baseflow	43	7.8	1.9	0.09	4.0	0.039
12/20/17	Storm	43	7.6	1.7	4.01	0.0	0.033
1/12/18	Storm	33	7.3	8.6	1.08	3.1	0.363
1/26/18	Baseflow	33	7.4	2.2	0.60	4.83	0.067

Notes: The EMCs presented here for all species except TPH were calculated by replacing 'non-detects" with respective MDL.

EMC for TPH were calculated by replacing non-detected values with null (0) concentration. Values reported as nd (not detected) indicates that all components of TPH were below their respective MDL

Shaded values had one or more sub-samples with a concentration reported below the MDL.

*Table 3-8. Summary of event mean concentrations calculated for upstream (**1636845**) and downstream (**1636846**) stations on Little Catoctin Creek, Md. Concentrations were calculated after replacing non-detected values with the minimum detection level.--Continued*

[kg/L, kilograms per liter; mg/L, milligrams per liter; µg/L, micrograms per liter; MDL, method detection level; MPN, most probable number; -- not measured or data not yet received]

DOWNSTREAM (1636846)

Event date	Stream condition	Average temperature (ºF)	pH (standard units)	BOD-5 (mg/L)	Total Kjeldahl nitrogen (mg/L)	Nitrite + Nitrate (mg/L)	Total phosphorous (mg/L)
MDL	--	--	--	2	0.5	0.04	0.05
Construction samples							
2/7/18	Storm	35	7.4	--	0.61	4.3	0.134
2/11/18	Storm	38	7.4	--	1.15	3.0	0.743
2/23/18	Storm	45	7.5	--	0.92	2.6	0.930
3/2/18	Storm	44	7.5	5.5	0.57	2.7	0.314
3/23/18	Baseflow	37	8.1	2.9	0.01	4.2	0.036
4/16/18	Storm	47	7.3	10.1	1.25	1.7	1.458
4/27/18	Storm	56	7.7	4.3	0.63	2.8	0.097
5/14/18	Storm	67	7.1	3.6	0.76	2.2	0.451
5/22/18	Storm	70	7.5	16	0.87	2.0	5.13
6/2/18	Storm	74	6.7	13.1	1.45	1.3	1.960
6/20/18	Storm	75	8.5	--	1.60	3.2	0.934
7/16/18	Baseflow	77	7.7	--	0.36	3.4	0.079
8/21/18	Storm	72	7.2	11	1.05	1.3	1.68
9/17/18	Storm	72	7.6	6.9	0.68	3.2	0.508
10/26/18	Storm	51	7.6	6.8	0.85	2.7	0.586
11/9/18	Storm	--	--	0.0	0.68	2.6	0.847
11/29/18	Baseflow	40	7.6	2.3	0.37	4.9	0.049
12/15/18	Storm	43	7.6	17	1.73	2.4	2.529
12/21/18	Storm	46	7.6	8.0	0.85	1.7	0.500
2/3/19	Baseflow	39	7.5	22	0.81	4.4	0.090
2/6/19	Storm	45	7.7	5.3	0.57	3.9	0.129
2/11/19	Storm	35	7.5	6.6	0.64	1.7	0.908
2/21/19	Storm	45	7.5	6.3	0.68	3.1	0.249
3/21/19	Storm	44	7.4	13	1.40	2.0	2.396

Notes: The EMCs presented here for all species except TPH were calculated by replacing ‘non-detects” with respective MDL.

EMC for TPH were calculated by replacing non-detected values with null (0) concentration. Values reported as nd (not detected) indicates that all components of TPH were below their respective MDL

Shaded values had one or more sub-samples with a concentration reported below the MDL.

*Table 3-8. Summary of event mean concentrations calculated for upstream (**1636845**) and downstream (**1636846**) stations on Little Catoctin Creek, Md. Concentrations were calculated after replacing non-detected values with the minimum detection level.--Continued*

[kg/L, kilograms per liter; mg/L, milligrams per liter; µg/L, micrograms per liter; MDL, method detection level; MPN, most probable number; -- not measured or data not yet received]

DOWNSTREAM (1636846)

Event date	Stream condition	Average temperature (ºF)	pH (standard units)	BOD-5 (mg/L)	Total Kjeldahl nitrogen (mg/L)	Nitrite + Nitrate (mg/L)	Total phosphorous (mg/L)
MDL	--	--	--	2	0.5	0.04	0.05
Post-construction samples							
4/19/19	Storm	64	7.8	2.8	0.60	2.70	0.118
4/26/19	Storm	64	7.8	8.7	0.76	2.99	0.128
5/23/19	Storm	73	7.6	10	0.80	3.14	0.393
5/30/19	Baseflow	76	8.0	1.8	0.60	3.50	0.075
6/13/19	Storm	65	7.5	3.8	0.71	2.95	0.543
6/27/19	Baseflow	77	8.8	3.1	0.43	2.93	0.091
6/29/19	Storm	78	7.7	15	0.65	2.60	0.206
7/31/2019	Baseflow	75	7.8	2.4	0.51	2.76	0.092
8/18/2019	Storm	75	7.2	14	0.93	2.31	0.920
9/30/2019	Storm	69	7.3	2.8	0.44	2.01	0.106
10/7/2019	Storm	63	7.2	4.7	0.63	2.21	0.287
10/22/2019	Storm	57	7.4	2.6	0.46	2.02	0.201
10/30/2019	Storm	60	7.5	3.1	0.69	1.86	0.221
11/24/2019	Storm	42	7.4	7.6	0.92	2.70	0.325
1/25/2020	Storm	38	7.5	14	1.02	1.80	1.713
2/6/2020	Storm	43	7.5	3.9	2.25	0.97	0.230
3/13/2020	Storm	52	7.7	1.9	0.61	3.30	0.068
4/13/2020	Storm	57	7.5	5.3	0.89	1.51	0.300
4/23/2020	Storm	52	7.4	13.3	0.91	2.03	0.254
4/30/2020	Storm	57	7.2	15	0.98	1.14	1.034
6/6/2022	Baseflow	66	7.7	2.0	0.64	2.40	0.092
6/27/2022	Storm	74	7.4	2.0	0.86	1.88	0.168

Notes: The EMCs presented here for all species except TPH were calculated by replacing 'non-detects" with respective MDL.

EMC for TPH were calculated by replacing non-detected values with null (0) concentration. Values reported as nd (not detected) indicates that all components of TPH were below their respective MDL

Red highlighted values were flagged by USGS for failing laboratory QA/QC checks and are likely biased high.

Shaded values had one or more sub-samples with a concentration reported below the MDL.

*Table 3-8. Summary of event mean concentrations calculated for upstream (**1636845**) and downstream (**1636846**) stations on Little Catoctin Creek, Md. Concentrations were calculated after replacing non-detected values with the minimum detection level.--Continued*

[kg/L, kilograms per liter; mg/L, milligrams per liter; µg/L, micrograms per liter; MDL, method detection level; MPN, most probable number; -- not measured or data not yet received]

DOWNSTREAM (1636846)

Event date	Stream condition	Suspended sediment (mg/L)	Total suspended solids (mg/L)	Dissolved copper (µg/L)	Dissolved lead (µg/L)	Dissolved zinc (µg/L)
MDL		1	1	0.36	0.071	4
Pre-construction samples						
1/23/17	Storm	1,380	1,110	31.7	22.9	107
2/23/17	Baseflow	4	15	0.9	0.1	2
3/1/17	Storm	23	18	2.2	0.5	2
3/31/17	Storm	543	332	16.6	8.0	37
4/6/17	Storm	1,250	901	30.3	22.0	95
5/5/17	Storm	375	271	14.9	6.2	32
5/25/17	Storm	398	356	20.9	8.2	44
6/19/17	Storm	147	162	9.3	3.5	24
7/6/17	Storm	518	477	20.7	10.5	49
8/7/17	Baseflow	7	15	1.1	0.2	2
8/24/17	Baseflow	8	15	1.2	0.1	2
9/26/17	Baseflow	3	15	1.5	0.1	2
10/9/17	Storm	27	26	4.4	0.5	4
10/24/17	Storm	15	15	1.7	0.1	1
10/29/17	Storm	364	321	15.7	7.0	41
11/29/17	Baseflow	1	15	1.4	0.1	2
12/20/17	Storm	3	15	3.2	0.1	2
1/12/18	Storm	37	35	3.5	0.7	4
1/26/18	Baseflow	2	18	0.3	--	2

Notes: The EMCs presented here for all species except TPH were calculated by replacing 'non-detects" with respective MDL.

EMC for TPH were calculated by replacing non-detected values with null (0) concentration. Values reported as nd (not detected) indicates that all components of TPH were below their respective MDL

Shaded values had one or more sub-samples with a concentration reported below the MDL.

*Table 3-8. Summary of event mean concentrations calculated for upstream (**1636845**) and downstream (**1636846**) stations on Little Catoctin Creek, Md. Concentrations were calculated after replacing non-detected values with the minimum detection level.--Continued*

[kg/L, kilograms per liter; mg/L, milligrams per liter; µg/L, micrograms per liter; MDL, method detection level; MPN, most probable number; -- not measured or data not yet received]

DOWNSTREAM (1636846)						
Event date	Stream condition	Suspended sediment (mg/L)	Total suspended solids (mg/L)	Dissolved copper (µg/L)	Dissolved lead (µg/L)	Dissolved zinc (µg/L)
MDL		1	1	0.36	0.071	4
Construction samples						
2/7/18	Storm	9	15	1.7	0.3	2
2/11/18	Storm	145	130	7.5	3.3	16
2/23/18	Storm	294	280	15.8	7.9	31
3/2/18	Storm	46	43	5.8	1.3	6
3/23/18	Baseflow	5	15	1.0	0.1	2
4/16/18	Storm	480	361	21.7	6.6	36
4/27/18	Storm	11	16	1.7	0.3	2
5/14/18	Storm	127	78	6.0	2.4	12
5/22/18	Storm	564	530	16.0	11.8	48
6/2/18	Storm	812	696	22.9	14.9	64
6/20/18	Storm	337	254	10.1	6.3	33
7/16/18	Baseflow	10	15	2.5	0.2	2
8/21/18	Storm	1,000	812	26.4	16.9	79
9/17/18	Storm	155	150	7.3	3.0	15
10/26/18	Storm	182	176	8.4	3.7	19
11/9/18	Storm	246	201	9.9	6.3	29
11/29/18	Baseflow	9	15	1.0	0.1	2
12/15/18	Storm	1178	771	36.4	20.6	93
12/21/18	Storm	110	85	8.6	2.4	14
2/3/19	Baseflow	--	--	--	--	--
2/6/19	Storm	107	26	3.8	0.7	6
2/11/19	Storm	537	435	13.4	10.3	41
2/21/19	Storm	85	73	3.2	1.5	12
3/21/19	Storm	1,310	1,160	35.5	23.4	103

Notes: The EMCs presented here for all species except TPH were calculated by replacing ‘non-detects” with respective MDL.

EMC for TPH were calculated by replacing non-detected values with null (0) concentration. Values reported as nd (not detected) indicates that all components of TPH were below their respective MDL

Shaded values had one or more sub-samples with a concentration reported below the MDL.

*Table 3-8. Summary of event mean concentrations calculated for upstream (**1636845**) and downstream (**1636846**) stations on Little Catoctin Creek, Md. Concentrations were calculated after replacing non-detected values with the minimum detection level.--Continued*

[kg/L, kilograms per liter; mg/L, milligrams per liter; µg/L, micrograms per liter; MDL, method detection level; MPN, most probable number; -- not measured or data not yet received]

DOWNSTREAM (1636846)						
Event date	Stream condition	Suspended sediment (mg/L)	Total suspended solids (mg/L)	Dissolved copper (µg/L)	Dissolved lead (µg/L)	Dissolved zinc (µg/L)
MDL	--	1	1	0.36	0.071	4
Post-construction samples						
4/19/19	Storm	82	24	2.6	0.62	4
4/26/19	Storm	15	15	1.6	0.38	4
5/23/19	Storm	68	90	11.0	2.36	14
5/30/19	Baseflow	12	15	1.4	0.24	2
6/13/19	Storm	81	108	6.0	2.00	12
6/27/19	Baseflow	8	15	1.0	0.16	2
6/29/19	Storm	4	15	8.7	0.27	8
7/31/2019	Baseflow	6	15	1.5	0.14	2
8/18/2019	Storm	169	152	12.7	3.29	21
9/30/2019	Storm	6	18	5.7	0.14	3
10/7/2019	Storm	24	23	7.6	0.43	4
10/22/2019	Storm	12	15	3.6	0.23	11
10/30/2019	Storm	14	15	8.9	0.27	4
11/24/2019	Storm	42	36	6.6	0.84	7
1/25/2020	Storm	1,210	1,005	48.3	20.6	104
2/6/2020	Storm	28	26	11.2	0.76	6
3/13/2020	Storm	15	15	7.8	0.33	4
4/13/2020	Storm	46	45	11.7	1.07	9
4/23/2020	Storm	308	28	13.9	0.78	9
4/30/2020	Storm	641	648	18.1	288	60
6/6/2022	Baseflow	--	8.1	0.7	0.1	4
6/27/2022	Storm	--	5.7	1.0	0.21	4

Notes: The EMCs presented here for all species except TPH were calculated by replacing 'non-detects" with respective MDL.

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Shaded values had one or more sub-samples with a concentration reported below the MDL.

*Table 3-8. Summary of event mean concentrations calculated for upstream (**1636845**) and downstream (**1636846**) stations on Little Catoctin Creek, Md. Concentrations were calculated after replacing non-detected values with the minimum detection level.--Continued*

[kg/L, kilograms per liter; mg/L, milligrams per liter; µg/L, micrograms per liter; MDL, method detection level; MPN, most probable number; -- not measured or data not yet received]

DOWNSTREAM (1636846)					
Event date	Stream condition	Hardness (mg/L)	*Enterococcus* (MPN)	*E. coli* (MPN)	TPH (µg/L)
MDL		15	--	--	1500
Pre-construction samples					
1/23/17	Storm	62	46,100	216,000	0.15
2/23/17	Baseflow	105	640	1,400	nd
3/1/17	Storm	102	2,390	18,800	nd
3/31/17	Storm	54	41,700	228,000	0.06
4/6/17	Storm	61	50,500	212,000	0.12
5/5/17	Storm	70	129,000	240,000	nd
5/25/17	Storm	63	132,000	1,720,000	0.08
6/19/17	Storm	95	994,000	2,070,000	0.05
7/6/17	Storm	51	83,800	2,770,000	0.12
8/7/17	Baseflow	116	2,200	80,000	nd
8/24/17	Baseflow	124	830	61,000	nd
9/26/17	Baseflow	133	590	41,000	nd
10/9/17	Storm	116	699,000	2,090,000	0.03
10/24/17	Storm	44	126,000	3,230,000	nd
10/29/17	Storm	62	365,000	5,180,000	nd
11/29/17	Baseflow	114	980	17,000	nd
12/20/17	Storm	103	310	16,000	nd
1/12/18	Storm	78	3,490	214,000	nd
1/26/18	Baseflow	39	21	4,500	nd

Notes: The EMCs presented here for all species except TPH were calculated by replacing 'non-detects" with respective MDL.

EMC for TPH were calculated by replacing non-detected values with null (0) concentration. Values reported as nd (not detected) indicates that all components of TPH were below their respective MDL

Shaded values had one or more sub-samples with a concentration reported below the MDL.

*Table 3-8. Summary of event mean concentrations calculated for upstream (**1636845**) and downstream (**1636846**) stations on Little Catoctin Creek, Md. Concentrations were calculated after replacing non-detected values with the minimum detection level.--Continued*

[kg/L, kilograms per liter; mg/L, milligrams per liter; µg/L, micrograms per liter; MDL, method detection level; MPN, most probable number; -- not measured or data not yet received]

DOWNSTREAM (1636846)					
Event date	Stream condition	Hardness (mg/L)	*Enterococcus* (MPN)	*E. coli* (MPN)	TPH (µg/L)
MDL	--	15	--	--	1500
Construction samples					
2/7/18	Storm	92	310	34,000	nd
2/11/18	Storm	82	3,240	115,000	0.01
2/23/18	Storm	85	9,100	82,000	nd
3/2/18	Storm	94	2,600	39,000	nd
3/23/18	Baseflow	120	300	3,700	0.01
4/16/18	Storm	46	11,100	227,000	nd
4/27/18	Storm	91	8,020	60,200	nd
5/14/18	Storm	63	19,600	305,000	nd
5/22/18	Storm	54	40,000	2,250,000	nd
6/2/18	Storm	54	38,000	2,400,000	nd
6/20/18	Storm	101	79,000	2,400,000	nd
7/16/18	Baseflow	104	590	25,000	nd
8/21/18	Storm	58	307,000	2,400,000	nd
9/17/18	Storm	99	130,000	2,600,000	nd
10/26/18	Storm	90	23,700	1,920,000	nd
11/9/18	Storm	77	--	--	nd
11/29/18	Baseflow	91	210	3,500	nd
12/15/18	Storm	62	22,200	533,000	0.01
12/21/18	Storm	57	6,740	174,000	nd
2/3/19	Baseflow	--	52	2,500	nd
2/6/19	Storm	89	1,070	12,600	nd
2/11/19	Storm	52	1,660	24,900	nd
2/21/19	Storm	98	3,750	12,800	nd
3/21/19	Storm	52	13,600	57,700	0.01

Notes: The EMCs presented here for all species except TPH were calculated by replacing 'non-detects" with respective MDL.

EMC for TPH were calculated by replacing non-detected values with null (0) concentration. Values reported as nd (not detected) indicates that all components of TPH were below their respective MDL

Shaded values had one or more sub-samples with a concentration reported below the MDL.

*Table 3-8. Summary of event mean concentrations calculated for upstream (**1636845**) and downstream (**1636846**) stations on Little Catoctin Creek, Md. Concentrations were calculated after replacing non-detected values with the minimum detection level.--Continued*

[kg/L, kilograms per liter; mg/L, milligrams per liter; µg/L, micrograms per liter; MDL, method detection level; MPN, most probable number; -- not measured or data not yet received]

DOWNSTREAM (1636846)					
Event date	Stream condition	Hardness (mg/L)	*Enterococcus* (MPN)	*E. coli* (MPN)	TPH (µg/L)
MDL	--	15	--	--	1500
Post-construction samples					
4/19/19	Storm	90	2,770	19,400	nd
4/26/19	Storm	90	34,800	127,000	nd
5/23/19	Storm	84	62,700	539,000	nd
5/30/19	Baseflow	90	1,500	20,000	nd
6/13/19	Storm	94	60,100	240,000	nd
6/27/19	Baseflow	96	2,500	18,000	nd
6/29/19	Storm	100	9,460	1,190,000	nd
7/31/2019	Baseflow	110	39,000	990	nd
8/18/2019	Storm	79	1,710,000	12,3000	nd
9/30/2019	Storm	113	125,000	3,440	nd
10/7/2019	Storm	119	240,000	172,000	nd
10/22/2019	Storm	121	172,000	7,320	nd
10/30/2019	Storm	116	132,000	14,800	0.02
11/24/2019	Storm	106	161,000	7,020	nd
1/25/2020	Storm	58	217,000	21,800	nd
2/6/2020	Storm	83	35,400	3,540	nd
3/13/2020	Storm	95	6,400	1,650	nd
4/13/2020	Storm	71	163,000	19,000	nd
4/23/2020	Storm	82	198,000	19,700	nd
4/30/2020	Storm	29	90,800	79,900	0.19
6/6/2022	Baseflow	140	--	908	nd
6/27/2022	Storm	127	--	798	600

Notes: The EMCs presented here for all species except TPH were calculated by replacing 'non-detects" with respective MDL.

EMC for TPH were calculated by replacing non-detected values with null (0) concentration. Values reported as nd (not detected) indicates that all components of TPH were below their respective MDL

Shaded values had one or more sub-samples with a concentration reported below the MDL.

4 Biological and Physical Habitat Monitoring

This section summarizes biological and physical habitat monitoring data collected during the summer index period (June 1 - September 30) in 2022 by Coastal Resources, Inc. (CRI), and provides a synopsis of the post-restoration biological and physical habitat conditions present within Little Catoctin Creek. It was compiled to support MDOT SHA's MS4 reporting requirements (FY2022) for this restoration project.

MDOT SHA identified three stream reaches on Little Catoctin Creek to monitor over the course of the study to assess changes in biological condition and stream physical habitat quality associated with the restoration. The study reaches included:

1. Control reach located west of MD 180 (upstream of the planned restoration);
2. Restoration reach extending approximately 3,100 linear feet east of MD 180; and
3. Downstream reach located east (downstream) of the restoration reach.

Fish community conditions were assessed at six sites on Little Catoctin Creek in June of 2022. PRFR-205-X and PRFR-206-X were located west of MD-180 and upstream of the planned restoration; PRFR-203-X and PRFR-204-X were located within the restoration; and PRFR-201-X and PRFR-202-X were located east (downstream) of the restoration reach (Figure 8). Each site is 75 meters in length, following Maryland Biological Stream Survey (MBSS) protocols. Physical habitat assessments and in-situ water quality data were also collected at all six sites, concurrent with fish sampling.

In the spring of 2020, Maryland Department of Natural Resources (MDNR) collected benthic macroinvertebrate samples at each of the six sites along Little Catoctin Creek, as well as at a seventh site (PRFR-107-X) on a tributary entering the upstream reach to the west of MD-180, to assess its potential influence on conditions in the Little Catoctin Creek mainstem. Only benthic macroinvertebrates were sampled at PRFR-107-X in 2020. Fish and physical habitat were not assessed at this site.

This report summarizes the results of monitoring phase BIO4, which includes the 2020 benthic macroinvertebrate community data at the seven monitoring sites and 2022 in-situ water quality, fish community, and physical habitat data collected at the six monitoring sites. Benthic macroinvertebrate samples were collected from all seven sites on April 23rd, 2020. In-situ water quality, fish, and physical habitat data were collected on June 8th (PRFR-203-X and PRFR-204-X), June 10th (PRFR-205-X and PRFR-206-X), and June 15th (PRFR-201-X and PRFR-202-X) in 2022. All 2022 summer sampling was conducted during the MBSS summer index period (June 1 through September 30) and within MDOT SHA's FY22 NPDES/MS4 permit reporting year. The reporting herein satisfies the BIO4 monitoring requirements documented in the MDE-approved monitoring plan for Little Catoctin Creek (SHA 2016).

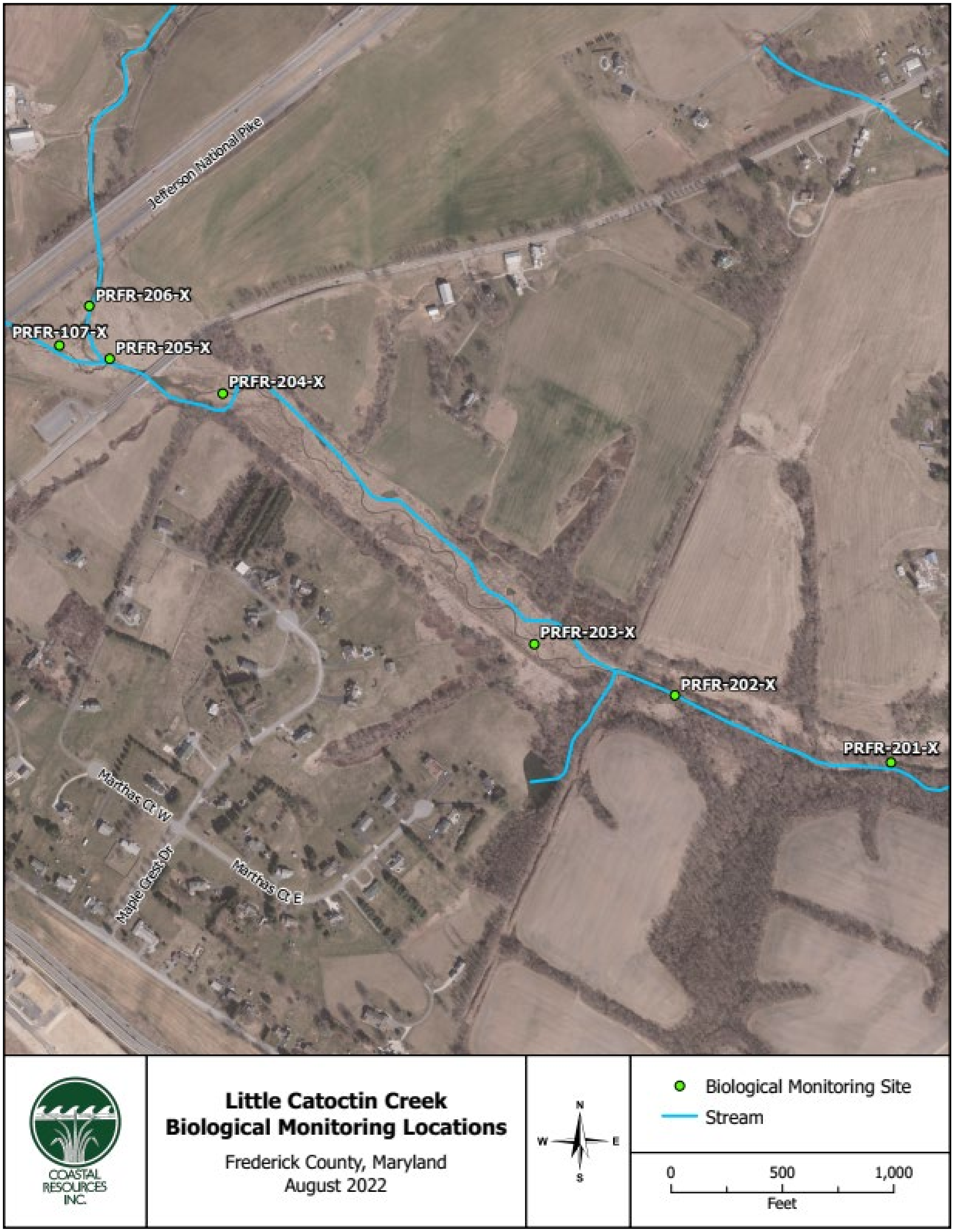

Figure 8. Locations of the seven biological monitoring sites in Little Catoctin Creek.

4.1 Methods

Biological and physical habitat assessments at all sites summarized in this report were conducted following Maryland Biological Stream Survey (MBSS) sampling protocols. Detailed descriptions of these protocols are provided by Stranko et al. (2019). However, a brief description of sampling protocols used for this project are as follows:

4.1.1 In-situ Water Quality

In-situ water quality data were collected along Little Catoctin using a *YSI ProDSS*© in 2022. Temperature, dissolved oxygen (DO), pH, specific conductance, and turbidity data were recorded for all six sites. Data collected for each site were compared to the Code of Maryland Regulations (COMAR), Water Quality Criteria Specific to Designated Uses (COMAR 26.08.02.03-3). Little Catoctin Creek is classified as a Use I-P stream (Water Contact Recreation, Protection of Aquatic Life, and Public Water Supply). The associated COMAR water quality criteria for Use I-P streams are presented in Table 4-1. Currently, there is no COMAR criterion for specific conductance. Morgan *et al.* (2007) identified a critical threshold of impairment of Fish Index of Biotic Integrity (FIBI) scores for urban Maryland streams at a specific conductance of 0.171 mS/cm; however, Morgan *et al.* (2012) found that the relationship between specific conductance and FIBI scores in Highlands streams are insignificant.

Table 4-1. Water Quality Parameters and Associated Stream Use Class Criteria

Parameter	Use I-P[1]
Temperature	Maximum of 32°C (90°F) or ambient temperature, whichever is greater
pH	6.5 to 8.5
DO	Minimum of 5 mg/L
Turbidity	Maximum of 150 NTU and maximum monthly average of 50 NTU

[1] Water Contact Recreation, Protection of Aquatic Life, and Public Water Supply

4.1.2 Benthic Macroinvertebrates

Benthic macroinvertebrate samples were processed, subsampled, and identified using protocols detailed in *Laboratory Methods for Benthic Macroinvertebrate Processing and Taxonomy* (Boward and Friedman 2019), under the supervision of a staff manager with current MBSS laboratory processing and subsampling certification. In the laboratory, samples were transferred to a gridded tray and subsampled using a fixed-count method. Grids were randomly picked in entirety until a total of 120 organisms were collected. If the total number of organisms removed from the first grid was equal to or greater than 120, subsampling was complete for the sample. If the number of organisms was less than 120, the subsampler moved on to pick the next randomly selected grid. The last grid chosen was picked in its entirety.

Samples from each monitoring site were identified to genus, or the lowest taxonomic level possible. Chironomidae larvae and Oligochaeta were subsampled, mounted, and identified using MBSS methods by a taxonomist with current Society for Freshwater Science (SFS) genus-level certifications for eastern EPT taxa and Chironomidae (Boward and Friedman 2019). The final classification and abundance of each organism was entered into a Microsoft Access database that contained information on the tolerance value, functional feeding group (FFG), and habit (characteristic behavior) of each taxonomic group.

Benthic macroinvertebrate data were used to calculate a Benthic Index of Biotic Integrity (BIBI) for each site (Stribling *et al.* 1998; Southerland *et al.* 2005) using R statistical software (R Core Team 2022). In order to document more subtle changes in the benthic macroinvertebrate communities, further analyses of taxa composition and dominance, pollution tolerance, and FFGs were conducted, when appropriate. Diversity indices such as taxa richness, Shannon-Weiner Diversity Index, and Simpson's Evenness Index were also calculated for each site. For analyses, sites were categorized into either upstream, downstream, pre-restoration and post-restoration types. Upstream and downstream site types include data from all monitoring years (2016-2020), whereas pre-restoration and post-restoration site types included data from only those time periods for the sites within the restoration reach. A one-way ANOVA was performed to compare the effect of the four site types on each of the following benthic community metrics: taxa richness, Shannon Weiner Diversity Index, Simpson's Evenness Index, and BIBI score. One-way ANOVAs were also used to compare the effect of the four site types on the following benthic macroinvertebrate FFGs: collectors, filterers, predators, scrapers, and shredders. A Tukey's Honestly Significant Difference (HSD) post-hoc test was performed on all comparisons with a significant ANOVA.

This BIBI method compares the macroinvertebrate community within a given stream to reference macroinvertebrate communities in least-impaired, state-wide reference streams. The BIBI uses eight community metrics found to characterize macroinvertebrate community health in Maryland's Highland streams, including:

- Total Number of Taxa
- Number of EPT Taxa
- Number of Ephemeroptera Taxa
- Percent Intolerant to Urban
- Percent Tanytarsini
- Number of Scraper Taxa
- Percent Swimmer Taxa
- Percent Diptera

The individual metrics used are defined and described below. The BIBI is calculated by assigning each metric a score based on its value. The combined scores of the eight metrics are then averaged to determine the BIBI. BIBI scores and their associated narrative ratings are presented in Table 4-2.

1. **Total Number of Taxa** – This metric reflects the health of the community through measurement of the total number of unique taxa in a sample. An increase in taxa is assumed to be directly related to the increase in water quality, habitat diversity, and/or habitat suitability.

2. **Number of EPT Taxa** – The richness of the generally intolerant insect orders of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). This value summarizes taxa richness with macroinvertebrates that are considered to be intolerant of pollution. Therefore, a higher number of taxa within the sample suggests better water quality conditions.

3. **Number of Ephemeroptera Taxa** – The richness of mayfly taxa indicates the ability of a stream to support this generally intolerant insect order.

4. **Percent Intolerant to Urban** – Intolerant taxa are the first to be eliminated by disturbances. This metric is the percentage of insects with tolerance ratings from zero to three on the zero to ten scale that make up the total sample.

5. **Percent Tanytarsini** – This metric reflects the percentage of Tanytarsini in the total sample. An increase in Tanytarsini indicates an increase in water quality.

6. **Number of Scraper Taxa** – Scraper taxa feed on periphyton and other macrofauna, which are more abundant in high quality habitats. An increase in herbivorous scraper taxa indicate a lack of stressors in the environment.

7. **Percent Swimmer Taxa** – The decrease in richness of taxa that primarily swim indicates a decrease in anthropogenic stressors.

8. **Percent Diptera** – The percent of Diptera or "true" fly larvae and pupae in a sample, suggests worse water quality conditions.

Table 4-2. MBSS BIBI Scores and Ratings

BIBI Score	Narrative Rating	Characteristics
4.00 – 5.00	Good	Comparable to reference streams considered to be minimally impacted, biological metrics fall within the upper 50 percent of reference site conditions.
3.00 – 3.99	Fair	Comparable to reference conditions, but some aspects of biological integrity may not resemble the qualities of minimally impacted streams.
2.00 – 2.99	Poor	Significant deviation from reference conditions, indicating some degradation. On average, biological metrics fall below the 10th percentile of reference site values.
1.00 – 1.99	Very Poor	Strong deviation from reference conditions, with most aspects of biological integrity not resembling the qualities of minimally impacted streams, indicating severe degradation. On average, most or all metrics fall below the 10th percentile of reference site values.

Source: Stribling *et al.* 1998

4.1.3 Physical Habitat

Physical habitat was assessed at each of the six sites using the MBSS summer physical habitat methodology, which assesses the condition and availability of the stream habitat for aquatic biota (Stranko *et al.* 2019). The MBSS physical habitat methods are based on the Environmental Protection Agency's Rapid Bioassessment Protocol (Barbour *et al.* 1999) and modified for use in Maryland streams.

4.1.4 Fish Community

MBSS field sampling and data analysis protocols were used to assess the condition of the fish communities along Little Catoctin Creek (Stranko *et al.* 2019; Roth *et al.* 2000; Southerland *et al.* 2005). Fish communities were sampled at each of the six sites following MBSS double-pass electrofishing procedures. Sampling was overseen by a certified MBSS crew leader and fish identification was conducted by a certified MBSS fish taxonomist. Captured fish were identified to species, counted, and examined for external pathologies or other abnormalities. Any individuals that could not be identified to species were retained for identification in the laboratory. For each electrofishing pass, all fish were weighed together for an aggregate biomass measurement in grams. Representative photo vouchers were retained for each species collected and all fish were released following processing.

Fish data were used to calculate a Fish Index of Biotic Integrity (FIBI) score for each site (Roth *et al.* 2000; Southerland *et al.* 2005) with R statistical software (R Core Team 2022). The FIBI compares the fish community within a given stream to reference fish communities in the least-impaired reference streams for a certain MBSS stratum, which is based largely on physiographic province. All six sites are located in the MBSS Warmwater Highlands stratum. To document more subtle changes in fish communities, analyses of taxa composition and dominance, pollution tolerance, and FFG were conducted, when appropriate. Diversity indices such as taxa richness, Shannon-Weiner Diversity Index, and Simpson’s Evenness Index were also calculated for each site. A one-way ANOVA was performed to compare the effect of the four site types (upstream, downstream, pre-restoration, and post-restoration) on each of the following fish community metrics: taxa richness, Shannon Weiner Diversity Index, Simpson's Evenness Index, and FIBI score. A Tukey’s Honestly Significant Difference (HSD) post-hoc test was performed on all comparisons with a significant ANOVA.

Warmwater Highlands

The Warmwater Highlands FIBI uses six comparative community metrics found to characterize fish community health. The individual metrics are defined and described below.

1. Abundance per Square Meter – The number of individuals captured at a site, divided by the surface area sampled. Surface area is computed as the length of stream sampled (75 meters) multiplied by the average stream width. The number of individuals per square meter is expected to decrease with greater impairment.

2. Number of Benthic Fish Species (Adjusted for Watershed Area) – Total number of fish species that reside primarily on the stream bottom, adjusted for watershed size. Darter, sculpin, madtom, and lamprey species were included as benthic specialists in this metric. Benthic species tend to decrease with greater impairment or disturbance.

3. Percent Tolerant Fish – The percentage of individuals rated as tolerant to anthropogenic stress. The composition of individuals is expected to increase with greater impairment.

4. Percent Generalists, Omnivores, and Invertivores – The percentage of individuals classified into the trophic groups of generalist, omnivore, or invertivore. These are the most general of all feeding groups and their composition is expected to increase with greater impairment.

5. Percent Insectivores – The percent of individuals that feed on invertebrates. The composition of individuals is expected to decrease with greater impairment.

6. Percent Abundance of Dominant Taxon – Percentage of sample made up of the most dominant species. This percentage is expected to increase with greater impairment.

The FIBI is calculated by assigning each metric a score based on its value. The combined scores of the metrics are then averaged to determine the overall FIBI score. Table 4-3 presents overall FIBI scores and their associated narrative ratings.

Table 4-3. MBSS FIBI Scores and Ratings

FIBI Score	Narrative Rating	Characteristics
4.00 – 5.00	Good	Comparable to reference streams considered to be minimally impacted, biological metrics fall within the upper 50 percent of reference site conditions.
3.00 – 3.99	Fair	Comparable to reference conditions, but some aspects of biological integrity may not resemble the qualities of minimally impacted streams.
2.00 – 2.99	Poor	Significant deviation from reference conditions, indicating some degradation. On average, biological metrics fall below the 10th percentile of reference site values.
1.00 – 1.99	Very Poor	Strong deviation from reference conditions, with most aspects of biological integrity not resembling the qualities of minimally impacted streams, indicating severe degradation. On average, most or all metrics fall below the 10th percentile of reference site values.

Source: Roth et al. 2000

4.2 Results

Monitoring data for water quality, benthic macroinvertebrate communities, physical habitat, and fish communities are summarized below. Site summary sheets that include detailed data from 2022 and previous monitoring years are presented in Attachment B.

4.2.1 In-situ Water Quality

In general, in-situ water quality parameters were similar among all six sites in 2022 (Table 4-4). All sites met COMAR standards for Use I-P streams for water temperature, DO, pH, and turbidity. Specific conductance was above 0.171 mS/cm at all sites, the value at which it has been shown to negatively affect the fish community in urban Maryland streams (Morgan *et al*., 2007). Water temperature differed slightly among sites, however; time of day and ambient air temperatures during sampling were likely driving factors.

Table 4-4. 2022 Summer In-Situ Water Quality Results at Little Catoctin Creek

Reach	Site	Water Temp (°C)	DO (mg/L)	pH	Specific Conductance (mS/cm)	Turbidity (NTU)
Downstream	PRFR-201-X	20.8	7.66	7.51	0.314	3.2
	PRFR-202-X	25.3	9.44	8.04	0.308	3.1
Restoration	PRFR-203-X	18.8	8.35	7.38	0.332	2.7
	PRFR-204-X	22.3	7.43	7.37	0.312	5.9
Upstream	PRFR-205-X	17.1	7.10	7.71	0.308	3.4
	PRFR-206-X	20.8	7.84	7.21	0.283	4.4

4.2.2 Benthic Macroinvertebrates

A total of 64 benthic macroinvertebrate taxa were collected in the 100-organism subsamples in Little Catoctin Creek in 2020, across all seven sites. BIBI scores at all sites were similar, in general, and ranged from 1.25 to 2.75 (Figure 9). A summary of benthic macroinvertebrate conditions at each site within the three study reaches can be found below.

<u>Downstream</u>

For site PRFR-201-X, taxa richness was 21 in 2020. There were four Ephemeroptera, Plecoptera and Trichoptera (EPT) taxa, three pollution-intolerant taxa, and six pollution-tolerant taxa (Table 4-5). The BIBI score was 2.00 in 2020, with a narrative rating of Poor.

Taxa richness was 28 at site PRFR-202-X in 2020. There were four EPT taxa, three pollution-intolerant taxa, and nine pollution-tolerant taxa. The BIBI score at site PRFR-202-X was 2.25 in 2020, with a narrative rating of Poor.

Table 4-5. BIBI Scores, Number of EPT Taxa, and Pollution-intolerant and Tolerant Benthic Macroinvertebrate Taxa from the Downstream Study Reach in Little Catoctin Creek

Site	Phase	Year	Number of EPT Taxa	Number of Intolerant Taxa	Number of Tolerant Taxa	BIBI	Narrative Rating
PRFR-201-X	Pre-Restoration	2016	6	6	12	2.00	Poor
		2017	3	2	8	1.75	Very Poor
	Post-Restoration	2019	3	5	10	2.75	Poor
		2020	**4**	**3**	**6**	**2.00**	**Poor**
PRFR-202-X	Pre-Restoration	2016	6	3	13	2.25	Poor
		2017	1	1	9	1.75	Very Poor
	Post-Restoration	2019	3	1	11	2.50	Poor
		2020	**4**	**3**	**9**	**2.25**	**Poor**

Number of EPT taxa, number of intolerant taxa, and number of tolerant taxa totals do not include excluded taxa.

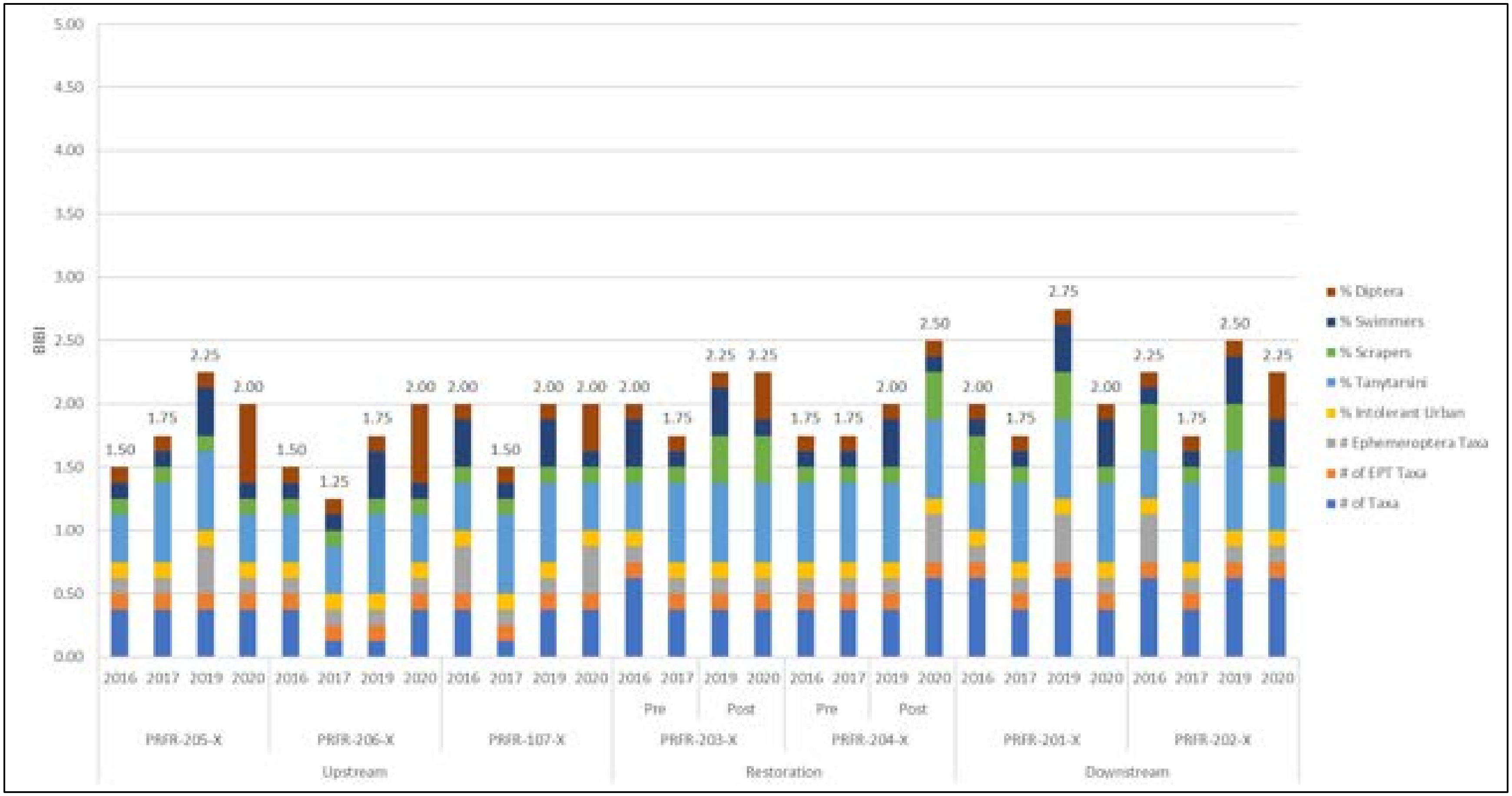

Figure 9. Graph of BIBI Metric Contribution to BIBI Score per Site per Year

Restoration

The total number of taxa at site PRFR-203 in 2020 was 20. The number of EPT taxa was one, the number of pollution-intolerant taxa was one, and the number of pollution-tolerant taxa was eight (Table 4-6). The BIBI score was 2.25 in 2020 and received a narrative rating of Poor.

For site PRFR-204-X, the total number of taxa in 2020 was 26. There were five EPT taxa, three pollution-intolerant taxa, and 12 pollution-tolerant taxa. Site PRFR-204-X had a BIBI score of 2.50 in 2020, with a narrative rating of Poor.

Table 4-6. BIBI Scores, Number of EPT Taxa, and Pollution-intolerant and Tolerant Benthic Macroinvertebrate Taxa from the Restoration Study Reach in Little Catoctin Creek

Site	Phase	Year	Number of EPT Taxa	Number of Intolerant Taxa	Number of Tolerant Taxa	BIBI	Narrative Rating
PRFR-203-X	Pre-Restoration	2016	5	4	11	2.00	Poor
		2017	3	2	11	1.75	Very Poor
	Post-Restoration	2019	3	2	12	2.25	Poor
		2020	**1**	**1**	**8**	**2.25**	**Poor**
PRFR-204-X	Pre-Restoration	2016	1	3	9	1.75	Very Poor
		2017	0	3	8	1.75	Very Poor
	Post-Restoration	2019	2	2	10	2.00	Poor
		2020	**5**	**3**	**12**	**2.50**	**Poor**

Number of EPT taxa, number of intolerant taxa, and number of tolerant taxa totals do not include excluded taxa.

Upstream

Site PRFR-205-X had a total of 16 taxa in 2020. The number of EPT taxa was three, the number of pollution-intolerant taxa was one, and the number of pollution-tolerant taxa was six (Table 4-7). The BIBI score was 2.00, with a narrative rating of Poor.

Taxa richness at site PRFR-206-X was 23 in 2020. There were two EPT taxa, zero pollution-intolerant taxa, and 12 pollution-tolerant taxa. The BIBI score was 2.00 at site PRFR-206-X, with a narrative rating of Poor.

For site PRFR-107-X, taxa richness was 22 in 2020. The number of EPT taxa was six, the number of pollution-intolerant taxa was two, and the number of pollution-tolerant taxa was 10. Site PRFR-107-X had a BIBI score of 2.00 in 2020, with a narrative rating of Poor.

Table 4-7. BIBI Scores, Number of EPT Taxa, and Pollution-intolerant and Tolerant Benthic Macroinvertebrate Taxa from the Upstream Study Reach in Little Catoctin Creek

Site	Phase	Year	Number of EPT Taxa	Number of Intolerant Taxa	Number of Tolerant Taxa	BIBI	Narrative Rating
PRFR-205-X	Pre-Restoration	2016	1	3	6	1.50	Very Poor
		2017	0	1	12	1.75	Very Poor
	Post-Restoration	2019	4	3	9	2.25	Poor
		2020	**3**	**1**	**6**	**2.00**	**Poor**
PRFR-206-X	Pre-Restoration	2016	1	2	6	1.50	Very Poor
		2017	0	1	9	1.25	Very Poor
	Post-Restoration	2019	1	1	6	1.75	Very Poor
		2020	**2**	**0**	**12**	**2.00**	**Poor**
PRFR-107-X	Pre-Restoration	2016	3	3	8	2.00	Poor
		2017	1	3	6	1.50	Very Poor
	Post-Restoration	2019	2	2	11	2.00	Poor
		2020	**6**	**2**	**10**	**2.00**	**Poor**

Number of EPT taxa, number of intolerant taxa, and number of tolerant taxa totals do not include excluded taxa.

<u>Statistical Analyses</u>

Shannon-Weiner Diversity Index, Simpson's Evenness Index, taxa richness, and BIBI scores are presented in Table 4-8 and Figure 10. There were no significant differences found among the four site types for both the Shannon-Weiner Diversity Index and Simpson's Evenness Index in one-way ANOVAs. Results of a one-way ANOVA indicate that mean species richness was significantly different among the site types ($F(3, 24) = 4.367$, $p = 0.014$) and results of a Tukey's HSD pairwise comparison show that the mean species richness was significantly different between the downstream and upstream site types (adjusted $p = 0.008$, 95% C.I. = 1.579, 12.505). Results of a one-way ANOVA indicate that mean BIBI scores were significantly different among the site types ($F(3, 24) = 4.246$, $p = 0.015$). A Tukey's HSD post-hoc analysis showed no significant pairwise differences in BIBI score between the site types; however, the post-restoration and upstream site types, as well as the downstream and upstream site types, had marginally significant p-values of 0.052 and 0.050, respectively. This combination of test results is possible since the Tukey's HSD analysis is a more conservative test relative to the ANOVA because it controls the overall error rate and adjusts for multiple comparisons. Also, an ANOVA tests the entire independent variable against the dependent variable while the Tukey's HSD test compares differences among pairs of variables and adjusts for these multiple comparisons.

There were no significant differences among the site types and the percentage of each FFG, except for percentage of scrapers (Figure 11). Based on a Tukey's HSD test, the percentage of scrapers was significantly different ($F(3, 24) = 5.155$, $p = 0.007$) between the upstream and post-restoration site types ($p = 0.022$, 95% C.I. = 0.107, 6.432) and between the upstream and downstream site types ($p = 0.018$, 95% C.I. = 0.404, 5.167).

Table 4-8. Average Metric Values Among Study Reaches Using Benthic Macroinvertebrate Data

Reach	Phase	Year	Taxa Richness	S-W (D')[1]	Simpson's Evenness Index	BIBI	Rating
Downstream	Pre-Restoration	2016	31.00	2.62	0.85	2.13	Poor
		2017	17.50	2.03	0.81	1.75	Very Poor
	Post-Restoration	2019	25.50	2.50	0.86	2.63	Poor
		2020	**24.50**	**2.47**	**0.84**	**2.13**	**Poor**
Restoration	Pre-Restoration	2016	23.00	2.39	0.83	1.88	Very Poor
		2017	18.00	1.91	0.72	1.75	Very Poor
	Post-Restoration	2019	21.00	2.40	0.87	2.13	Poor
		2020	**23.00**	**2.27**	**0.82**	**2.38**	**Poor**
Upstream	Pre-Restoration	2016	18.00	2.20	0.82	1.67	Very Poor
		2017	13.67	2.09	0.81	1.50	Very Poor
	Post-Restoration	2019	18.33	2.30	0.86	2.00	Poor
		2020	**20.33**	**1.62**	**0.59**	**2.00**	**Poor**

Restoration and downstream groups are averages of two sites; upstream is an average of three sites.

[1]S-W (D') = Shannon-Weiner Diversity Index.

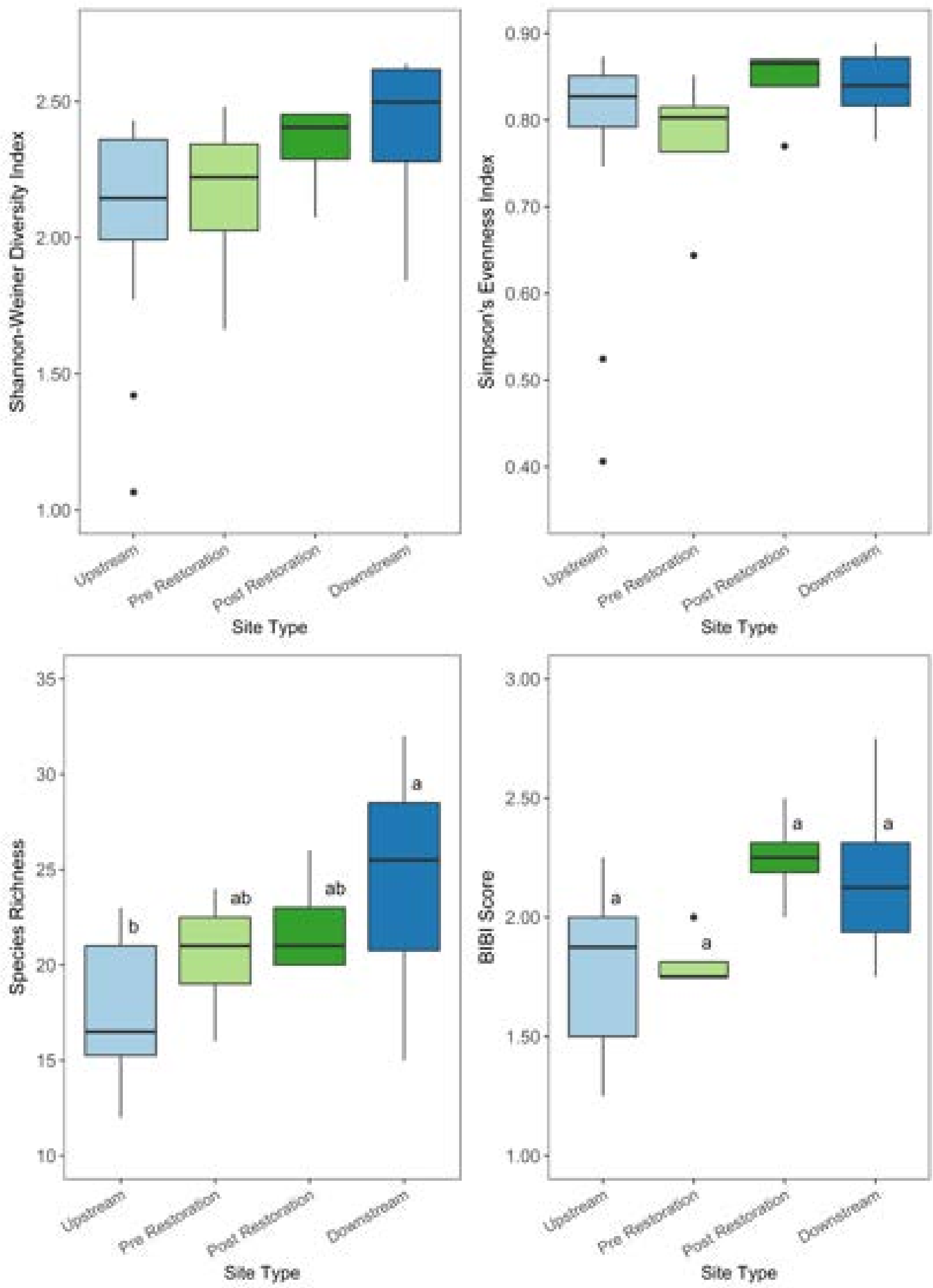

Figure 10. Boxplots of Benthic Macroinvertebrate Community Metrics Among Site Types

Note: Site types sharing the same letter are not statistically different, per a Tukey's HSD pair-wise comparison. Upstream and Downstream site types include data from all monitoring years (2016-2020), whereas the Pre-Restoration and Post-Restoration site types included data from only those time periods for the sites within the restoration reach.

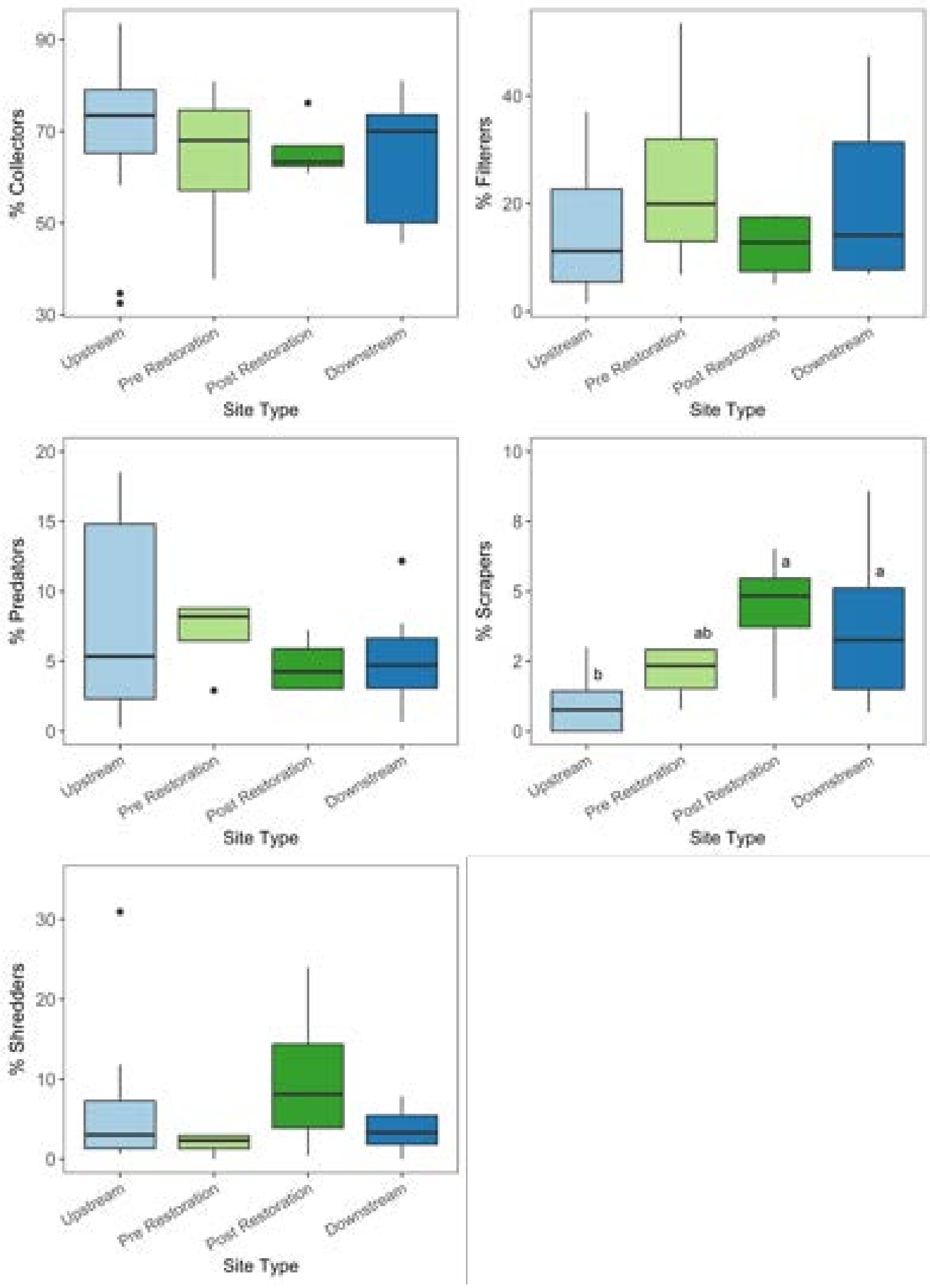

Figure 11. Boxplots of Benthic Macroinvertebrate Functional Feeding Groups Among Site Types

Note: Site types sharing the same letter are not statistically different, per a Tukey's HSD pair-wise comparison. Upstream and Downstream site types include data from all monitoring years (2016-2020), whereas the Pre-Restoration and Post-Restoration site types included data from only those time periods for the sites within the restoration reach.

4.2.3 Physical Habitat

A summary of physical habitat conditions at each site within the three study reaches is presented below.

Downstream

All habitat parameters fell in the suboptimal range at site PRFR-201-X in 2022 (Table 4-9). Pool and glide extent was 44 meters, while riffle and run extent was 21 meters. Embeddedness was 55 percent in 2022, while shading was 75 percent.

For site PRFR-202-X, instream habitat and epifaunal substrate fell in the low optimal range, while all other habitat parameters fell in the suboptimal range in 2022. Pool and glide extent was 27 meters, while riffle and run extent was 48 meters. Embeddedness was 40 percent, while shading was 70 percent at site PRFR-202-X.

Restoration

All habitat parameters fell in the suboptimal range at site PRFR-203-X in 2022, except for riffle and run quality, which fell in the low optimal range (Table 4-10). Pool and glide extent was 32 meters, while riffle and run extent was 43 meters. Percent embeddedness was 60 in 2022, while percent shading was 30.

For site PRFR-204-X, all habitat parameters fell in the marginal range in 2022, except for riffle and run quality, which fell in the low suboptimal range. Pool and glide extent was 54 meters in 2022, while riffle and run extent was 31 meters. Embeddedness was 75 percent at site PRFR-204-X, while shading was 45 percent.

Upstream

In 2022, velocity and depth diversity, and pool and glide quality were in the upper marginal range, while all other parameters fell in the mid-suboptimal range at site PRFR-205-X (Table 4-11). Pool and glide extent was 43 meters, while riffle and run extent was 32 meters. Percent embeddedness was 50 in 2022, while percent shading was 17.

At site PRFR-206-X, all habitat parameters fell in the suboptimal range in 2022. Pool and glide extent was 37 meters, while riffle and run extent was 38 meters. Percent embeddedness was 50 in 2022, and percent shading was 20 at site PRFR-206-X.

Table 4-9. Physical Habitat Data from the Downstream Study Reach at Little Catoctin Creek Before and After Restoration

Site	Phase	Year	Instream Habitat	Epifaunal Substrate	Velocity & Depth Diversity	Pool & Glide Quality	Pool & Glide Extent (m)	Riffle & Run Quality	Riffle & Run Extent (m)	Embedded -ness (%)	Shading (%)
PRFR-201-X	Pre-Restoration	2016	15	15	14	15	54	16	23	40	60
		2017	12	15	12	13	66	13	16	50	70
	Post-Restoration	2019	12	13	12	12	55	11	20	40	50
		2022	**14**	**14**	**12**	**13**	**54**	**13**	**21**	**55**	**75**
PRFR-202-X	Pre-Restoration	2016	18	17	14	17	55	16	23	25	40
		2017	15	12	12	15	62	12	17	55	35
	Post-Restoration	2019	13	13	13	12	30	14	45	50	35
		2022	**16**	**16**	**13**	**14**	**27**	**15**	**48**	**40**	**70**

Table 4-10. Physical Habitat Data from the Restoration Study Reach in Little Catoctin Creek Before and After Restoration

Site	Phase	Year	Instream Habitat	Epifaunal Substrate	Velocity & Depth Diversity	Pool & Glide Quality	Pool & Glide Extent (m)	Riffle & Run Quality	Riffle & Run Extent (m)	Embedded-ness (%)	Shading (%)
PRFR-203-X	Pre-Restoration	2016	16	15	14	16	61	16	28	25	20
		2017	14	12	12	15	61	14	26	25	35
	Post-Restoration	2019	10	11	11	11	37	15	38	35	5
		2022	**12**	**15**	**13**	**11**	**32**	**16**	**43**	**60**	**30**
PRFR-204-X	Pre-Restoration	2016	13	16	13	12	36	17	51	15	20
		2017	11	12	13	12	44	12	33	25	35

Site	Phase	Year	Instream Habitat	Epifaunal Substrate	Velocity & Depth Diversity	Pool & Glide Quality	Pool & Glide Extent (m)	Riffle & Run Quality	Riffle & Run Extent (m)	Embedded-ness (%)	Shading (%)
	Post-Restoration	2019	8	10	9	8	24	10	51	40	5
		2022	**10**	**10**	**9**	**7**	**44**	**11**	**31**	**75**	**45**

Table 4-11. Physical Habitat Data from the Upstream Study Reach in Little Catoctin Creek Before and After Restoration

Site	Phase	Year	Instream Habitat	Epifaunal Substrate	Velocity & Depth Diversity	Pool & Glide Quality	Pool & Glide Extent (m)	Riffle & Run Quality	Riffle & Run Extent (m)	Embedded-ness (%)	Shading (%)
PRFR-205-X	Pre-Restoration	2016	15	12	13	13	41	16	38	30	10
		2017	10	11	9	9	49	15	35	20	25
	Post-Restoration	2019	11	9	9	8	42	13	43	40	5
		2022	**13**	**14**	**10**	**10**	**43**	**13**	**32**	**50**	**17**
PRFR-206-X	Pre-Restoration	2016	12	11	12	11	41	11	35	40	15
		2017	8	11	11	11	38	13	41	25	20
	Post-Restoration	2019	13	9	11	12	54	10	24	30	5
		2022	**11**	**13**	**12**	**12**	**37**	**12**	**38**	**50**	**20**

4.2.4 Fish Community

The fish community was rated as Good in the downstream reach, and as Fair in both the restoration and upstream reaches in 2022 (Table 4-11 and Figure 12). All six sites were scored using the Warmwater Highlands FIBI. A total of 20 different species were observed within the study area in 2022. A detailed discussion of the fish community at each site is provided below.

Table 4-12. 2022 FIBI Scores at Little Catoctin Creek

Reach	Site	FIBI	Narrative Rating
Downstream	PRFR-201-X	4.00	Good
	PRFR-202-X	4.00	Good
Restoration	PRFR-203-X	3.33	Fair
	PRFR-204-X	3.33	Fair
Upstream	PRFR-205-X	3.67	Fair
	PRFR-206-X	3.00	Fair

Downstream

In 2022, PRFR-201-X and PRFR-202-X both had FIBI scores of 4.00, with a narrative rating of Good (Table 4-13). For PRFR-201-X, all FIBI metric scores, except for the percent tolerant metric, remained the same in every monitoring year. Beginning in 2017 an increase in the percentage of tolerant species at the site caused a reduction in FIBI score. For PRFR-202-X, all FIBI metric scores, except for the percentage of insectivores and the percent abundance of dominant taxa, remained the same across all monitoring years. Beginning in 2017, the percent abundance of dominant taxa decreased, and beginning in 2019, the percentage of insectivores increased. Both changes caused an increase in metric scores and the overall FIBI.

In aggregate, 19 fish species were observed at the downstream sites in 2022. Bluntnose minnow (*Pimephales notatus*) was the most dominant species observed at both sites and comprised 28 percent of the community at PRFR-201-X and 30 percent of the community at PRFR-202-X. The next most abundant taxa included blacknose dace (*Rhinichthys atratulus*, 15 percent), central stoneroller (*Campostoma anomalum*, 12 percent), and silverjaw minnow (*Notropis buccatus*, 9 percent) at PRFR-201-X and silverjaw minnow (22 percent), blacknose dace (12 percent), and central stoneroller (11 percent) at PRFR-202-X. Bluntnose minnow and blacknose dace are species that are tolerant to urbanization, while central stoneroller and silverjaw minnow are considered intolerant to urbanization. In 2022, the majority of the fish community at both sites was comprised of non-specialized functional feeding groups (i.e., generalists, omnivores, and invertivores) as indicated by the percent generalists, generalists, omnivores, and invertivores FIBI metric.

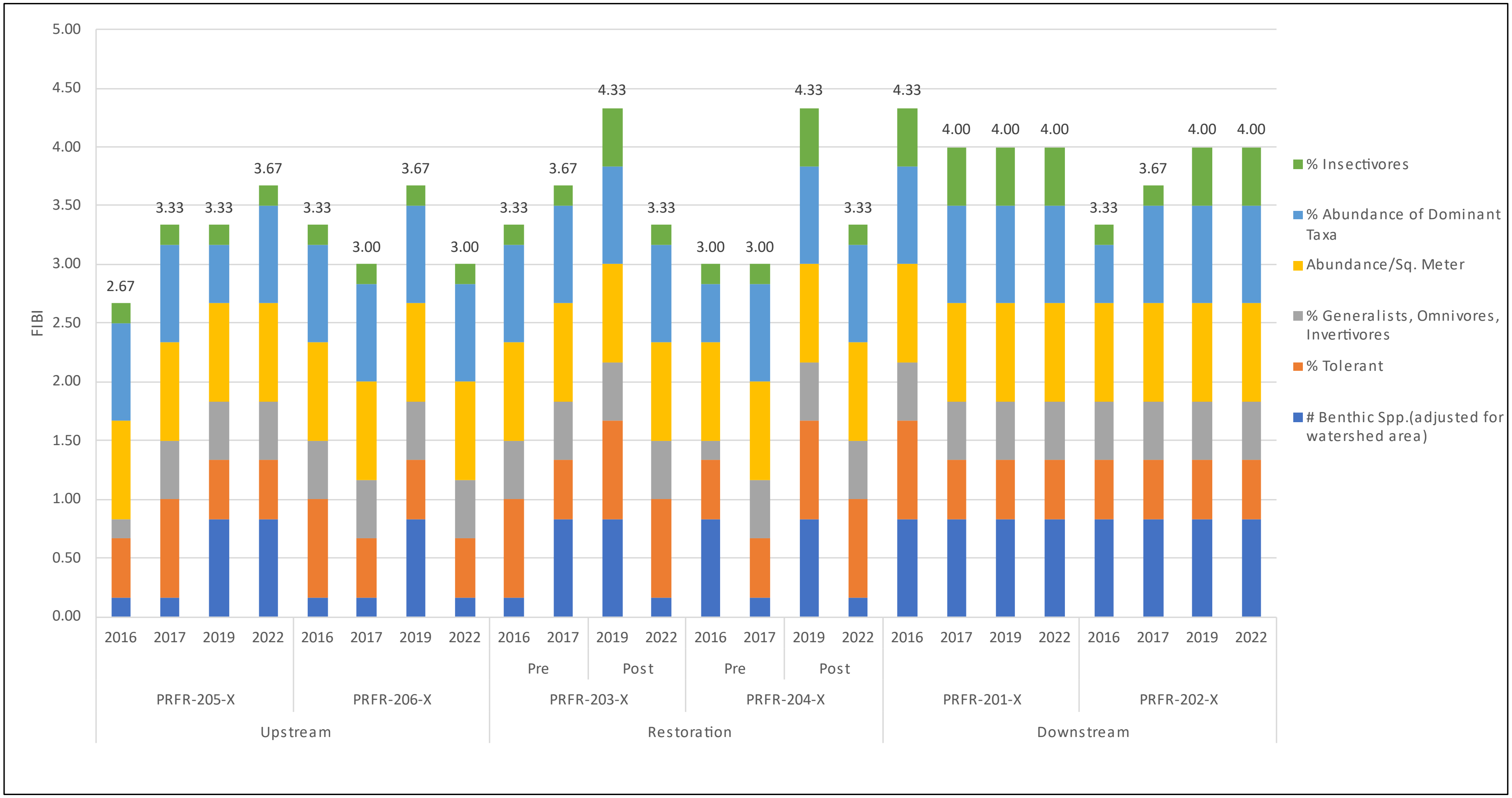

Figure 12. Graph of FIBI Metric Contribution to FIBI Score per Site per Year

Table 4-13. 2022 Warmwater Highlands FIBI Metrics, Scores, and Ratings for the Downstream Study Reach in Little Catoctin Creek

FIBI Parameter	**PRFR-201-X**				**PRFR-202-X**			
	2016	**2017**	**2019**	**2022**	**2016**	**2017**	**2019**	**2022**
Abundance per Square Meter	1.48	1.55	2.90	**1.74**	2.05	1.77	3.87	**1.93**
% Abundance of Dominant Taxa	16.78	23.92	17.67	**27.90**	41.88	21.20	29.39	**29.61**
Number of Benthic species (adjusted)	0.52	0.52	0.52	**1.03**	1.05	0.52	1.05	**0.52**
% Generalist, Omnivores, Invertivores	94.98	93.46	86.43	**84.84**	95.74	87.41	89.87	**87.76**
% Insectivores	3.63	1.72	1.71	**2.55**	0.78	0.62	2.89	**1.45**
% Tolerant	33.91	58.18	42.71	**54.25**	65.73	52.49	47.23	**52.11**
Score: Abundance per Square Meter	5	5	5	**5**	5	5	5	**5**
Score: Number of Benthic species (adjusted)	5	5	5	**5**	5	5	5	**5**
Score: % Tolerant	5	3	3	**3**	3	3	3	**3**
Score: % Generalist, Omnivores, Invertivores	3	3	3	**3**	3	3	3	**3**
Score: % Abundance of Dominant Taxa	5	5	5	**5**	3	5	5	**5**
Score: % Insectivores	3	3	3	**3**	1	1	3	**3**
Overall FIBI Score	4.33	4.00	4.00	**4.00**	3.33	3.67	4.00	**4.00**
Narrative Rating	Good	Good	Good	**Good**	Fair	Fair	Good	**Good**

Restoration

Site PRFR-203-X had a FIBI score of 3.33 in 2022, with a rating of Fair (Table 4-14). FIBI metric scores for abundance per square meter; percent generalists, omnivores, and invertivores; and percent abundance of dominant taxa were the same in all monitoring years. The metric score for the number of benthic species (adjusted for watershed size) decreased in 2022 due to the absence of greenside darter (*Etheostoma blennioides*) and fantail darter (*E. flabellare*) that were observed in previous years. The 2019 fantail darter captures also increased the metric score for percentage of insectivores. A total of 14 different fish species were observed in 2022. Central stoneroller was the most dominant taxa, which comprised 23 percent of the community, followed by yellow bullhead (*Ameiurus natalis*), which comprised 13 percent of the community, and bluehead chub (*Nocomis leptocephalus*) and common shiner (*Luxilus cornutus*), which both also comprised 13 percent of the community. Central stoneroller, bluehead chub, and common shiner are intolerant species, while yellow bullhead has no tolerance designation. Bluehead chub is a non-native species that has been extending its range throughout Potomac River tributaries. The majority of the fish community at PRFR-203-X consisted of non-specialized functional feeding groups (i.e., generalists, omnivores, and invertivores) as indicated by the percent generalists, generalists, omnivores, and invertivores FIBI metric.

Table 4-14. 2022 Warmwater Highlands FIBI Metrics, Scores, and Ratings for the Restoration Study Reach in Little Catoctin Creek

FIBI Parameter	PRFR-203-X				PRFR-204-X			
	Pre-Restoration		Post-Restoration		Pre-Restoration		Post-Restoration	
	2016	2017	2019	2022	2016	2017	2019	2022
Abundance per Square Meter	3.68	3.68	7.09	**2.57**	1.02	1.25	7.98	**1.09**
% Abundance of Dominant Taxa	22.10	19.86	31.05	**22.65**	38.48	33.24	27.23	**20.74**
Number of Benthic species (adjusted)	0.00	0.53	0.53	**0.00**	0.54	0.00	0.54	**0.00**
% Generalist, Omnivores, Invertivores	90.99	81.21	85.34	**77.35**	97.56	95.34	88.82	**93.33**
% Insectivores	0.00	0.10	1.45	**0.00**	0.27	0.00	1.09	**0.00**
% Tolerant	36.48	43.52	23.82	**30.39**	68.56	68.22	37.64	**34.81**
Score: Abundance per Square Meter	5	5	5	**5**	5	5	5	**5**
Score: Number of Benthic species (adjusted)	1	5	5	**1**	5	1	5	**1**
Score: % Tolerant	5	3	5	**5**	3	3	5	**5**
Score: % Generalist, Omnivores, Invertivores	3	3	3	**3**	1	3	3	**3**
Score: % Abundance of Dominant Taxa	5	5	5	**5**	3	5	5	**5**
Score: % Insectivores	1	1	3	**1**	1	1	3	**1**
Overall FIBI Score	3.33	3.67	4.33	**3.33**	3.00	3.00	4.33	**3.33**
Narrative Rating	Fair	Fair	Good	**Fair**	Fair	Fair	Good	**Fair**

The FIBI score at site PRFR-204-X was also 3.33 in 2022, with a rating of Fair. FIBI metric scores for abundance per square meter were the same in all survey years. Fantail darter captures increased FIBI metric scores for number of benthic species (adjusted for watershed area) in 2016 and 2019 and percent insectivores in 2019. In 2022, the absence of benthic species caused a lower metric score and overall FIBI score. Fewer captures of tolerant fish species in 2019 and 2022 increased the metric score for percentage tolerant fish species. A total of 12 different fish species were observed in 2022. The most prevalent taxa were common shiner, bluehead chub, and green sunfish (*Lepomis cyanellus*), which comprised 21 percent, 17 percent, and 13 percent of the community, respectively. Common shiner and bluehead chub are intolerant species, while green sunfish is a tolerant species. The fish community was primarily comprised of non-specialized functional feeding groups (i.e., generalists, omnivores, and invertivores) as indicated by the percent generalists, generalists, omnivores, and invertivores FIBI metric.

Upstream

In 2022, PRFR-205-X and PRFR-206, had FIBI scores of 3.67 and 3.00, respectively. Narrative ratings for both sites were Fair (*Table 4-15*). FIBI metrics for the abundance of dominant taxa, at both sites, were the same for all monitoring years. A decrease in percent generalists, omnivores, and invertivores and an increase in the number of benthic species (adjusted for watershed size), with the capture of fantail darters in 2019 and 2022, caused slight increases in the FIBI score at PRFR-205-X over time. Fourteen species of fish were observed at PRFR-205-X in 2022. Bluntnose minnow, green sunfish, blacknose dace, and bluegill (*L. marochirus*) comprised 28 percent, 16 percent, 12 percent, and 9 percent of the community, respectively, and are all tolerant to urbanization.

At PRFR-206-X, FIBI metric scores for percent insectivores; percent generalists, omnivores, and invertivores; percent abundance of dominant taxa; and abundance per square meter were the same in each monitoring year. Changes in FIBI score were caused by an increase in the number of fish species tolerant to urbanization in 2017, 2019, and 2022, and from and the number of benthic species (adjusted for watershed size), with the capture of fantail darter in 2019. Thirteen species of fish were observed at PRFR-206-X in 2022. The most abundant species were bluntnose minnow, bluegill, bluehead chub, and common shiner, which comprised 21 percent, 15 percent, 10 percent, and 9 percent of the community, respectively.

Table 4-15. 2022 Warmwater Highlands FIBI Metrics, Scores, and Ratings for the Upstream Study Reach in Little Catoctin Creek

FIBI Parameter	PRFR-205-X				PRFR-206-X			
	2016	**2017**	**2019**	**2022**	**2016**	**2017**	**2019**	**2022**
Abundance per Square Meter	4.07	2.75	9.02	**2.13**	1.05	3.14	3.20	**1.74**
% Abundance of Dominant Taxa	22.34	17.59	39.80	**27.66**	20.69	35.89	29.19	**21.40**
Number of Benthic species (adjusted)	0.00	0.00	0.62	**0.61**	0.00	0.00	0.62	**0.00**
% Generalist, Omnivores, Invertivores	98.16	90.59	91.03	**93.39**	95.98	93.27	92.16	**92.56**
% Insectivores	0.00	0.00	0.32	**0.20**	0.00	0.00	0.87	**0.00**
% Tolerant	45.08	38.65	54.94	**65.33**	32.18	48.04	50.44	**48.37**
Score: Abundance per Square Meter	5	5	5	**5**	5	5	5	**5**
Score: Number of Benthic species (adjusted)	1	1	5	**5**	1	1	5	**1**
Score: % Tolerant	3	5	3	**3**	5	3	3	**3**
Score: % Generalist, Omnivores, Invertivores	1	3	3	**3**	3	3	3	**3**
Score: % Abundance of Dominant Taxa	5	5	3	**5**	5	5	5	**5**
Score: % Insectivores	1	1	1	**1**	1	1	1	**1**
Overall FIBI Score	2.67	3.33	3.33	**3.67**	3.33	3.00	3.67	**3.00**
Narrative Rating	Poor	Fair	Fair	**Fair**	Fair	Fair	Fair	**Fair**

Statistical Analyses

A one-way ANOVA was performed to compare the effect of the four site types (upstream, downstream, pre-restoration, and post-restoration) on each of the following fish community metrics: taxa richness, Shannon-Weiner Diversity Index, Simpson's Evenness Index, and FIBI score (Table 4-16 and Figure 13). There were no significant differences among the four site types for the Shannon Weiner Diversity Index, Simpson's Evenness Index, and taxa richness. Based on a Tukey's HSD test, FIBI score was significantly different ($F(3, 20) = 5.805$, $p = 0.005$) between the downstream and upstream site types ($p = 0.008$, 95% C.I. = 0.143, 1.107).

Table 4-16. Average Metric Values Among Study Reaches Using Fish Community Data

Reach	Phase	Year	Taxa Richness	S-W (D')[1]	Simpson's Evenness Index	FIBI	Rating
Downstream	Pre-Restoration	2016	17.50	2.27	0.84	3.83	Fair
		2017	15.00	2.37	0.88	3.84	Fair
	Post-Restoration	2019	18.00	2.29	0.87	4.00	Good
		2022	**17.00**	**2.17**	**0.84**	**4.00**	**Good**
Restoration	Pre-Restoration	2016	14.00	2.12	0.84	3.33	Fair
		2017	15.50	2.18	0.85	3.34	Fair
	Post-Restoration	2019	16.00	2.16	0.84	4.33	Good
		2022	**13.00**	**2.25**	**0.88**	**3.33**	**Fair**
Upstream	Pre-Restoration	2016	14.50	2.26	0.87	3.17	Fair
		2017	14.00	2.15	0.84	3.17	Fair
	Post-Restoration	2019	18.00	2.11	0.82	3.50	Fair
		2022	**13.50**	**2.27**	**0.87**	**3.33**	**Fair**

[1]S-W (D’) = Shannon-Weiner Diversity Index.

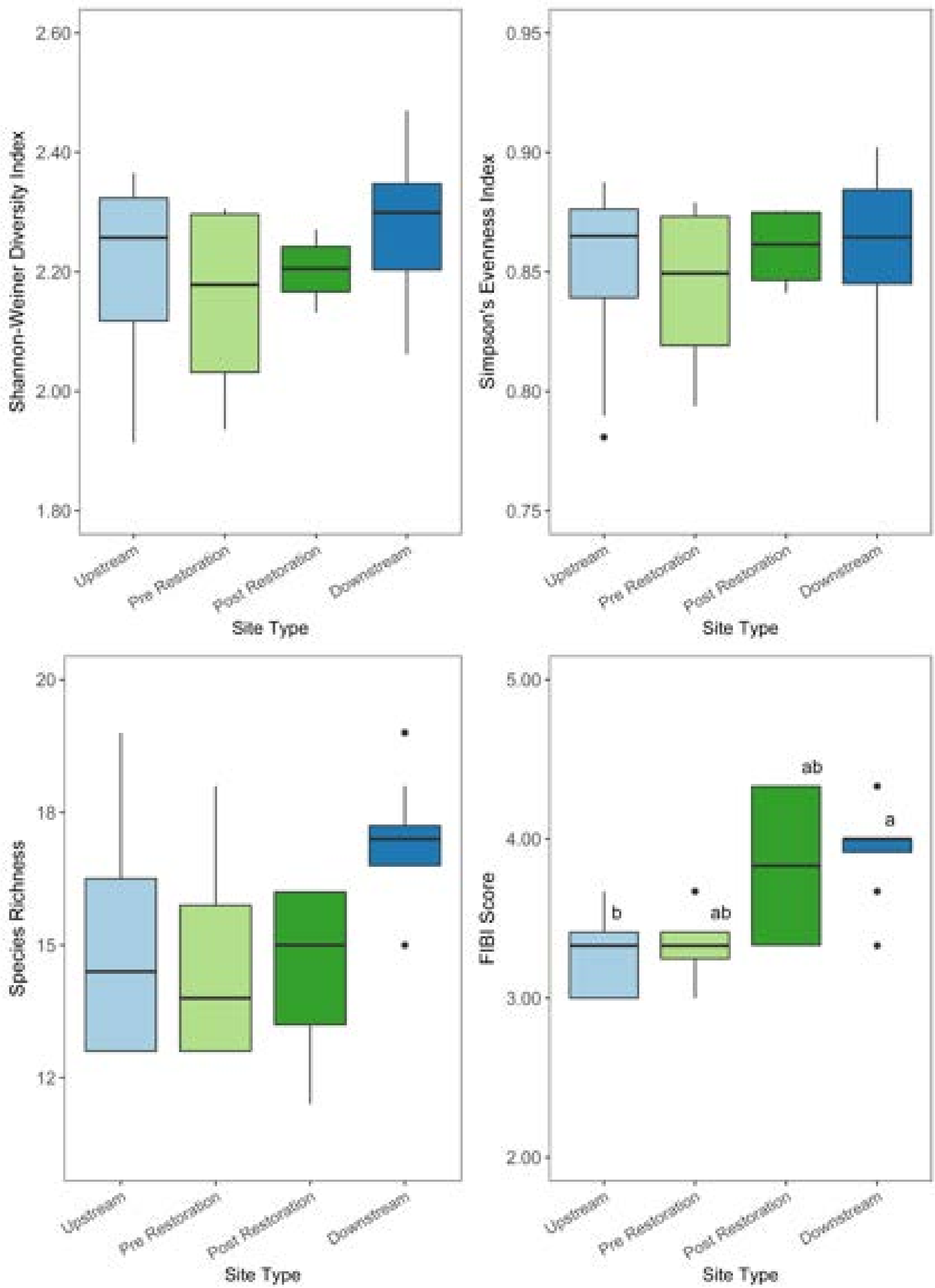

Figure 13. Boxplots of Fish Community Metrics Among Site Types

Note: Site types sharing the same letter are not statistically different, per a Tukey's HSD pair-wise comparison. Upstream and Downstream site types include data from all monitoring years (2016-2022), whereas the Pre-Restoration and Post-Restoration site types included data from only those time periods for the sites within the restoration reach.

4.3 Discussion

In-situ water quality parameters were similar among all six sites in 2022. All sites met COMAR standards for Use I-P streams for water temperature, DO, pH, and turbidity. Specific conductance was above 0.171 mS/cm, the value at which it has been shown to negatively affect the fish community in urban Maryland streams (Morgan *et al*., 2007), at all sites.

The benthic community in the three study reaches (downstream, restoration, and upstream) in Little Catoctin Creek varied slightly across sampling years; however, this variation can likely be attributed to variability in biotic responses associated with precipitation and other naturally occurring factors, as well as sampling variability. BIBI scores ranged from 1.75 to 2.75 across all sites, with narrative ratings ranging from Very Poor to Poor, across all monitoring years. The number of EPT taxa was similar for all sites, ranging from zero to six from 2016 to 2020, with no discernible trend through time. The BIBI metric score for the number of taxa was among the most variable metrics. The metrics for number of taxa and percent scrapers were some of the main drivers of BIBI scores, particularly in 2019 and 2020. The number of pollution-intolerant taxa also ranged from zero to six between 2016 and 2020, with the highest number of pollution-intolerant taxa occurring in the downstream study reach at site PRFR-201-X in 2016. The number of taxa tolerant to pollution was between six and 13 throughout all three study reaches before and after restoration. The site with the highest number of pollution-tolerant taxa was in the downstream reach at site PRFR-202-X in 2016. The highest BIBI score (2.75) occurred in 2019 in the downstream study reach, at site PRFR-201-X.

Average taxa richness and Shannon-Weiner Diversity Index values for benthic macroinvertebrates were highest at the downstream sites and lowest at the upstream sites (Table 4-17). Average Simpson's Evenness Index values for benthic macroinvertebrates were highest at the downstream and restoration sites after restoration and lowest at the upstream sites (Table 4-17). Although there was a significant difference in BIBI scores among site types, the difference was not detected by a Tukey's HSD comparison. Average BIBI scores were highest at the restoration sites after restoration and at the downstream sites, while upstream sites had the lowest average BIBI scores (Table 4-17). Percent scrapers were notably higher for the post-restoration and downstream reaches, compared to the upstream reach. The percent composition of scraper taxa, a specialized feeding group, is expected to increase with decreasing environmental stressors. Overall, trends through time were variable for the downstream, restoration, and upstream study reaches, based on data from 2016 through 2020. In other restoration research conducted by MDNR, it typically takes several years of monitoring before BIBI scores approach pre-restoration levels, and rarely do they surpass pre-restoration scores (Palmer *et al.* 2009).

Table 4-17. Average Metric Values Across Monitoring Years Using Benthic Macroinvertebrate Data

Reach	Year	Taxa Richness	S-W (D')[1]	Simpson's	BIBI	Rating
Downstream	Average	24.63	2.40	0.84	2.16	Poor
Restoration	Pre-Rest. Avg.	20.50	2.15	0.78	1.81	Very Poor
	Post-Rest. Avg.	22.00	2.34	0.84	2.25	Poor
Upstream	Average	17.58	2.05	0.77	1.79	Very Poor

Restoration and downstream groups are averages of two sites; upstream is an average of three sites.
[1]S-W (D') = Shannon-Weiner Diversity Index.

Physical habitat conditions across all six sites were similar before and after restoration, in general. All physical habitat parameters ranged from upper marginal to upper optimal across all reaches throughout all monitoring years. Physical habitat metric scores were lowest across all sites at site PRFR-204-X after restoration in 2019, while scores were highest across all sites at site PRFR-202-X before restoration in 2016. Embeddedness was variable, ranging from 15 to 75 percent across all sites before and after restoration. Percent embeddedness was lowest across all sites at site PRFR-204-X before restoration in 2016 and was highest at site PRFR-204-X after restoration in 2022. Embeddedness was notably higher within the restoration reach in 2022, compared to previous monitoring years, suggesting possible movement and deposition of fine sediments within the restoration reach. However, it should be noted that these values are based on visual estimates rather than quantitative measurements. Percent shading was also variable before and after restoration and ranged from 5 to 75 across all sites. Site PRFR-201-X had the highest percent shading after restoration in 2022, while sites PRFR-203-X, PRFR-204-X, PRFR-205-X, and PRFR-206-X had the lowest percent shading after restoration in 2019, across all six sites. Between 2019 and 2022, percent shading increased notably at PRFR-202-X and at both restoration sites. The increase in shading at the restoration sites was due to the establishment and growth of herbaceous vegetation in the floodplain, primarily reed canary grass (*Phalaris arundinacea*), that was bordering and overhanging both restoration reaches in 2022. Presumably, there were minimal changes to the riparian vegetative community at PRFR-202-X between 2019 and 2022; therefore, the increase in shading could be due to expansion of the canopy over the three-year period or scoring inconsistencies between field crews in those years, as percent shading is estimated visually and not quantitatively measured.

FIBI scores ranged from 3.00 to 4.00 across all six sites in 2022, with narrative ratings ranging from Fair to Good. Before and after restoration, FIBI scores ranged from 3.00 to 4.33 within the restoration reach, with narrative ratings ranging from Fair to Good. Within the restoration reach, the highest FIBI score occurred in 2019 following restoration at site PRFR-203-X, while the lowest FIBI score occurred prior to restoration in 2016 and 2017 at site PRFR-204-X. The FIBI metric for abundance per square meter was the same at all sites across all years. The number of benthic species (adjusted for watershed size) was the most variable FIBI metric for restoration and upstream sites and was one of the main drivers of differences observed for these sites. Monitoring years in which benthic fish species, such as greenside darter and fantail darter, were observed increased the FIBI metric score and the overall FIBI score.

Dominant taxa at both sites within the restoration reach were variable across all monitoring years. The FFG assemblage was dominated by generalist, omnivores, and invertivores within the restoration for all monitoring years. Similar to benthic macroinvertebrate community indices, average fish taxa richness, Shannon-Weiner Diversity Index values for fish, and FIBI score were the highest at the downstream sites (Table 4-18). Average values for Simpson's Evenness Index for fish were highest for the downstream sites and restoration sites after restoration (Table 4-18). Average taxa richness was lowest at the restoration sites after restoration and average Shannon-Weiner Diversity Index and Simpson's Evenness Index values for fish were lowest at the restoration sites prior to restoration (Table 4-18). FIBI scores were significantly higher within the downstream reach, compared to the upstream reach. No significant difference was detected for post-restoration FIBI scores, compared to other site types, which was likely driven by variability in post-restoration FIBI scores that ranged from 3.33 to 4.33.

Table 4-18. Average Metric Values Among Monitoring Years Using Fish Data

Reach	Year	Taxa Richness	S-W (D')[1]	Simpson's	FIBI	Rating
Downstream	Average	16.88	2.27	0.86	3.92	Fair
Restoration	Pre-Rest. Avg.	14.75	2.15	0.84	3.33	Fair
	Post-Rest. Avg.	14.50	2.20	0.86	3.83	Fair
Upstream	Average	15.00	2.20	0.85	3.29	Fair

[1]S-W (D') = Shannon-Weiner Diversity Index.

4.4 Conclusions

This report summarizes the results of the 2020 benthic macroinvertebrate sampling effort and the 2022 fish community sampling and physical habitat assessment effort, which successfully completes the requirements of phase BIO4 of the MDE-approved monitoring plan for Little Catoctin Creek. All sites met COMAR standards for Use I-P streams for water temperature, DO, pH, and turbidity. The benthic macroinvertebrate communities in the three study reaches (downstream, restoration, and upstream) in Little Catoctin Creek were variable, but largely comparable before and after restoration, with BIBI scores ranging from 1.75 to 2.75 and narrative ratings ranging from Very Poor to Poor. Although there was a significant difference in BIBI scores among site types, the difference did not result in mean separation by a Tukey's HSD comparison. Average BIBI scores were highest at the restoration sites after restoration and at the downstream sites, while upstream sites had the lowest average BIBI scores. Physical habitat metric scores were similar before and after restoration, in general, with higher embeddedness observed at the restoration sites in 2022. All physical habitat parameters ranged from upper marginal to upper optimal across all reaches throughout all monitoring years. FIBI scores ranged from 3.00 to 4.00 across all six sites in 2022, with narrative ratings ranging from Fair to Good. No significant differences were observed in any diversity, evenness, or IBI score metrics for fish and benthic macroinvertebrates between pre- and post-restoration sites. Statistically measurable improvements to physical and biological conditions in Little Catoctin Creek may not be observed until the stream continues to stabilize and biotic communities have a chance to respond and stabilize following restoration activities. In addition, the maturation of riparian plantings will likely improve stream shading and other ecological processes within the restoration reach. Additional biological assessments would be helpful in characterizing post-restoration stream conditions, to account for inherent annual fluctuations of biotic communities and to detect community responses as the restoration matures.

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ATTACHMENT A: CHEMICAL MONITORING DATA

A-1: In Situ Water Quality Measurements

In Situ Discrete Water Quality Measurements Task 13 Assessment of Controls

Little Catoctin Creek, Frederick, MD (June 2022)

Sampling Location	Sample Type	Date, Local Time	Water Temperature (°C)	Conductivity (mS/cm)	Turbidity (NTU)	pH	Dissolved Oxygen (mg/L)
1636845	Baseflow	6/6/2022 1015	19.0	322.1	3.39	7.25	8.77
1636846	Baseflow	6/6/2022 1145	19.0	379.9	7.41	7.67	9.21
1636845	Rising	6/27/2022 1025	22.5	329.2	4.88	7.12	7.42
	Peak	6/27/2022 1330	22.1	317.2	4.81	7.32	7.77
	Receding	6/27/2022 1535	24.2	327.4	5.03	7.37	7.86
1636846	Rising	6/27/2022 1115	22.5	336.2	6.21	7.29	8.43
	Peak	6/27/2022 1440	23.9	341.8	2.32	7.40	8.38
	Receding	6/27/2022 1515	23.5	337.2	4.50	7.44	8.52

Notes:

°C = Degrees Celsius.

mg/L = Milligram(s) per liter.

mS/cm = microsiemens per cenimeter

NTU = Nephelometric Turbidity unit

A-2: Estimated Flow Measurements

Little Catoctin Creek Estimated Flow Measurements Recorded 6/27/22

Station: Upstream 1636845

Sample ID	Time	Water Depth (ft)	WSEL (ft)	Rating Curve Flow (cfs)
Rising	6/27/2022 10:25	1.9	417.16	0.27
Peak	6/27/2022 13:30	2.10	417.36	0.63
Receding	6/27/2022 15:35	2.00	417.26	0.41

USGS Datum	413.26
shift	2

Station: Downstream 1636846

Sample ID	Time	Water Depth (ft)	WSEL (ft)	Rating Curve Flow (cfs)
Rising	6/27/2022 11:15	0.50	394.61	0.35
Peak	6/27/2022 14:40	0.70	394.81	0.57
Receding	6/27/2022 15:15	0.70	394.81	0.57

USGS Datum	395.79
shift	1

A-3: Laboratory Reports

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Environment Testing
America

ANALYTICAL REPORT

Eurofins Lancaster Laboratories Environment Testing, LLC
2425 New Holland Pike
Lancaster, PA 17601
Tel: (717)656-2300

Laboratory Job ID: 410-86438-1

Client Project/Site: BCS2017-03D Task 13 - NPDES MS4 Compliance

For:

EA Engineering, Science, and Technology
225 Schilling Circle
Suite 400
Hunt Valley, Maryland 21031

Attn: Sanita Corum

Authorized for release by:
6/21/2022 5:13:48 PM

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· QC results that exceed the upper limits and are associated with non-detect samples are qualified but further narration is not required since the bias is high and does not change a non-detect result. Further narration is also not required with QC blank detection when the associated sample concentration is non-detect or more than ten times the level in the blank.
· Matrix QC may not be reported if insufficient sample or site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD is performed, unless otherwise specified in the method.
· Surrogate and/or isotope dilution analyte recoveries (if applicable) which are outside of the QC window are confirmed unless attributed to a dilution or otherwise noted in the narrative.
Regulated compliance samples (e.g. SDWA, NPDES) must comply with the associated agency requirements/permits.

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Vanessa M. Badman

Vanessa Badman
Project Manager
6/21/2022 5:13:48 PM

Table of Contents

Qualifiers

Metals

Qualifier	Qualifier Description
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

General Chemistry

Qualifier	Qualifier Description
F1	MS and/or MSD recovery exceeds control limits.
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
1C	Result is from the primary column on a dual-column method.
2C	Result is from the confirmation column on a dual-column method.
CFL	Contains Free Liquid
CFU	Colony Forming Unit
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MCL	EPA recommended "Maximum Contaminant Level"
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
MPN	Most Probable Number
MQL	Method Quantitation Limit
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
NEG	Negative / Absent
POS	Positive / Present
PQL	Practical Quantitation Limit
PRES	Presumptive
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)
TNTC	Too Numerous To Count

Case Narrative

Job ID: 410-86438-1

Laboratory: Eurofins Lancaster Laboratories Environment Testing, LLC

Narrative

Job Narrative
410-86438-1

Receipt
The samples were received on 6/6/2022 3:35 PM. Unless otherwise noted below, the samples arrived in good condition, and, where required, properly preserved and on ice. The temperature of the cooler at receipt time was 0.5°C

Receipt Exceptions
The Field Sampler was not listed on the Chain of Custody.

Received unlabeled 250mL plastic sulfuric acid preserved container.

LCC22-BF01-U (410-86438-1) and LCC22-BF01-D (410-86438-2)

Metals
No additional analytical or quality issues were noted, other than those described above or in the Definitions/ Glossary page.

General Chemistry
No additional analytical or quality issues were noted, other than those described above or in the Definitions/ Glossary page.

1 2 3 4 5 6 7 8 9 10 11 12 13 14

Detection Summary

Client: EA Engineering, Science, and Technology | Job ID: 410-86438-1

Project/Site: BCS2017-03D Task 13 - NPDES MS4 Compliance

Client Sample ID: LCC22-BF01-U | Lab Sample ID: 410-86438-1

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Copper	0.66	J	1.0	0.36	ug/L	1		200.8 Rev 5.4	Total/NA
Lead	0.11	J	0.50	0.071	ug/L	1		200.8 Rev 5.4	Total/NA
Hardness as calcium carbonate	110		25	7.5	mg/L	2.5		130.2	Total/NA
Total Suspended Solids	3.0		3.0	1.0	mg/L	1		2540D-2011	Total/NA
Total Kjeldahl Nitrogen	200		100	50	mg/L	100		351.2	Total/NA
Nitrate as N	2.7		0.10	0.040	mg/L	1		353.2	Total/NA
Nitrate Nitrite as N	2.7	F1	0.10	0.040	mg/L	1		353.2	Total/NA
Nitrite as N	0.023	J	0.050	0.015	mg/L	1		353.2	Total/NA
Total Phosphorus as P	0.093	J	0.10	0.050	mg/L	1		365.1	Total/NA
Total Phosphorus as PO4	0.29	J	0.31	0.25	mg/L	1		365.1	Total/NA

Client Sample ID: LCC22-BF01-D | Lab Sample ID: 410-86438-2

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Copper	0.74	J	1.0	0.36	ug/L	1		200.8 Rev 5.4	Total/NA
Lead	0.097	J	0.50	0.071	ug/L	1		200.8 Rev 5.4	Total/NA
Hardness as calcium carbonate	140		25	7.5	mg/L	2.5		130.2	Total/NA
Total Suspended Solids	8.1		3.0	1.0	mg/L	1		2540D-2011	Total/NA
Total Kjeldahl Nitrogen	0.64	J	1.0	0.50	mg/L	1		351.2	Total/NA
Nitrate as N	2.4		0.10	0.040	mg/L	1		353.2	Total/NA
Nitrate Nitrite as N	2.4		0.10	0.040	mg/L	1		353.2	Total/NA
Nitrite as N	0.027	J	0.050	0.015	mg/L	1		353.2	Total/NA
Total Phosphorus as P	0.092	J	0.10	0.050	mg/L	1		365.1	Total/NA
Total Phosphorus as PO4	0.28	J	0.31	0.25	mg/L	1		365.1	Total/NA

This Detection Summary does not include radiochemical test results.

Client Sample ID: LCC22-BF01-U

Lab Sample ID: 410-86438-1

Date Collected: 06/06/22 10:15

Matrix: Water

Date Received: 06/06/22 15:35

Method: 200.8 Rev 5.4 - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Copper	**0.66**	**J**	1.0	0.36	ug/L		06/08/22 21:41	06/15/22 15:12	1
Lead	**0.11**	**J**	0.50	0.071	ug/L		06/08/22 21:41	06/15/22 15:12	1
Zinc	ND		10	4.0	ug/L		06/08/22 21:41	06/15/22 15:12	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Hardness as calcium carbonate	**110**		25	7.5	mg/L			06/08/22 12:10	2.5
HEM (Oil & Grease)	ND		5.3	1.5	mg/L			06/16/22 11:07	1
SGT-HEM (TPH)	ND		5.3	1.5	mg/L			06/16/22 11:07	1
Total Suspended Solids	**3.0**		3.0	1.0	mg/L			06/07/22 16:21	1
Total Kjeldahl Nitrogen	**200**		100	50	mg/L		06/15/22 13:55	06/21/22 15:46	100
Nitrate as N	**2.7**		0.10	0.040	mg/L			06/08/22 09:35	1
Nitrate Nitrite as N	**2.7**	**F1**	0.10	0.040	mg/L			06/08/22 08:11	1
Nitrite as N	**0.023**	**J**	0.050	0.015	mg/L			06/07/22 07:21	1
Total Phosphorus as P	**0.093**	**J**	0.10	0.050	mg/L		06/08/22 08:33	06/08/22 14:21	1
Total Phosphorus as PO4	**0.29**	**J**	0.31	0.25	mg/L		06/08/22 08:33	06/08/22 14:21	1
Biochemical Oxygen Demand	ND		2.0	2.0	mg/L			06/07/22 17:32	1

Client Sample ID: LCC22-BF01-D

Lab Sample ID: 410-86438-2

Date Collected: 06/06/22 11:45

Matrix: Water

Date Received: 06/06/22 15:35

Method: 200.8 Rev 5.4 - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Copper	**0.74**	**J**	1.0	0.36	ug/L		06/08/22 21:41	06/15/22 15:10	1
Lead	**0.097**	**J**	0.50	0.071	ug/L		06/08/22 21:41	06/15/22 15:10	1
Zinc	ND		10	4.0	ug/L		06/08/22 21:41	06/15/22 15:10	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Hardness as calcium carbonate	**140**		25	7.5	mg/L			06/08/22 12:17	2.5
HEM (Oil & Grease)	ND		5.2	1.5	mg/L			06/16/22 11:07	1
SGT-HEM (TPH)	ND		5.2	1.5	mg/L			06/16/22 11:07	1
Total Suspended Solids	**8.1**		3.0	1.0	mg/L			06/07/22 16:21	1
Total Kjeldahl Nitrogen	**0.64**	**J**	1.0	0.50	mg/L		06/15/22 13:55	06/21/22 13:52	1
Nitrate as N	**2.4**		0.10	0.040	mg/L			06/07/22 06:50	1
Nitrate Nitrite as N	**2.4**		0.10	0.040	mg/L			06/08/22 08:09	1
Nitrite as N	**0.027**	**J**	0.050	0.015	mg/L			06/07/22 07:22	1
Total Phosphorus as P	**0.092**	**J**	0.10	0.050	mg/L		06/08/22 08:33	06/08/22 14:21	1
Total Phosphorus as PO4	**0.28**	**J**	0.31	0.25	mg/L		06/08/22 08:33	06/08/22 14:21	1
Biochemical Oxygen Demand	ND		2.0	2.0	mg/L			06/07/22 17:32	1

Method: 200.8 Rev 5.4 - Metals (ICP/MS)

Lab Sample ID: MB 410-263609/1-A
Client Sample ID: Method Blank
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 266025
Prep Batch: 263609

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Copper	ND		1.0	0.36	ug/L		06/08/22 21:41	06/15/22 14:49	1
Lead	ND		0.50	0.071	ug/L		06/08/22 21:41	06/15/22 14:49	1
Zinc	ND		10	4.0	ug/L		06/08/22 21:41	06/15/22 14:49	1

Lab Sample ID: LCS 410-263609/2-A
Client Sample ID: Lab Control Sample
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 266025
Prep Batch: 263609

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Copper	500	477		ug/L		95	85 - 115
Lead	50.0	51.1		ug/L		102	85 - 115
Zinc	500	508		ug/L		102	85 - 115

Lab Sample ID: LCSD 410-263609/3-A
Client Sample ID: Lab Control Sample Dup
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 266025
Prep Batch: 263609

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	RPD Limit
Copper	500	475		ug/L		95	85 - 115	0	20
Lead	50.0	50.5		ug/L		101	85 - 115	1	20
Zinc	500	504		ug/L		101	85 - 115	1	20

Method: 130.2 - Hardness, Total (mg/l as CaCO3)

Lab Sample ID: MB 410-263463/6
Client Sample ID: Method Blank
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 263463

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Hardness as calcium carbonate	ND		10	3.0	mg/L			06/08/22 10:01	1

Lab Sample ID: LCS 410-263463/7
Client Sample ID: Lab Control Sample
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 263463

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Hardness as calcium carbonate	40.0	40.6		mg/L		101	91 - 108

Method: 1664A - HEM and SGT-HEM

Lab Sample ID: MB 410-266273/1
Client Sample ID: Method Blank
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 266273

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
HEM (Oil & Grease)	ND		5.0	1.4	mg/L			06/16/22 11:07	1
SGT-HEM (TPH)	ND		5.0	1.4	mg/L			06/16/22 11:07	1

Method: 1664A - HEM and SGT-HEM (Continued)

Lab Sample ID: LCS 410-266273/2
Matrix: Water
Analysis Batch: 266273
Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
HEM (Oil & Grease)	40.0	36.60		mg/L		92	78 - 114
SGT-HEM (TPH)	20.0	16.00		mg/L		80	64 - 132

Lab Sample ID: LCSD 410-266273/3
Matrix: Water
Analysis Batch: 266273
Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	RPD Limit
HEM (Oil & Grease)	40.0	36.50		mg/L		91	78 - 114	0	13
SGT-HEM (TPH)	20.0	16.00		mg/L		80	64 - 132	0	23

Method: 2540D-2011 - Solids, Total Suspended (TSS)

Lab Sample ID: MB 410-263052/1
Matrix: Water
Analysis Batch: 263052
Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Suspended Solids	ND		3.0	1.0	mg/L			06/07/22 16:21	1

Lab Sample ID: LCS 410-263052/2
Matrix: Water
Analysis Batch: 263052
Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Total Suspended Solids	150	144		mg/L		96	89 - 105

Method: 351.2 - Nitrogen, Total Kjeldahl

Lab Sample ID: MB 410-265885/2-A
Matrix: Water
Analysis Batch: 267815
Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 265885

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Kjeldahl Nitrogen	ND		1.0	0.50	mg/L		06/15/22 13:55	06/21/22 13:33	1

Lab Sample ID: LCS 410-265885/1-A
Matrix: Water
Analysis Batch: 267815
Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 265885

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Total Kjeldahl Nitrogen	3.96	3.80		mg/L		96	90 - 110

Method: 353.2 - Nitrogen, Nitrite

Lab Sample ID: MB 410-262822/13
Matrix: Water
Analysis Batch: 262822
Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Nitrite as N	ND		0.050	0.015	mg/L			06/07/22 07:18	1

QC Sample Results

Client: EA Engineering, Science, and Technology | Job ID: 410-86438-1
Project/Site: BCS2017-03D Task 13 - NPDES MS4 Compliance

Method: 353.2 - Nitrogen, Nitrite

Lab Sample ID: LCS 410-262822/14 | **Client Sample ID: Lab Control Sample**
Matrix: Water | **Prep Type: Total/NA**
Analysis Batch: 262822

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Nitrite as N	0.700	0.672		mg/L		96	90 - 110

Lab Sample ID: LCSD 410-262822/15 | **Client Sample ID: Lab Control Sample Dup**
Matrix: Water | **Prep Type: Total/NA**
Analysis Batch: 262822

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	RPD Limit
Nitrite as N	0.700	0.668		mg/L		95	90 - 110	1	20

Method: 353.2 - Nitrogen, Nitrate-Nitrite

Lab Sample ID: MB 410-263524/25 | **Client Sample ID: Method Blank**
Matrix: Water | **Prep Type: Total/NA**
Analysis Batch: 263524

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Nitrate Nitrite as N	ND		0.10	0.040	mg/L			06/08/22 07:41	1

Lab Sample ID: LCS 410-263524/24 | **Client Sample ID: Lab Control Sample**
Matrix: Water | **Prep Type: Total/NA**
Analysis Batch: 263524

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Nitrate Nitrite as N	2.50	2.47		mg/L		99	90 - 110

Lab Sample ID: 410-86438-1 MS | **Client Sample ID: LCC22-BF01-U**
Matrix: Water | **Prep Type: Total/NA**
Analysis Batch: 263524

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec Limits
Nitrate Nitrite as N	2.7	F1	1.00	3.22	F1	mg/L		55	90 - 110

Lab Sample ID: 410-86438-1 DU | **Client Sample ID: LCC22-BF01-U**
Matrix: Water | **Prep Type: Total/NA**
Analysis Batch: 263524

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Nitrate Nitrite as N	2.7	F1	2.66		mg/L		0.5	10

Method: 365.1 - Phosphorus, Total

Lab Sample ID: MB 410-263282/2-A | **Client Sample ID: Method Blank**
Matrix: Water | **Prep Type: Total/NA**
Analysis Batch: 263650 | **Prep Batch: 263282**

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Phosphorus as P	ND		0.10	0.050	mg/L		06/08/22 08:33	06/08/22 14:17	1
Total Phosphorus as PO4	ND		0.31	0.25	mg/L		06/08/22 08:33	06/08/22 14:17	1

Method: 365.1 - Phosphorus, Total (Continued)

Lab Sample ID: LCS 410-263282/1-A
Client Sample ID: Lab Control Sample
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 263650
Prep Batch: 263282

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Total Phosphorus as P	1.33	1.35		mg/L		102	90 - 110
Total Phosphorus as PO4	4.07	4.13		mg/L		102	90 - 110

Method: 405.1 - BOD, 5-Day

Lab Sample ID: SCB 410-264593/4
Client Sample ID: Method Blank
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 264593

Analyte	SCB Result	SCB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Biochemical Oxygen Demand	0.949		0.0000010	0.0000010	mg/L			06/07/22 15:30	1

Lab Sample ID: USB 410-264593/2
Client Sample ID: Method Blank
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 264593

Analyte	USB Result	USB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Biochemical Oxygen Demand	ND		0.0000010	0.0000010	mg/L			06/07/22 15:30	1

QC Association Summary

Client: EA Engineering, Science, and Technology — Job ID: 410-86438-1

Project/Site: BCS2017-03D Task 13 - NPDES MS4 Compliance

Metals

Prep Batch: 263609

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-86438-1	LCC22-BF01-U	Total/NA	Water	200.8 Rev 5.4	
410-86438-2	LCC22-BF01-D	Total/NA	Water	200.8 Rev 5.4	
MB 410-263609/1-A	Method Blank	Total/NA	Water	200.8 Rev 5.4	
LCS 410-263609/2-A	Lab Control Sample	Total/NA	Water	200.8 Rev 5.4	
LCSD 410-263609/3-A	Lab Control Sample Dup	Total/NA	Water	200.8 Rev 5.4	

Analysis Batch: 266025

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-86438-1	LCC22-BF01-U	Total/NA	Water	200.8 Rev 5.4	263609
410-86438-2	LCC22-BF01-D	Total/NA	Water	200.8 Rev 5.4	263609
MB 410-263609/1-A	Method Blank	Total/NA	Water	200.8 Rev 5.4	263609
LCS 410-263609/2-A	Lab Control Sample	Total/NA	Water	200.8 Rev 5.4	263609
LCSD 410-263609/3-A	Lab Control Sample Dup	Total/NA	Water	200.8 Rev 5.4	263609

General Chemistry

Analysis Batch: 260661

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-86438-2	LCC22-BF01-D	Total/NA	Water	353.2	

Analysis Batch: 262822

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-86438-1	LCC22-BF01-U	Total/NA	Water	353.2	
410-86438-2	LCC22-BF01-D	Total/NA	Water	353.2	
MB 410-262822/13	Method Blank	Total/NA	Water	353.2	
LCS 410-262822/14	Lab Control Sample	Total/NA	Water	353.2	
LCSD 410-262822/15	Lab Control Sample Dup	Total/NA	Water	353.2	

Analysis Batch: 263052

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-86438-1	LCC22-BF01-U	Total/NA	Water	2540D-2011	
410-86438-2	LCC22-BF01-D	Total/NA	Water	2540D-2011	
MB 410-263052/1	Method Blank	Total/NA	Water	2540D-2011	
LCS 410-263052/2	Lab Control Sample	Total/NA	Water	2540D-2011	

Prep Batch: 263282

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-86438-1	LCC22-BF01-U	Total/NA	Water	365.1	
410-86438-2	LCC22-BF01-D	Total/NA	Water	365.1	
MB 410-263282/2-A	Method Blank	Total/NA	Water	365.1	
LCS 410-263282/1-A	Lab Control Sample	Total/NA	Water	365.1	

Analysis Batch: 263326

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-86438-1	LCC22-BF01-U	Total/NA	Water	353.2	

Analysis Batch: 263463

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-86438-1	LCC22-BF01-U	Total/NA	Water	130.2	
410-86438-2	LCC22-BF01-D	Total/NA	Water	130.2	
MB 410-263463/6	Method Blank	Total/NA	Water	130.2	

General Chemistry (Continued)

Analysis Batch: 263463 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
LCS 410-263463/7	Lab Control Sample	Total/NA	Water	130.2	

Analysis Batch: 263524

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-86438-1	LCC22-BF01-U	Total/NA	Water	353.2	
410-86438-2	LCC22-BF01-D	Total/NA	Water	353.2	
MB 410-263524/25	Method Blank	Total/NA	Water	353.2	
LCS 410-263524/24	Lab Control Sample	Total/NA	Water	353.2	
410-86438-1 MS	LCC22-BF01-U	Total/NA	Water	353.2	
410-86438-1 DU	LCC22-BF01-U	Total/NA	Water	353.2	

Analysis Batch: 263650

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-86438-1	LCC22-BF01-U	Total/NA	Water	365.1	263282
410-86438-2	LCC22-BF01-D	Total/NA	Water	365.1	263282
MB 410-263282/2-A	Method Blank	Total/NA	Water	365.1	263282
LCS 410-263282/1-A	Lab Control Sample	Total/NA	Water	365.1	263282

Analysis Batch: 264593

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-86438-1	LCC22-BF01-U	Total/NA	Water	405.1	
410-86438-2	LCC22-BF01-D	Total/NA	Water	405.1	
SCB 410-264593/4	Method Blank	Total/NA	Water	405.1	
USB 410-264593/2	Method Blank	Total/NA	Water	405.1	
LCS 410-264593/5	Lab Control Sample	Total/NA	Water	405.1	

Prep Batch: 265885

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-86438-1	LCC22-BF01-U	Total/NA	Water	351.2	
410-86438-2	LCC22-BF01-D	Total/NA	Water	351.2	
MB 410-265885/2-A	Method Blank	Total/NA	Water	351.2	
LCS 410-265885/1-A	Lab Control Sample	Total/NA	Water	351.2	

Analysis Batch: 266273

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-86438-1	LCC22-BF01-U	Total/NA	Water	1664A	
410-86438-2	LCC22-BF01-D	Total/NA	Water	1664A	
MB 410-266273/1	Method Blank	Total/NA	Water	1664A	
LCS 410-266273/2	Lab Control Sample	Total/NA	Water	1664A	
LCSD 410-266273/3	Lab Control Sample Dup	Total/NA	Water	1664A	

Analysis Batch: 267815

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-86438-1	LCC22-BF01-U	Total/NA	Water	351.2	265885
410-86438-2	LCC22-BF01-D	Total/NA	Water	351.2	265885
MB 410-265885/2-A	Method Blank	Total/NA	Water	351.2	265885
LCS 410-265885/1-A	Lab Control Sample	Total/NA	Water	351.2	265885

Lab Chronicle

Client: EA Engineering, Science, and Technology | Job ID: 410-86438-1

Project/Site: BCS2017-03D Task 13 - NPDES MS4 Compliance

Client Sample ID: LCC22-BF01-U | **Lab Sample ID: 410-86438-1**

Date Collected: 06/06/22 10:15 | **Matrix: Water**

Date Received: 06/06/22 15:35

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	200.8 Rev 5.4			263609	06/08/22 21:41	UAMX	ELLE
Total/NA	Analysis	200.8 Rev 5.4		1	266025	06/15/22 15:12	UCIG	ELLE
Total/NA	Analysis	130.2		2.5	263463	06/08/22 12:10	USAE	ELLE
Total/NA	Analysis	1664A		1	266273	06/16/22 11:07	UYB0	ELLE
Total/NA	Analysis	2540D-2011		1	263052	06/07/22 16:21	UOCA	ELLE
Total/NA	Prep	351.2			265885	06/15/22 13:55	F8AU	ELLE
Total/NA	Analysis	351.2		100	267815	06/21/22 15:46	JCG7	ELLE
Total/NA	Analysis	353.2		1	263524	06/08/22 08:11	FL4F	ELLE
Total/NA	Analysis	353.2		1	262822	06/07/22 07:21	CBM8	ELLE
Total/NA	Analysis	353.2		1	263326	06/08/22 09:35	USJM	ELLE
Total/NA	Prep	365.1			263282	06/08/22 08:33	CBM8	ELLE
Total/NA	Analysis	365.1		1	263650	06/08/22 14:21	CBM8	ELLE
Total/NA	Analysis	405.1		1	264593	06/07/22 17:32	F8TI	ELLE

Client Sample ID: LCC22-BF01-D | **Lab Sample ID: 410-86438-2**

Date Collected: 06/06/22 11:45 | **Matrix: Water**

Date Received: 06/06/22 15:35

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	200.8 Rev 5.4			263609	06/08/22 21:41	UAMX	ELLE
Total/NA	Analysis	200.8 Rev 5.4		1	266025	06/15/22 15:10	UCIG	ELLE
Total/NA	Analysis	130.2		2.5	263463	06/08/22 12:17	USAE	ELLE
Total/NA	Analysis	1664A		1	266273	06/16/22 11:07	UYB0	ELLE
Total/NA	Analysis	2540D-2011		1	263052	06/07/22 16:21	UOCA	ELLE
Total/NA	Prep	351.2			265885	06/15/22 13:55	F8AU	ELLE
Total/NA	Analysis	351.2		1	267815	06/21/22 13:52	JCG7	ELLE
Total/NA	Analysis	353.2		1	263524	06/08/22 08:09	FL4F	ELLE
Total/NA	Analysis	353.2		1	262822	06/07/22 07:22	CBM8	ELLE
Total/NA	Analysis	353.2		1	260661	06/07/22 06:50	USJM	ELLE
Total/NA	Prep	365.1			263282	06/08/22 08:33	CBM8	ELLE
Total/NA	Analysis	365.1		1	263650	06/08/22 14:21	CBM8	ELLE
Total/NA	Analysis	405.1		1	264593	06/07/22 17:32	F8TI	ELLE

Laboratory References:

ELLE = Eurofins Lancaster Laboratories Environment Testing, LLC, 2425 New Holland Pike, Lancaster, PA 17601, TEL (717)656-2300

Laboratory: Eurofins Lancaster Laboratories Environment Testing, LLC

Unless otherwise noted, all analytes for this laboratory were covered under each accreditation/certification below.

Authority	Program	Identification Number	Expiration Date
Maryland	State	100	06-30-23

The following analytes are included in this report, but the laboratory is not certified by the governing authority. This list may include analytes for which the agency does not offer certification.

Analysis Method	Prep Method	Matrix	Analyte
130.2		Water	Hardness as calcium carbonate
1664A		Water	HEM (Oil & Grease)
1664A		Water	SGT-HEM (TPH)
200.8 Rev 5.4	200.8 Rev 5.4	Water	Copper
200.8 Rev 5.4	200.8 Rev 5.4	Water	Lead
200.8 Rev 5.4	200.8 Rev 5.4	Water	Zinc
2540D-2011		Water	Total Suspended Solids
351.2	351.2	Water	Total Kjeldahl Nitrogen
353.2		Water	Nitrate as N
353.2		Water	Nitrate Nitrite as N
353.2		Water	Nitrite as N
365.1	365.1	Water	Total Phosphorus as P
365.1	365.1	Water	Total Phosphorus as PO4
405.1		Water	Biochemical Oxygen Demand

Method Summary

Client: EA Engineering, Science, and Technology
Job ID: 410-86438-1
Project/Site: BCS2017-03D Task 13 - NPDES MS4 Compliance

Method	Method Description	Protocol	Laboratory
200.8 Rev 5.4	Metals (ICP/MS)	EPA	ELLE
130.2	Hardness, Total (mg/l as CaCO3)	MCAWW	ELLE
1664A	HEM and SGT-HEM	1664A	ELLE
2540D-2011	Solids, Total Suspended (TSS)	SM	ELLE
351.2	Nitrogen, Total Kjeldahl	MCAWW	ELLE
353.2	Nitrate by Calculation	EPA	ELLE
353.2	Nitrogen, Nitrate-Nitrite	MCAWW	ELLE
353.2	Nitrogen, Nitrite	MCAWW	ELLE
365.1	Phosphorus, Total	EPA	ELLE
405.1	BOD, 5-Day	MCAWW	ELLE
200.8 Rev 5.4	Preparation, Total Metals	EPA	ELLE
351.2	Nitrogen, Total Kjeldahl	MCAWW	ELLE
365.1	Sample Digestion for Total Phosphorus	MCAWW	ELLE

Protocol References:

1664A = EPA-821-98-002

EPA = US Environmental Protection Agency

MCAWW = "Methods For Chemical Analysis Of Water And Wastes", EPA-600/4-79-020, March 1983 And Subsequent Revisions.

SM = "Standard Methods For The Examination Of Water And Wastewater"

Laboratory References:

ELLE = Eurofins Lancaster Laboratories Environment Testing, LLC, 2425 New Holland Pike, Lancaster, PA 17601, TEL (717)656-2300

Sample Summary

Client: EA Engineering, Science, and Technology
Project/Site: BCS2017-03D Task 13 - NPDES MS4 Compliance

Job ID: 410-86438-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
410-86438-1	LCC22-BF01-U	Water	06/06/22 10:15	06/06/22 15:35
410-86438-2	LCC22-BF01-D	Water	06/06/22 11:45	06/06/22 15:35

410-86438 Chain of Custody

Client: EA Engineering Science, and Technology, Inc., PBC 225 Schilling Circle, Suite 400 Hunt Valley, MD, 21031	Project Manager: Michael Durbano Phone: (609) 332-0534 Field Contact: Michael Durbano Phone: 609-332-0534	Parameters/Method Numbers for Analysis	Chain of Custody Record
Project Name: BCS2017-03D Task 13 - NPDES MS4 Compliance Project#: 15816143			Laboratory: Eurofins Lancaster Laboratories 2425 New Holland Pike Lancaster, PA 17601 Phone: 717-656-2300 ATTN: Vanessa Badman

Date	Time	Water	Sample Identification	No. of Containers	Nitrite - Nitrogen, Nitrite _353.2	BOD, 5-day _405.1	Pres - Nitrogen, Nitrate & Nitrite _353.2	Total Phosphorus _365.1	TKN_351.2	Total Lead, Copper, Zinc_200.8	Total hardness (mg/l as CaCO3) _ 130.2	Oil & Grease and TPH _ 1664A_NP	Total Suspended Solids (TSS) Single Dry _2540D	Remarks
6/6/22	10:15		LCC22-BF01-U	9	✓	✓	✓	✓	✓	✓	✓	✓	✓	
6/6/22	1145		LCC22-BF01-D	9	✓	✓	✓	✓	✓	✓	✓	✓	✓	

Sampled by: (Signature)	Date/Time	Relinquished by: (Signature)
[signature]	6/6/22 1535	
Relinquished by: (Signature)	Date/Time	Received by Laboratory: (Signature)
		[signature] 6/6/22 1535

Login Sample Receipt Checklist

Client: EA Engineering, Science, and Technology

Job Number: 410-86438-1

Login Number: 86438

List Source: Eurofins Lancaster Laboratories Environment Testing, LLC

List Number: 1

Creator: Jeremiah, Cory T

Question	Answer	Comment
The cooler's custody seal is intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable (</=6C, not frozen).	True	
Cooler Temperature is recorded.	True	
WV: Container Temperature is acceptable (</=6C, not frozen).	N/A	
WV: Container Temperature is recorded.	N/A	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
There are no discrepancies between the containers received and the COC.	False	Refer to Job Narrative for details.
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
There is sufficient vol. for all requested analyses.	True	
Is the Field Sampler's name present on COC?	False	Refer to Job Narrative for details.
Sample custody seals are intact.	N/A	

eurofins | Environment Testing America

ANALYTICAL REPORT

Eurofins Lancaster Laboratories Environment Testing, LLC
2425 New Holland Pike
Lancaster, PA 17601
Tel: (717)656-2300

Laboratory Job ID: 410-89136-1
Client Project/Site: BCS2017-03D Task 13 - NPDES MS4 Compliance
Revision: 1

For:
EA Engineering, Science, and Technology
225 Schilling Circle
Suite 400
Hunt Valley, Maryland 21031

Attn: Sanita Corum

Vanessa M. Badman

Authorized for release by:
7/14/2022 9:22:51 AM

Vanessa Badman, Project Manager
(717)556-9762
Vanessa.Badman@et.eurofinsus.com

The test results in this report meet all 2003 NELAC, 2009 TNI, and 2016 TNI requirements for accredited parameters, exceptions are noted in this report. This report may not be reproduced except in full, and with written approval from the laboratory. For questions please contact the Project Manager at the e-mail address or telephone number listed on this page.

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

Analytical test results meet all requirements of the associated regulatory program (e.g., NELAC (TNI), DoD, and ISO 17025) unless otherwise noted under the individual analysis. Data qualifiers are applied to note exceptions. Noncompliant quality control (QC) is further explained in narrative comments.
· QC results that exceed the upper limits and are associated with non-detect samples are qualified but further narration is not required since the bias is high and does not change a non-detect result. Further narration is also not required with QC blank detection when the associated sample concentration is non-detect or more than ten times the level in the blank.
· Matrix QC may not be reported if insufficient sample or site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD is performed, unless otherwise specified in the method.
· Surrogate and/or isotope dilution analyte recoveries (if applicable) which are outside of the QC window are confirmed unless attributed to a dilution or otherwise noted in the narrative.
Regulated compliance samples (e.g. SDWA, NPDES) must comply with the associated agency requirements/permits.

Measurement uncertainty values, as applicable, are available upon request.

Test results relate only to the sample tested. Clients should be aware that a critical step in a chemical or microbiological analysis is the collection of the sample. Unless the sample analyzed is truly representative of the bulk of material involved, the test results will be meaningless. If you have questions regarding the proper techniques of collecting samples, please contact us. We cannot be held responsible for sample integrity, however, unless sampling has been performed by a member of our staff. Times are local to the area of activity. Parameters listed in the 40 CFR Part 136 Table II as "analyze immediately" and tested in the laboratory are not performed within 15 minutes of collection.

WARRANTY AND LIMITS OF LIABILITY - In accepting analytical work, we warrant the accuracy of test results for the sample as submitted. The foregoing express warranty is exclusive and is given in lieu of all other warranties, expressed or implied, except as otherwise agreed. We disclaim any other warranties, expressed or implied, including a warranty of fitness for particular purpose and warranty of merchantability. In no event shall Eurofins Lancaster Laboratories Environmental, LLC be liable for indirect, special, consequential, or incidental damages including, but not limited to, damages for loss of profit or goodwill regardless of (A) the negligence (either sole or concurrent) of Eurofins Lancaster Laboratories Environmental and (B) whether Eurofins Lancaster Laboratories Environmental has been informed of the possibility of such damages. We accept no legal responsibility for the purposes for which the client uses the test results. Except as otherwise agreed, no purchase order or other order for work shall be accepted by Eurofins Lancaster Laboratories Environmental which includes any conditions that vary from the Standard Terms and Conditions, and Eurofins Lancaster Laboratories Environmental hereby objects to any conflicting terms contained in any acceptance or order submitted by client.

Vanessa M. Badman

Vanessa Badman
Project Manager
7/14/2022 9:22:51 AM

Table of Contents

Qualifiers

Metals

Qualifier	Qualifier Description
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

General Chemistry

Qualifier	Qualifier Description
F5	Duplicate RPD exceeds limit, and one or both sample results are less than 5 times RL, and the absolute difference between results is < the upper reporting limits for both.
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
1C	Result is from the primary column on a dual-column method.
2C	Result is from the confirmation column on a dual-column method.
CFL	Contains Free Liquid
CFU	Colony Forming Unit
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MCL	EPA recommended "Maximum Contaminant Level"
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
MPN	Most Probable Number
MQL	Method Quantitation Limit
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
NEG	Negative / Absent
POS	Positive / Present
PQL	Practical Quantitation Limit
PRES	Presumptive
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)
TNTC	Too Numerous To Count

Case Narrative

Client: EA Engineering, Science, and Technology — Job ID: 410-89136-1

Project/Site: BCS2017-03D Task 13 - NPDES MS4 Compliance

Job ID: 410-89136-1

Laboratory: Eurofins Lancaster Laboratories Environment Testing, LLC

Narrative

Job Narrative
410-89136-1

REVISION

The report being provided is a revision of the original report sent on 7/13/2022. The report (revision 1) is being revised due to the modification of two sample IDs per client request.

Report revision history

Receipt

The samples were received on 6/28/2022 9:05 AM. Unless otherwise noted below, the samples arrived in good condition, and, where required, properly preserved and on ice. The temperatures of the 2 coolers at receipt time were -0.4°C and -0.4°C

Metals

No additional analytical or quality issues were noted, other than those described above or in the Definitions/ Glossary page.

General Chemistry

No additional analytical or quality issues were noted, other than those described above or in the Definitions/ Glossary page.

Detection Summary

Client: EA Engineering, Science, and Technology	Job ID: 410-89136-1
Project/Site: BCS2017-03D Task 13 - NPDES MS4 Complianc

Client Sample ID: LCC22-RI-01 — Lab Sample ID: 410-89136-1

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Copper	3.0		1.0	0.36	ug/L	1		200.8 Rev 5.4	Total/NA
Lead	2.1		0.50	0.071	ug/L	1		200.8 Rev 5.4	Total/NA
Zinc	8.0	J	10	4.0	ug/L	1		200.8 Rev 5.4	Total/NA
Hardness as calcium carbonate	160		50	15	mg/L	5		130.2	Total/NA
HEM (Oil & Grease)	2.3	J	6.0	1.7	mg/L	1		1664A	Total/NA
Total Suspended Solids	4.8		3.0	1.0	mg/L	1		2540D-2011	Total/NA
Total Kjeldahl Nitrogen	1.4		1.0	0.50	mg/L	1		351.2	Total/NA
Nitrate as N	2.1		0.10	0.040	mg/L	1		353.2	Total/NA
Nitrate Nitrite as N	2.1		0.10	0.040	mg/L	1		353.2	Total/NA
Nitrite as N	0.025	J	0.050	0.015	mg/L	1		353.2	Total/NA
Total Phosphorus as P	0.39		0.10	0.050	mg/L	1		365.1	Total/NA
Total Phosphorus as PO4	1.2		0.31	0.25	mg/L	1		365.1	Total/NA

Client Sample ID: LCC22-P-01-U — Lab Sample ID: 410-89136-2

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Copper	0.86	J	1.0	0.36	ug/L	1		200.8 Rev 5.4	Total/NA
Lead	0.17	J	0.50	0.071	ug/L	1		200.8 Rev 5.4	Total/NA
Hardness as calcium carbonate	110		50	15	mg/L	5		130.2	Total/NA
HEM (Oil & Grease)	2.3	J	5.6	1.6	mg/L	1		1664A	Total/NA
Total Suspended Solids	5.8		3.0	1.0	mg/L	1		2540D-2011	Total/NA
Total Kjeldahl Nitrogen	1.3		1.0	0.50	mg/L	1		351.2	Total/NA
Nitrate as N	2.0		0.10	0.040	mg/L	1		353.2	Total/NA
Nitrate Nitrite as N	2.0		0.10	0.040	mg/L	1		353.2	Total/NA
Nitrite as N	0.024	J	0.050	0.015	mg/L	1		353.2	Total/NA
Total Phosphorus as P	0.15		0.10	0.050	mg/L	1		365.1	Total/NA
Total Phosphorus as PO4	0.47		0.31	0.25	mg/L	1		365.1	Total/NA

Client Sample ID: LCC22-RE-01-U — Lab Sample ID: 410-89136-3

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Copper	0.85	J	1.0	0.36	ug/L	1		200.8 Rev 5.4	Total/NA
Lead	0.096	J	0.50	0.071	ug/L	1		200.8 Rev 5.4	Total/NA
Hardness as calcium carbonate	130		50	15	mg/L	5		130.2	Total/NA
HEM (Oil & Grease)	6.4		5.4	1.5	mg/L	1		1664A	Total/NA
SGT-HEM (TPH)	1.8	J	5.4	1.5	mg/L	1		1664A	Total/NA
Total Suspended Solids	4.2		3.0	1.0	mg/L	1		2540D-2011	Total/NA
Total Kjeldahl Nitrogen	0.86	J	1.0	0.50	mg/L	1		351.2	Total/NA
Nitrate as N	2.0		0.10	0.040	mg/L	1		353.2	Total/NA
Nitrate Nitrite as N	2.0		0.10	0.040	mg/L	1		353.2	Total/NA
Nitrite as N	0.021	J	0.050	0.015	mg/L	1		353.2	Total/NA
Total Phosphorus as P	0.14		0.10	0.050	mg/L	1		365.1	Total/NA
Total Phosphorus as PO4	0.44		0.31	0.25	mg/L	1		365.1	Total/NA

Client Sample ID: LCC22-RI-01-D — Lab Sample ID: 410-89136-4

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Copper	1.1		1.0	0.36	ug/L	1		200.8 Rev 5.4	Total/NA
Lead	0.32	J	0.50	0.071	ug/L	1		200.8 Rev 5.4	Total/NA
Hardness as calcium carbonate	120		50	15	mg/L	5		130.2	Total/NA
HEM (Oil & Grease)	2.6	J	5.4	1.5	mg/L	1		1664A	Total/NA
Total Suspended Solids	1.9	J	3.0	1.0	mg/L	1		2540D-2011	Total/NA

This Detection Summary does not include radiochemical test results.

Client Sample ID: LCC22-RI-01-D (Continued) — Lab Sample ID: 410-89136-4

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Total Kjeldahl Nitrogen	0.70	J	1.0	0.50	mg/L	1		351.2	Total/NA
Nitrate as N	1.7		0.10	0.040	mg/L	1		353.2	Total/NA
Nitrate Nitrite as N	1.7		0.10	0.040	mg/L	1		353.2	Total/NA
Nitrite as N	0.041	J	0.050	0.015	mg/L	1		353.2	Total/NA
Total Phosphorus as P	0.13		0.10	0.050	mg/L	1		365.1	Total/NA
Total Phosphorus as PO4	0.39		0.31	0.25	mg/L	1		365.1	Total/NA

Client Sample ID: LCC22-P-01-D — Lab Sample ID: 410-89136-5

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Copper	0.83	J	1.0	0.36	ug/L	1		200.8 Rev 5.4	Total/NA
Hardness as calcium carbonate	130		50	15	mg/L	5		130.2	Total/NA
HEM (Oil & Grease)	2.6	J	5.6	1.6	mg/L	1		1664A	Total/NA
Total Suspended Solids	1.8	J	3.0	1.0	mg/L	1		2540D-2011	Total/NA
Total Kjeldahl Nitrogen	0.93	J	1.0	0.50	mg/L	1		351.2	Total/NA
Nitrate as N	1.9		0.10	0.040	mg/L	1		353.2	Total/NA
Nitrate Nitrite as N	1.9		0.10	0.040	mg/L	1		353.2	Total/NA
Nitrite as N	0.038	J	0.050	0.015	mg/L	1		353.2	Total/NA
Total Phosphorus as P	0.23		0.10	0.050	mg/L	1		365.1	Total/NA
Total Phosphorus as PO4	0.72		0.31	0.25	mg/L	1		365.1	Total/NA

Client Sample ID: LCC22-RE-01-D — Lab Sample ID: 410-89136-6

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Copper	1.1		1.0	0.36	ug/L	1		200.8 Rev 5.4	Total/NA
Lead	0.28	J	0.50	0.071	ug/L	1		200.8 Rev 5.4	Total/NA
Hardness as calcium carbonate	130		50	15	mg/L	5		130.2	Total/NA
HEM (Oil & Grease)	1.9	J	6.0	1.7	mg/L	1		1664A	Total/NA
SGT-HEM (TPH)	1.8	J	6.0	1.7	mg/L	1		1664A	Total/NA
Total Suspended Solids	12		3.0	1.0	mg/L	1		2540D-2011	Total/NA
Total Kjeldahl Nitrogen	0.88	J	1.0	0.50	mg/L	1		351.2	Total/NA
Nitrate as N	1.9		0.10	0.040	mg/L	1		353.2	Total/NA
Nitrate Nitrite as N	1.9		0.10	0.040	mg/L	1		353.2	Total/NA
Nitrite as N	0.032	J	0.050	0.015	mg/L	1		353.2	Total/NA
Total Phosphorus as P	0.13		0.10	0.050	mg/L	1		365.1	Total/NA
Total Phosphorus as PO4	0.40		0.31	0.25	mg/L	1		365.1	Total/NA

This Detection Summary does not include radiochemical test results.

Client Sample Results

Client: EA Engineering, Science, and Technology — Job ID: 410-89136-1
Project/Site: BCS2017-03D Task 13 - NPDES MS4 Complianc

Client Sample ID: LCC22-RI-01 — Lab Sample ID: 410-89136-1

Date Collected: 06/27/22 10:25 — **Matrix: Water**
Date Received: 06/28/22 09:05

Method: 200.8 Rev 5.4 - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Copper	3.0		1.0	0.36	ug/L		07/02/22 05:58	07/06/22 18:13	1
Lead	2.1		0.50	0.071	ug/L		07/02/22 05:58	07/06/22 18:13	1
Zinc	8.0	J	10	4.0	ug/L		07/02/22 05:58	07/06/22 18:13	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Hardness as calcium carbonate	160		50	15	mg/L			06/30/22 08:55	5
HEM (Oil & Grease)	2.3	J	6.0	1.7	mg/L			07/01/22 17:26	1
SGT-HEM (TPH)	ND		6.0	1.7	mg/L			07/01/22 17:26	1
Total Suspended Solids	4.8		3.0	1.0	mg/L			06/29/22 07:33	1
Total Kjeldahl Nitrogen	1.4		1.0	0.50	mg/L		07/11/22 13:56	07/12/22 11:45	1
Nitrate as N	2.1		0.10	0.040	mg/L			06/29/22 06:30	1
Nitrate Nitrite as N	2.1		0.10	0.040	mg/L			07/07/22 08:05	1
Nitrite as N	0.025	J	0.050	0.015	mg/L			06/29/22 06:46	1
Total Phosphorus as P	0.39		0.10	0.050	mg/L		07/08/22 08:16	07/11/22 09:46	1
Total Phosphorus as PO4	1.2		0.31	0.25	mg/L		07/08/22 08:16	07/11/22 09:46	1
Biochemical Oxygen Demand	ND		2.0	2.0	mg/L			06/28/22 17:18	1

Client Sample ID: LCC22-P-01-U — Lab Sample ID: 410-89136-2

Date Collected: 06/27/22 13:30 — **Matrix: Water**
Date Received: 06/28/22 09:05

Method: 200.8 Rev 5.4 - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Copper	0.86	J	1.0	0.36	ug/L		07/02/22 05:58	07/06/22 18:29	1
Lead	0.17	J	0.50	0.071	ug/L		07/02/22 05:58	07/06/22 18:29	1
Zinc	ND		10	4.0	ug/L		07/02/22 05:58	07/06/22 18:29	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Hardness as calcium carbonate	110		50	15	mg/L			06/30/22 09:12	5
HEM (Oil & Grease)	2.3	J	5.6	1.6	mg/L			07/01/22 17:26	1
SGT-HEM (TPH)	ND		5.6	1.6	mg/L			07/01/22 17:26	1
Total Suspended Solids	5.8		3.0	1.0	mg/L			06/29/22 07:33	1
Total Kjeldahl Nitrogen	1.3		1.0	0.50	mg/L		07/12/22 09:00	07/13/22 10:25	1
Nitrate as N	2.0		0.10	0.040	mg/L			06/29/22 06:30	1
Nitrate Nitrite as N	2.0		0.10	0.040	mg/L			07/07/22 08:07	1
Nitrite as N	0.024	J	0.050	0.015	mg/L			06/29/22 06:57	1
Total Phosphorus as P	0.15		0.10	0.050	mg/L		07/08/22 08:15	07/11/22 08:00	1
Total Phosphorus as PO4	0.47		0.31	0.25	mg/L		07/08/22 08:15	07/11/22 08:00	1
Biochemical Oxygen Demand	ND		2.0	2.0	mg/L			06/28/22 17:18	1

Client Sample ID: LCC22-RE-01-U — Lab Sample ID: 410-89136-3

Date Collected: 06/27/22 15:35 — **Matrix: Water**
Date Received: 06/28/22 09:05

Method: 200.8 Rev 5.4 - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Copper	0.85	J	1.0	0.36	ug/L		07/07/22 15:32	07/08/22 11:35	1
Lead	0.096	J	0.50	0.071	ug/L		07/07/22 15:32	07/08/22 11:35	1
Zinc	ND		10	4.0	ug/L		07/07/22 15:32	07/08/22 11:35	1

Client Sample Results

Client: EA Engineering, Science, and Technology | Job ID: 410-89136-1

Project/Site: BCS2017-03D Task 13 - NPDES MS4 Complianc

Client Sample ID: LCC22-RE-01-U

Lab Sample ID: 410-89136-3

Date Collected: 06/27/22 15:35

Matrix: Water

Date Received: 06/28/22 09:05

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Hardness as calcium carbonate	130		50	15	mg/L			06/30/22 09:35	5
HEM (Oil & Grease)	6.4		5.4	1.5	mg/L			07/01/22 17:26	1
SGT-HEM (TPH)	1.8	J	5.4	1.5	mg/L			07/01/22 17:26	1
Total Suspended Solids	4.2		3.0	1.0	mg/L			06/29/22 07:33	1
Total Kjeldahl Nitrogen	0.86	J	1.0	0.50	mg/L		07/12/22 09:00	07/13/22 10:27	1
Nitrate as N	2.0		0.10	0.040	mg/L			06/29/22 06:30	1
Nitrate Nitrite as N	2.0		0.10	0.040	mg/L			07/07/22 08:13	1
Nitrite as N	0.021	J	0.050	0.015	mg/L			06/29/22 07:00	1
Total Phosphorus as P	0.14		0.10	0.050	mg/L		07/05/22 11:30	07/06/22 10:03	1
Total Phosphorus as PO4	0.44		0.31	0.25	mg/L		07/05/22 11:30	07/06/22 10:03	1
Biochemical Oxygen Demand	ND		2.0	2.0	mg/L			06/28/22 17:18	1

Client Sample ID: LCC22-RI-01-D

Lab Sample ID: 410-89136-4

Date Collected: 06/27/22 11:15

Matrix: Water

Date Received: 06/28/22 09:05

Method: 200.8 Rev 5.4 - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Copper	1.1		1.0	0.36	ug/L		07/07/22 15:35	07/11/22 17:17	1
Lead	0.32	J	0.50	0.071	ug/L		07/07/22 15:35	07/11/22 17:17	1
Zinc	ND		10	4.0	ug/L		07/07/22 15:35	07/11/22 17:17	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Hardness as calcium carbonate	120		50	15	mg/L			06/30/22 09:41	5
HEM (Oil & Grease)	2.6	J	5.4	1.5	mg/L			07/01/22 17:26	1
SGT-HEM (TPH)	ND		5.4	1.5	mg/L			07/01/22 17:26	1
Total Suspended Solids	1.9	J	3.0	1.0	mg/L			06/29/22 07:33	1
Total Kjeldahl Nitrogen	0.70	J	1.0	0.50	mg/L		07/12/22 09:00	07/13/22 10:21	1
Nitrate as N	1.7		0.10	0.040	mg/L			06/29/22 06:30	1
Nitrate Nitrite as N	1.7		0.10	0.040	mg/L			07/07/22 08:15	1
Nitrite as N	0.041	J	0.050	0.015	mg/L			06/29/22 06:47	1
Total Phosphorus as P	0.13		0.10	0.050	mg/L		07/08/22 08:15	07/11/22 08:00	1
Total Phosphorus as PO4	0.39		0.31	0.25	mg/L		07/08/22 08:15	07/11/22 08:00	1
Biochemical Oxygen Demand	ND		2.0	2.0	mg/L			06/28/22 18:05	1

Client Sample ID: LCC22-P-01-D

Lab Sample ID: 410-89136-5

Date Collected: 06/27/22 14:40

Matrix: Water

Date Received: 06/28/22 09:05

Method: 200.8 Rev 5.4 - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Copper	0.83	J	1.0	0.36	ug/L		07/07/22 15:32	07/08/22 11:37	1
Lead	ND		0.50	0.071	ug/L		07/07/22 15:32	07/08/22 11:37	1
Zinc	ND		10	4.0	ug/L		07/07/22 15:32	07/08/22 11:37	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Hardness as calcium carbonate	130		50	15	mg/L			06/30/22 09:47	5
HEM (Oil & Grease)	2.6	J	5.6	1.6	mg/L			07/01/22 17:26	1
SGT-HEM (TPH)	ND		5.6	1.6	mg/L			07/01/22 17:26	1

Client Sample Results

Client: EA Engineering, Science, and Technology | Job ID: 410-89136-1
Project/Site: BCS2017-03D Task 13 - NPDES MS4 Complianc

Client Sample ID: LCC22-P-01-D
Lab Sample ID: 410-89136-5
Date Collected: 06/27/22 14:40
Matrix: Water
Date Received: 06/28/22 09:05

General Chemistry (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Suspended Solids	1.8	J	3.0	1.0	mg/L			06/29/22 07:33	1
Total Kjeldahl Nitrogen	0.93	J	1.0	0.50	mg/L		07/12/22 09:00	07/13/22 10:52	1
Nitrate as N	1.9		0.10	0.040	mg/L			06/29/22 06:30	1
Nitrate Nitrite as N	1.9		0.10	0.040	mg/L			07/07/22 08:17	1
Nitrite as N	0.038	J	0.050	0.015	mg/L			06/29/22 06:59	1
Total Phosphorus as P	0.23		0.10	0.050	mg/L		07/05/22 11:30	07/06/22 10:03	1
Total Phosphorus as PO4	0.72		0.31	0.25	mg/L		07/05/22 11:30	07/06/22 10:03	1
Biochemical Oxygen Demand	ND		2.0	2.0	mg/L			06/28/22 18:05	1

Client Sample ID: LCC22-RE-01-D
Lab Sample ID: 410-89136-6
Date Collected: 06/27/22 15:15
Matrix: Water
Date Received: 06/28/22 09:05

Method: 200.8 Rev 5.4 - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Copper	1.1		1.0	0.36	ug/L		07/02/22 05:58	07/06/22 18:15	1
Lead	0.28	J	0.50	0.071	ug/L		07/02/22 05:58	07/06/22 18:15	1
Zinc	ND		10	4.0	ug/L		07/02/22 05:58	07/06/22 18:15	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Hardness as calcium carbonate	130		50	15	mg/L			06/30/22 09:53	5
HEM (Oil & Grease)	1.9	J	6.0	1.7	mg/L			07/01/22 17:26	1
SGT-HEM (TPH)	1.8	J	6.0	1.7	mg/L			07/01/22 17:26	1
Total Suspended Solids	12		3.0	1.0	mg/L			06/29/22 07:33	1
Total Kjeldahl Nitrogen	0.88	J	1.0	0.50	mg/L		07/12/22 09:00	07/13/22 10:15	1
Nitrate as N	1.9		0.10	0.040	mg/L			06/29/22 06:30	1
Nitrate Nitrite as N	1.9		0.10	0.040	mg/L			07/07/22 08:19	1
Nitrite as N	0.032	J	0.050	0.015	mg/L			06/29/22 07:00	1
Total Phosphorus as P	0.13		0.10	0.050	mg/L		07/05/22 11:30	07/06/22 10:03	1
Total Phosphorus as PO4	0.40		0.31	0.25	mg/L		07/05/22 11:30	07/06/22 10:03	1
Biochemical Oxygen Demand	ND		2.0	2.0	mg/L			06/28/22 18:05	1

QC Sample Results

Client: EA Engineering, Science, and Technology
Job ID: 410-89136-1
Project/Site: BCS2017-03D Task 13 - NPDES MS4 Complianc

Method: 200.8 Rev 5.4 - Metals (ICP/MS)

Lab Sample ID: MB 410-271913/1-A
Matrix: Water
Analysis Batch: 272937
Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 271913

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Copper	ND		1.0	0.36	ug/L		07/02/22 05:58	07/06/22 17:53	1
Lead	ND		0.50	0.071	ug/L		07/02/22 05:58	07/06/22 17:53	1
Zinc	ND		10	4.0	ug/L		07/02/22 05:58	07/06/22 17:53	1

Lab Sample ID: LCS 410-271913/2-A
Matrix: Water
Analysis Batch: 272937
Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 271913

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Copper	500	481		ug/L		96	85 - 115
Lead	50.0	52.4		ug/L		105	85 - 115
Zinc	500	504		ug/L		101	85 - 115

Lab Sample ID: MB 410-273255/1-A
Matrix: Water
Analysis Batch: 273579
Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 273255

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Copper	ND		1.0	0.36	ug/L		07/07/22 15:32	07/08/22 11:13	1
Lead	ND		0.50	0.071	ug/L		07/07/22 15:32	07/08/22 11:13	1
Zinc	ND		10	4.0	ug/L		07/07/22 15:32	07/08/22 11:13	1

Lab Sample ID: LCS 410-273255/2-A
Matrix: Water
Analysis Batch: 273579
Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 273255

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Copper	500	492		ug/L		98	85 - 115
Lead	50.0	52.7		ug/L		105	85 - 115
Zinc	500	506		ug/L		101	85 - 115

Lab Sample ID: MB 410-273257/1-A
Matrix: Water
Analysis Batch: 274410
Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 273257

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Copper	ND		1.0	0.36	ug/L		07/07/22 15:35	07/11/22 16:58	1
Lead	ND		0.50	0.071	ug/L		07/07/22 15:35	07/11/22 16:58	1
Zinc	ND		10	4.0	ug/L		07/07/22 15:35	07/11/22 16:58	1

Lab Sample ID: LCS 410-273257/2-A
Matrix: Water
Analysis Batch: 274410
Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 273257

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Copper	500	491		ug/L		98	85 - 115
Lead	50.0	52.7		ug/L		105	85 - 115
Zinc	500	500		ug/L		100	85 - 115

Method: 130.2 - Hardness, Total (mg/l as CaCO3)

Lab Sample ID: MB 410-271274/6
Matrix: Water
Analysis Batch: 271274
Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Hardness as calcium carbonate	ND		10	3.0	mg/L			06/30/22 08:09	1

Lab Sample ID: LCS 410-271274/7
Matrix: Water
Analysis Batch: 271274
Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Hardness as calcium carbonate	40.0	41.8		mg/L		104	91 - 108

Lab Sample ID: 410-89136-1 DU
Matrix: Water
Analysis Batch: 271274
Client Sample ID: LCC22-RI-01
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Hardness as calcium carbonate	160		127	F5	mg/L		21	7

Method: 1664A - HEM and SGT-HEM

Lab Sample ID: MB 410-271852/1
Matrix: Water
Analysis Batch: 271852
Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
HEM (Oil & Grease)	ND		5.0	1.4	mg/L			07/01/22 17:26	1
SGT-HEM (TPH)	ND		5.0	1.4	mg/L			07/01/22 17:26	1

Lab Sample ID: LCS 410-271852/2
Matrix: Water
Analysis Batch: 271852
Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
HEM (Oil & Grease)	40.0	32.00		mg/L		80	78 - 114
SGT-HEM (TPH)	20.0	14.90		mg/L		74	64 - 132

Lab Sample ID: LCSD 410-271852/3
Matrix: Water
Analysis Batch: 271852
Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	RPD Limit
HEM (Oil & Grease)	40.0	33.40		mg/L		84	78 - 114	4	13
SGT-HEM (TPH)	20.0	16.70		mg/L		84	64 - 132	11	23

Method: 2540D-2011 - Solids, Total Suspended (TSS)

Lab Sample ID: MB 410-270543/1
Matrix: Water
Analysis Batch: 270543
Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Suspended Solids	ND		3.0	1.0	mg/L			06/29/22 07:33	1

Method: 2540D-2011 - Solids, Total Suspended (TSS) (Continued)

Lab Sample ID: LCS 410-270543/2 — **Client Sample ID: Lab Control Sample**
Matrix: Water — **Prep Type: Total/NA**
Analysis Batch: 270543

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Total Suspended Solids	151	149		mg/L		99	89 - 105

Lab Sample ID: LCSD 410-270543/24 — **Client Sample ID: Lab Control Sample Dup**
Matrix: Water — **Prep Type: Total/NA**
Analysis Batch: 270543

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	RPD Limit
Total Suspended Solids	150	149		mg/L		99	89 - 105	0	20

Method: 351.2 - Nitrogen, Total Kjeldahl

Lab Sample ID: MB 410-274220/2-A — **Client Sample ID: Method Blank**
Matrix: Water — **Prep Type: Total/NA**
Analysis Batch: 274667 — **Prep Batch: 274220**

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Kjeldahl Nitrogen	ND		1.0	0.50	mg/L		07/11/22 13:56	07/12/22 11:08	1

Lab Sample ID: LCS 410-274220/1-A — **Client Sample ID: Lab Control Sample**
Matrix: Water — **Prep Type: Total/NA**
Analysis Batch: 274667 — **Prep Batch: 274220**

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Total Kjeldahl Nitrogen	3.96	3.65		mg/L		92	90 - 110

Lab Sample ID: MB 410-274592/2-A — **Client Sample ID: Method Blank**
Matrix: Water — **Prep Type: Total/NA**
Analysis Batch: 275074 — **Prep Batch: 274592**

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Kjeldahl Nitrogen	ND		1.0	0.50	mg/L		07/12/22 09:00	07/13/22 09:50	1

Lab Sample ID: LCS 410-274592/1-A — **Client Sample ID: Lab Control Sample**
Matrix: Water — **Prep Type: Total/NA**
Analysis Batch: 275074 — **Prep Batch: 274592**

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Total Kjeldahl Nitrogen	3.96	3.92		mg/L		99	90 - 110

Method: 353.2 - Nitrogen, Nitrite

Lab Sample ID: MB 410-270681/15 — **Client Sample ID: Method Blank**
Matrix: Water — **Prep Type: Total/NA**
Analysis Batch: 270681

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Nitrite as N	ND		0.050	0.015	mg/L			06/29/22 06:45	1

Client: EA Engineering, Science, and Technology
Job ID: 410-89136-1
Project/Site: BCS2017-03D Task 13 - NPDES MS4 Complianc

Method: 353.2 - Nitrogen, Nitrite (Continued)

Lab Sample ID: MB 410-270681/47
Client Sample ID: Method Blank
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 270681

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Nitrite as N	ND		0.050	0.015	mg/L			06/29/22 06:53	1

Lab Sample ID: LCS 410-270681/13
Client Sample ID: Lab Control Sample
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 270681

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Nitrite as N	0.700	0.686		mg/L		98	90 - 110

Lab Sample ID: LCS 410-270681/46
Client Sample ID: Lab Control Sample
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 270681

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Nitrite as N	0.700	0.686		mg/L		98	90 - 110

Lab Sample ID: LCSD 410-270681/14
Client Sample ID: Lab Control Sample Dup
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 270681

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	RPD Limit
Nitrite as N	0.700	0.684		mg/L		98	90 - 110	0	20

Method: 353.2 - Nitrogen, Nitrate-Nitrite

Lab Sample ID: MB 410-273199/22
Client Sample ID: Method Blank
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 273199

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Nitrate Nitrite as N	ND		0.10	0.040	mg/L			07/07/22 06:19	1

Lab Sample ID: MB 410-273199/57
Client Sample ID: Method Blank
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 273199

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Nitrate Nitrite as N	ND		0.10	0.040	mg/L			07/07/22 07:29	1

Lab Sample ID: LCS 410-273199/55
Client Sample ID: Lab Control Sample
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 273199

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Nitrate Nitrite as N	2.50	2.32		mg/L		93	90 - 110

Method: 353.2 - Nitrogen, Nitrate-Nitrite (Continued)

Lab Sample ID: LCSD 410-273199/56
Matrix: Water
Analysis Batch: 273199

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	RPD Limit
Nitrate Nitrite as N	2.50	2.34		mg/L		93	90 - 110	1	20

Method: 365.1 - Phosphorus, Total

Lab Sample ID: MB 410-272264/2-A
Matrix: Water
Analysis Batch: 272696

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 272264

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Phosphorus as P	ND		0.10	0.050	mg/L		07/05/22 11:30	07/06/22 09:26	1
Total Phosphorus as PO4	ND		0.31	0.25	mg/L		07/05/22 11:30	07/06/22 09:26	1

Lab Sample ID: LCS 410-272264/1-A
Matrix: Water
Analysis Batch: 272696

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 272264

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Total Phosphorus as P	1.33	1.41		mg/L		106	90 - 110
Total Phosphorus as PO4	4.07	4.32		mg/L		106	90 - 110

Lab Sample ID: MB 410-273497/2-A
Matrix: Water
Analysis Batch: 274108

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 273497

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Phosphorus as P	ND		0.10	0.050	mg/L		07/08/22 08:15	07/11/22 07:07	1
Total Phosphorus as PO4	ND		0.31	0.25	mg/L		07/08/22 08:15	07/11/22 07:07	1

Lab Sample ID: LCS 410-273497/1-A
Matrix: Water
Analysis Batch: 274108

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 273497

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Total Phosphorus as P	1.33	1.42		mg/L		107	90 - 110
Total Phosphorus as PO4	4.07	4.37		mg/L		107	90 - 110

Lab Sample ID: MB 410-273498/2-A
Matrix: Water
Analysis Batch: 274108

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 273498

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Phosphorus as P	ND		0.10	0.050	mg/L		07/08/22 08:16	07/11/22 08:00	1
Total Phosphorus as PO4	ND		0.31	0.25	mg/L		07/08/22 08:16	07/11/22 08:00	1

Lab Sample ID: LCS 410-273498/1-A
Matrix: Water
Analysis Batch: 274108

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 273498

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Total Phosphorus as P	1.33	1.45		mg/L		109	90 - 110

Client: EA Engineering, Science, and Technology
Job ID: 410-89136-1
Project/Site: BCS2017-03D Task 13 - NPDES MS4 Complianc

Method: 365.1 - Phosphorus, Total (Continued)

Lab Sample ID: LCS 410-273498/1-A
Client Sample ID: Lab Control Sample
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 274108
Prep Batch: 273498

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Total Phosphorus as PO4	4.07	4.44		mg/L		109	90 - 110

Method: 405.1 - BOD, 5-Day

Lab Sample ID: SCB 410-272015/4
Client Sample ID: Method Blank
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 272015

Analyte	SCB Result	SCB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Biochemical Oxygen Demand	0.819		0.0000010	0.0000010	mg/L			06/28/22 15:55	1

Lab Sample ID: USB 410-272015/2
Client Sample ID: Method Blank
Matrix: Water
Prep Type: Total/NA
Analysis Batch: 272015

Analyte	USB Result	USB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Biochemical Oxygen Demand	ND		0.0000010	0.0000010	mg/L			06/28/22 15:55	1

Metals

Prep Batch: 271913

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-89136-1	LCC22-RI-01	Total/NA	Water	200.8 Rev 5.4	
410-89136-2	LCC22-P-01-U	Total/NA	Water	200.8 Rev 5.4	
410-89136-6	LCC22-RE-01-D	Total/NA	Water	200.8 Rev 5.4	
MB 410-271913/1-A	Method Blank	Total/NA	Water	200.8 Rev 5.4	
LCS 410-271913/2-A	Lab Control Sample	Total/NA	Water	200.8 Rev 5.4	

Analysis Batch: 272937

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-89136-1	LCC22-RI-01	Total/NA	Water	200.8 Rev 5.4	271913
410-89136-2	LCC22-P-01-U	Total/NA	Water	200.8 Rev 5.4	271913
410-89136-6	LCC22-RE-01-D	Total/NA	Water	200.8 Rev 5.4	271913
MB 410-271913/1-A	Method Blank	Total/NA	Water	200.8 Rev 5.4	271913
LCS 410-271913/2-A	Lab Control Sample	Total/NA	Water	200.8 Rev 5.4	271913

Prep Batch: 273255

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-89136-3	LCC22-RE-01-U	Total/NA	Water	200.8 Rev 5.4	
410-89136-5	LCC22-P-01-D	Total/NA	Water	200.8 Rev 5.4	
MB 410-273255/1-A	Method Blank	Total/NA	Water	200.8 Rev 5.4	
LCS 410-273255/2-A	Lab Control Sample	Total/NA	Water	200.8 Rev 5.4	

Prep Batch: 273257

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-89136-4	LCC22-RI-01-D	Total/NA	Water	200.8 Rev 5.4	
MB 410-273257/1-A	Method Blank	Total/NA	Water	200.8 Rev 5.4	
LCS 410-273257/2-A	Lab Control Sample	Total/NA	Water	200.8 Rev 5.4	

Analysis Batch: 273579

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-89136-3	LCC22-RE-01-U	Total/NA	Water	200.8 Rev 5.4	273255
410-89136-5	LCC22-P-01-D	Total/NA	Water	200.8 Rev 5.4	273255
MB 410-273255/1-A	Method Blank	Total/NA	Water	200.8 Rev 5.4	273255
LCS 410-273255/2-A	Lab Control Sample	Total/NA	Water	200.8 Rev 5.4	273255

Analysis Batch: 274410

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-89136-4	LCC22-RI-01-D	Total/NA	Water	200.8 Rev 5.4	273257
MB 410-273257/1-A	Method Blank	Total/NA	Water	200.8 Rev 5.4	273257
LCS 410-273257/2-A	Lab Control Sample	Total/NA	Water	200.8 Rev 5.4	273257

General Chemistry

Analysis Batch: 270158

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-89136-1	LCC22-RI-01	Total/NA	Water	353.2	
410-89136-2	LCC22-P-01-U	Total/NA	Water	353.2	
410-89136-3	LCC22-RE-01-U	Total/NA	Water	353.2	
410-89136-4	LCC22-RI-01-D	Total/NA	Water	353.2	
410-89136-5	LCC22-P-01-D	Total/NA	Water	353.2	
410-89136-6	LCC22-RE-01-D	Total/NA	Water	353.2	

1 2 3 4 5 6 7 8 9 10 11 12 13 14

General Chemistry

Analysis Batch: 270543

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-89136-1	LCC22-RI-01	Total/NA	Water	2540D-2011	
410-89136-2	LCC22-P-01-U	Total/NA	Water	2540D-2011	
410-89136-3	LCC22-RE-01-U	Total/NA	Water	2540D-2011	
410-89136-4	LCC22-RI-01-D	Total/NA	Water	2540D-2011	
410-89136-5	LCC22-P-01-D	Total/NA	Water	2540D-2011	
410-89136-6	LCC22-RE-01-D	Total/NA	Water	2540D-2011	
MB 410-270543/1	Method Blank	Total/NA	Water	2540D-2011	
LCS 410-270543/2	Lab Control Sample	Total/NA	Water	2540D-2011	
LCSD 410-270543/24	Lab Control Sample Dup	Total/NA	Water	2540D-2011	

Analysis Batch: 270681

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-89136-1	LCC22-RI-01	Total/NA	Water	353.2	
410-89136-2	LCC22-P-01-U	Total/NA	Water	353.2	
410-89136-3	LCC22-RE-01-U	Total/NA	Water	353.2	
410-89136-4	LCC22-RI-01-D	Total/NA	Water	353.2	
410-89136-5	LCC22-P-01-D	Total/NA	Water	353.2	
410-89136-6	LCC22-RE-01-D	Total/NA	Water	353.2	
MB 410-270681/15	Method Blank	Total/NA	Water	353.2	
MB 410-270681/47	Method Blank	Total/NA	Water	353.2	
LCS 410-270681/13	Lab Control Sample	Total/NA	Water	353.2	
LCS 410-270681/46	Lab Control Sample	Total/NA	Water	353.2	
LCSD 410-270681/14	Lab Control Sample Dup	Total/NA	Water	353.2	

Analysis Batch: 271274

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-89136-1	LCC22-RI-01	Total/NA	Water	130.2	
410-89136-2	LCC22-P-01-U	Total/NA	Water	130.2	
410-89136-3	LCC22-RE-01-U	Total/NA	Water	130.2	
410-89136-4	LCC22-RI-01-D	Total/NA	Water	130.2	
410-89136-5	LCC22-P-01-D	Total/NA	Water	130.2	
410-89136-6	LCC22-RE-01-D	Total/NA	Water	130.2	
MB 410-271274/6	Method Blank	Total/NA	Water	130.2	
LCS 410-271274/7	Lab Control Sample	Total/NA	Water	130.2	
410-89136-1 DU	LCC22-RI-01	Total/NA	Water	130.2	

Analysis Batch: 271852

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-89136-1	LCC22-RI-01	Total/NA	Water	1664A	
410-89136-2	LCC22-P-01-U	Total/NA	Water	1664A	
410-89136-3	LCC22-RE-01-U	Total/NA	Water	1664A	
410-89136-4	LCC22-RI-01-D	Total/NA	Water	1664A	
410-89136-5	LCC22-P-01-D	Total/NA	Water	1664A	
410-89136-6	LCC22-RE-01-D	Total/NA	Water	1664A	
MB 410-271852/1	Method Blank	Total/NA	Water	1664A	
LCS 410-271852/2	Lab Control Sample	Total/NA	Water	1664A	
LCSD 410-271852/3	Lab Control Sample Dup	Total/NA	Water	1664A	

Analysis Batch: 272015

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-89136-1	LCC22-RI-01	Total/NA	Water	405.1	

General Chemistry (Continued)

Analysis Batch: 272015 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-89136-2	LCC22-P-01-U	Total/NA	Water	405.1	
410-89136-3	LCC22-RE-01-U	Total/NA	Water	405.1	
410-89136-4	LCC22-RI-01-D	Total/NA	Water	405.1	
410-89136-5	LCC22-P-01-D	Total/NA	Water	405.1	
410-89136-6	LCC22-RE-01-D	Total/NA	Water	405.1	
SCB 410-272015/4	Method Blank	Total/NA	Water	405.1	
USB 410-272015/2	Method Blank	Total/NA	Water	405.1	
LCS 410-272015/5	Lab Control Sample	Total/NA	Water	405.1	

Prep Batch: 272264

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-89136-3	LCC22-RE-01-U	Total/NA	Water	365.1	
410-89136-5	LCC22-P-01-D	Total/NA	Water	365.1	
410-89136-6	LCC22-RE-01-D	Total/NA	Water	365.1	
MB 410-272264/2-A	Method Blank	Total/NA	Water	365.1	
LCS 410-272264/1-A	Lab Control Sample	Total/NA	Water	365.1	

Analysis Batch: 272696

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-89136-3	LCC22-RE-01-U	Total/NA	Water	365.1	272264
410-89136-5	LCC22-P-01-D	Total/NA	Water	365.1	272264
410-89136-6	LCC22-RE-01-D	Total/NA	Water	365.1	272264
MB 410-272264/2-A	Method Blank	Total/NA	Water	365.1	272264
LCS 410-272264/1-A	Lab Control Sample	Total/NA	Water	365.1	272264

Analysis Batch: 273199

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-89136-1	LCC22-RI-01	Total/NA	Water	353.2	
410-89136-2	LCC22-P-01-U	Total/NA	Water	353.2	
410-89136-3	LCC22-RE-01-U	Total/NA	Water	353.2	
410-89136-4	LCC22-RI-01-D	Total/NA	Water	353.2	
410-89136-5	LCC22-P-01-D	Total/NA	Water	353.2	
410-89136-6	LCC22-RE-01-D	Total/NA	Water	353.2	
MB 410-273199/22	Method Blank	Total/NA	Water	353.2	
MB 410-273199/57	Method Blank	Total/NA	Water	353.2	
LCS 410-273199/55	Lab Control Sample	Total/NA	Water	353.2	
LCSD 410-273199/56	Lab Control Sample Dup	Total/NA	Water	353.2	

Prep Batch: 273497

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-89136-2	LCC22-P-01-U	Total/NA	Water	365.1	
410-89136-4	LCC22-RI-01-D	Total/NA	Water	365.1	
MB 410-273497/2-A	Method Blank	Total/NA	Water	365.1	
LCS 410-273497/1-A	Lab Control Sample	Total/NA	Water	365.1	

Prep Batch: 273498

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-89136-1	LCC22-RI-01	Total/NA	Water	365.1	
MB 410-273498/2-A	Method Blank	Total/NA	Water	365.1	
LCS 410-273498/1-A	Lab Control Sample	Total/NA	Water	365.1	

QC Association Summary

Client: EA Engineering, Science, and Technology

Job ID: 410-89136-1

Project/Site: BCS2017-03D Task 13 - NPDES MS4 Complianc

General Chemistry

Analysis Batch: 274108

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-89136-1	LCC22-RI-01	Total/NA	Water	365.1	273498
410-89136-2	LCC22-P-01-U	Total/NA	Water	365.1	273497
410-89136-4	LCC22-RI-01-D	Total/NA	Water	365.1	273497
MB 410-273497/2-A	Method Blank	Total/NA	Water	365.1	273497
MB 410-273498/2-A	Method Blank	Total/NA	Water	365.1	273498
LCS 410-273497/1-A	Lab Control Sample	Total/NA	Water	365.1	273497
LCS 410-273498/1-A	Lab Control Sample	Total/NA	Water	365.1	273498

Prep Batch: 274220

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-89136-1	LCC22-RI-01	Total/NA	Water	351.2	
MB 410-274220/2-A	Method Blank	Total/NA	Water	351.2	
LCS 410-274220/1-A	Lab Control Sample	Total/NA	Water	351.2	

Prep Batch: 274592

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-89136-2	LCC22-P-01-U	Total/NA	Water	351.2	
410-89136-3	LCC22-RE-01-U	Total/NA	Water	351.2	
410-89136-4	LCC22-RI-01-D	Total/NA	Water	351.2	
410-89136-5	LCC22-P-01-D	Total/NA	Water	351.2	
410-89136-6	LCC22-RE-01-D	Total/NA	Water	351.2	
MB 410-274592/2-A	Method Blank	Total/NA	Water	351.2	
LCS 410-274592/1-A	Lab Control Sample	Total/NA	Water	351.2	

Analysis Batch: 274667

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-89136-1	LCC22-RI-01	Total/NA	Water	351.2	274220
MB 410-274220/2-A	Method Blank	Total/NA	Water	351.2	274220
LCS 410-274220/1-A	Lab Control Sample	Total/NA	Water	351.2	274220

Analysis Batch: 275074

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
410-89136-2	LCC22-P-01-U	Total/NA	Water	351.2	274592
410-89136-3	LCC22-RE-01-U	Total/NA	Water	351.2	274592
410-89136-4	LCC22-RI-01-D	Total/NA	Water	351.2	274592
410-89136-5	LCC22-P-01-D	Total/NA	Water	351.2	274592
410-89136-6	LCC22-RE-01-D	Total/NA	Water	351.2	274592
MB 410-274592/2-A	Method Blank	Total/NA	Water	351.2	274592
LCS 410-274592/1-A	Lab Control Sample	Total/NA	Water	351.2	274592

Lab Chronicle

Client: EA Engineering, Science, and Technology — Job ID: 410-89136-1

Project/Site: BCS2017-03D Task 13 - NPDES MS4 Complianc

Client Sample ID: LCC22-RI-01 — Lab Sample ID: 410-89136-1

Date Collected: 06/27/22 10:25 — **Matrix: Water**

Date Received: 06/28/22 09:05

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	200.8 Rev 5.4			271913	07/02/22 05:58	UAMX	ELLE
Total/NA	Analysis	200.8 Rev 5.4		1	272937	07/06/22 18:13	UCIG	ELLE
Total/NA	Analysis	130.2		5	271274	06/30/22 08:55	USAE	ELLE
Total/NA	Analysis	1664A		1	271852	07/01/22 17:26	QT6L	ELLE
Total/NA	Analysis	2540D-2011		1	270543	06/29/22 07:33	M98K	ELLE
Total/NA	Prep	351.2			274220	07/11/22 13:56	F8AU	ELLE
Total/NA	Analysis	351.2		1	274667	07/12/22 11:45	JCG7	ELLE
Total/NA	Analysis	353.2		1	273199	07/07/22 08:05	CBM8	ELLE
Total/NA	Analysis	353.2		1	270681	06/29/22 06:46	P684	ELLE
Total/NA	Analysis	353.2		1	270158	06/29/22 06:30	USJM	ELLE
Total/NA	Prep	365.1			273498	07/08/22 08:16	CBM8	ELLE
Total/NA	Analysis	365.1		1	274108	07/11/22 09:46	CBM8	ELLE
Total/NA	Analysis	405.1		1	272015	06/28/22 17:18	F8TI	ELLE

Client Sample ID: LCC22-P-01-U — Lab Sample ID: 410-89136-2

Date Collected: 06/27/22 13:30 — **Matrix: Water**

Date Received: 06/28/22 09:05

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	200.8 Rev 5.4			271913	07/02/22 05:58	UAMX	ELLE
Total/NA	Analysis	200.8 Rev 5.4		1	272937	07/06/22 18:29	UCIG	ELLE
Total/NA	Analysis	130.2		5	271274	06/30/22 09:12	USAE	ELLE
Total/NA	Analysis	1664A		1	271852	07/01/22 17:26	QT6L	ELLE
Total/NA	Analysis	2540D-2011		1	270543	06/29/22 07:33	M98K	ELLE
Total/NA	Prep	351.2			274592	07/12/22 09:00	UJE2	ELLE
Total/NA	Analysis	351.2		1	275074	07/13/22 10:25	JCG7	ELLE
Total/NA	Analysis	353.2		1	273199	07/07/22 08:07	CBM8	ELLE
Total/NA	Analysis	353.2		1	270681	06/29/22 06:57	P684	ELLE
Total/NA	Analysis	353.2		1	270158	06/29/22 06:30	USJM	ELLE
Total/NA	Prep	365.1			273497	07/08/22 08:15	CBM8	ELLE
Total/NA	Analysis	365.1		1	274108	07/11/22 08:00	CBM8	ELLE
Total/NA	Analysis	405.1		1	272015	06/28/22 17:18	F8TI	ELLE

Client Sample ID: LCC22-RE-01-U — Lab Sample ID: 410-89136-3

Date Collected: 06/27/22 15:35 — **Matrix: Water**

Date Received: 06/28/22 09:05

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	200.8 Rev 5.4			273255	07/07/22 15:32	UJLA	ELLE
Total/NA	Analysis	200.8 Rev 5.4		1	273579	07/08/22 11:35	S4PD	ELLE
Total/NA	Analysis	130.2		5	271274	06/30/22 09:35	USAE	ELLE
Total/NA	Analysis	1664A		1	271852	07/01/22 17:26	QT6L	ELLE
Total/NA	Analysis	2540D-2011		1	270543	06/29/22 07:33	M98K	ELLE

Client Sample ID: LCC22-RE-01-U | Lab Sample ID: 410-89136-3

Date Collected: 06/27/22 15:35 | **Matrix: Water**
Date Received: 06/28/22 09:05

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	351.2			274592	07/12/22 09:00	UJE2	ELLE
Total/NA	Analysis	351.2		1	275074	07/13/22 10:27	JCG7	ELLE
Total/NA	Analysis	353.2		1	273199	07/07/22 08:13	CBM8	ELLE
Total/NA	Analysis	353.2		1	270681	06/29/22 07:00	P684	ELLE
Total/NA	Analysis	353.2		1	270158	06/29/22 06:30	USJM	ELLE
Total/NA	Prep	365.1			272264	07/05/22 11:30	CBM8	ELLE
Total/NA	Analysis	365.1		1	272696	07/06/22 10:03	CBM8	ELLE
Total/NA	Analysis	405.1		1	272015	06/28/22 17:18	F8TI	ELLE

Client Sample ID: LCC22-RI-01-D | Lab Sample ID: 410-89136-4

Date Collected: 06/27/22 11:15 | **Matrix: Water**
Date Received: 06/28/22 09:05

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	200.8 Rev 5.4			273257	07/07/22 15:35	UJLA	ELLE
Total/NA	Analysis	200.8 Rev 5.4		1	274410	07/11/22 17:17	UCIG	ELLE
Total/NA	Analysis	130.2		5	271274	06/30/22 09:41	USAE	ELLE
Total/NA	Analysis	1664A		1	271852	07/01/22 17:26	QT6L	ELLE
Total/NA	Analysis	2540D-2011		1	270543	06/29/22 07:33	M98K	ELLE
Total/NA	Prep	351.2			274592	07/12/22 09:00	UJE2	ELLE
Total/NA	Analysis	351.2		1	275074	07/13/22 10:21	JCG7	ELLE
Total/NA	Analysis	353.2		1	273199	07/07/22 08:15	CBM8	ELLE
Total/NA	Analysis	353.2		1	270681	06/29/22 06:47	P684	ELLE
Total/NA	Analysis	353.2		1	270158	06/29/22 06:30	USJM	ELLE
Total/NA	Prep	365.1			273497	07/08/22 08:15	CBM8	ELLE
Total/NA	Analysis	365.1		1	274108	07/11/22 08:00	CBM8	ELLE
Total/NA	Analysis	405.1		1	272015	06/28/22 18:05	F8TI	ELLE

Client Sample ID: LCC22-P-01-D | Lab Sample ID: 410-89136-5

Date Collected: 06/27/22 14:40 | **Matrix: Water**
Date Received: 06/28/22 09:05

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	200.8 Rev 5.4			273255	07/07/22 15:32	UJLA	ELLE
Total/NA	Analysis	200.8 Rev 5.4		1	273579	07/08/22 11:37	S4PD	ELLE
Total/NA	Analysis	130.2		5	271274	06/30/22 09:47	USAE	ELLE
Total/NA	Analysis	1664A		1	271852	07/01/22 17:26	QT6L	ELLE
Total/NA	Analysis	2540D-2011		1	270543	06/29/22 07:33	M98K	ELLE
Total/NA	Prep	351.2			274592	07/12/22 09:00	UJE2	ELLE
Total/NA	Analysis	351.2		1	275074	07/13/22 10:52	JCG7	ELLE
Total/NA	Analysis	353.2		1	273199	07/07/22 08:17	CBM8	ELLE
Total/NA	Analysis	353.2		1	270681	06/29/22 06:59	P684	ELLE
Total/NA	Analysis	353.2		1	270158	06/29/22 06:30	USJM	ELLE

1 2 3 4 5 6 7 8 9 10 11 12 13 14

Client Sample ID: LCC22-P-01-D
Lab Sample ID: 410-89136-5

Date Collected: 06/27/22 14:40
Matrix: Water
Date Received: 06/28/22 09:05

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	365.1			272264	07/05/22 11:30	CBM8	ELLE
Total/NA	Analysis	365.1		1	272696	07/06/22 10:03	CBM8	ELLE
Total/NA	Analysis	405.1		1	272015	06/28/22 18:05	F8TI	ELLE

Client Sample ID: LCC22-RE-01-D
Lab Sample ID: 410-89136-6

Date Collected: 06/27/22 15:15
Matrix: Water
Date Received: 06/28/22 09:05

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	200.8 Rev 5.4			271913	07/02/22 05:58	UAMX	ELLE
Total/NA	Analysis	200.8 Rev 5.4		1	272937	07/06/22 18:15	UCIG	ELLE
Total/NA	Analysis	130.2		5	271274	06/30/22 09:53	USAE	ELLE
Total/NA	Analysis	1664A		1	271852	07/01/22 17:26	QT6L	ELLE
Total/NA	Analysis	2540D-2011		1	270543	06/29/22 07:33	M98K	ELLE
Total/NA	Prep	351.2			274592	07/12/22 09:00	UJE2	ELLE
Total/NA	Analysis	351.2		1	275074	07/13/22 10:15	JCG7	ELLE
Total/NA	Analysis	353.2		1	273199	07/07/22 08:19	CBM8	ELLE
Total/NA	Analysis	353.2		1	270681	06/29/22 07:00	P684	ELLE
Total/NA	Analysis	353.2		1	270158	06/29/22 06:30	USJM	ELLE
Total/NA	Prep	365.1			272264	07/05/22 11:30	CBM8	ELLE
Total/NA	Analysis	365.1		1	272696	07/06/22 10:03	CBM8	ELLE
Total/NA	Analysis	405.1		1	272015	06/28/22 18:05	F8TI	ELLE

Laboratory References:

ELLE = Eurofins Lancaster Laboratories Environment Testing, LLC, 2425 New Holland Pike, Lancaster, PA 17601, TEL (717)656-2300

Laboratory: Eurofins Lancaster Laboratories Environment Testing, LLC

Unless otherwise noted, all analytes for this laboratory were covered under each accreditation/certification below.

Authority	Program	Identification Number	Expiration Date
Maryland	State	100	06-30-23

The following analytes are included in this report, but the laboratory is not certified by the governing authority. This list may include analytes for which the agency does not offer certification.

Analysis Method	Prep Method	Matrix	Analyte
130.2		Water	Hardness as calcium carbonate
1664A		Water	HEM (Oil & Grease)
1664A		Water	SGT-HEM (TPH)
200.8 Rev 5.4	200.8 Rev 5.4	Water	Copper
200.8 Rev 5.4	200.8 Rev 5.4	Water	Lead
200.8 Rev 5.4	200.8 Rev 5.4	Water	Zinc
2540D-2011		Water	Total Suspended Solids
351.2	351.2	Water	Total Kjeldahl Nitrogen
353.2		Water	Nitrate as N
353.2		Water	Nitrate Nitrite as N
353.2		Water	Nitrite as N
365.1	365.1	Water	Total Phosphorus as P
365.1	365.1	Water	Total Phosphorus as PO4
405.1		Water	Biochemical Oxygen Demand

Method Summary

Method	Method Description	Protocol	Laboratory
200.8 Rev 5.4	Metals (ICP/MS)	EPA	ELLE
130.2	Hardness, Total (mg/l as CaCO3)	MCAWW	ELLE
1664A	HEM and SGT-HEM	1664A	ELLE
2540D-2011	Solids, Total Suspended (TSS)	SM	ELLE
351.2	Nitrogen, Total Kjeldahl	MCAWW	ELLE
353.2	Nitrate by Calculation	EPA	ELLE
353.2	Nitrogen, Nitrate-Nitrite	MCAWW	ELLE
353.2	Nitrogen, Nitrite	MCAWW	ELLE
365.1	Phosphorus, Total	EPA	ELLE
405.1	BOD, 5-Day	MCAWW	ELLE
200.8 Rev 5.4	Preparation, Total Metals	EPA	ELLE
351.2	Nitrogen, Total Kjeldahl	MCAWW	ELLE
365.1	Sample Digestion for Total Phosphorus	MCAWW	ELLE

Protocol References:

1664A = EPA-821-98-002

EPA = US Environmental Protection Agency

MCAWW = "Methods For Chemical Analysis Of Water And Wastes", EPA-600/4-79-020, March 1983 And Subsequent Revisions.

SM = "Standard Methods For The Examination Of Water And Wastewater"

Laboratory References:

ELLE = Eurofins Lancaster Laboratories Environment Testing, LLC, 2425 New Holland Pike, Lancaster, PA 17601, TEL (717)656-2300

Sample Summary

Client: EA Engineering, Science, and Technology
Project/Site: BCS2017-03D Task 13 - NPDES MS4 Compliance

Job ID: 410-89136-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
410-89136-1	LCC22-RI-01	Water	06/27/22 10:25	06/28/22 09:05
410-89136-2	LCC22-P-01-U	Water	06/27/22 13:30	06/28/22 09:05
410-89136-3	LCC22-RE-01-U	Water	06/27/22 15:35	06/28/22 09:05
410-89136-4	LCC22-RI-01-D	Water	06/27/22 11:15	06/28/22 09:05
410-89136-5	LCC22-P-01-D	Water	06/27/22 14:40	06/28/22 09:05
410-89136-6	LCC22-RE-01-D	Water	06/27/22 15:15	06/28/22 09:05

410-89136 Chain of Custody

Client: EA Engineering Science, and Technology, Inc., PBC 225 Schilling Circle, Suite 400 Hunt Valley, MD, 21031	Project Manager: Michael Durbano Phone: (609) 332-0534 Field Contact: Michael Durbano Phone: 609-332-0534	Chain of Custody Record Laboratory: Eurofins Lancaster Laboratories 2425 New Holland Pike Lancaster, PA 17601 Phone: 717-656-2300 ATTN: Vanessa Badman

Project Name: BCS2017-03D Task 13 - NPDES MS4 Compliance

Project#: 1581613

Parameters/Method Numbers for Analysis

Date	Time	Water	Sample Identification	No. of Containers	Nitrite - Nitrogen, Nitrite _353.2	BOD, 5-day _405.1	Pres - Nitrogen, Nitrate & Nitrite _353.2	Total Phosphorus _365.1	TKN_351.2	Total Lead, Copper, Zinc_200.8	Total hardness (mg/l as CaCO3) _130.2	Oil & Grease and TPH _1664A_NP	Total Suspended Solids (TSS) Single Dry _2540D	Remarks
6/27/22	1025	X	LCC22-RI-01	9	X	X	X	X	X	X	X	X	X	
6/27/22	1330	X	LCC22-P-01-U	9	X	X	X	X	X	X	X	X	X	
6/27/22	1535	X	LCC22-RE-01-U	9	X	X	X	X	X	X	X	X	X	
6/27/22	1115	X	LCC22-RI-01-D	9	X	X	X	X	X	X	X	X	X	
6/27/22	1440	X	LCC22-P-01-D	9	X	X	X	X	X	X	X	X	X	
6/27/22	1515	X	LCC22-RE-01-D	9	X	X	X	X	X	X	X	X	X	
[illegible]														

Sampled by: (Signature)	Date/Time	Relinquished by: (Signature)
Michael Durbano	6/27/22 1515	
Relinquished by: (Signature)	**Date/Time**	**Received by Laboratory: (Signature)**
Michael Durbano	6/28/22 0905	6/28/22 0905

-0.4 -0.4

JM

Login Sample Receipt Checklist

Client: EA Engineering, Science, and Technology

Job Number: 410-89136-1

Login Number: 89136
List Number: 1
Creator: McCaskey, Jonathan

List Source: Eurofins Lancaster Laboratories Environment Testing, LLC

Question	Answer	Comment
The cooler's custody seal is intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable (</=6C, not frozen).	True	
Cooler Temperature is recorded.	True	
WV: Container Temperature is acceptable (</=6C, not frozen).	N/A	
WV: Container Temperature is recorded.	N/A	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
There are no discrepancies between the containers received and the COC.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
There is sufficient vol. for all requested analyses.	True	
Is the Field Sampler's name present on COC?	True	
Sample custody seals are intact.	N/A	
VOA sample vials do not have headspace >6mm in diameter (none, if from WV)?	True	

FOUNTAIN VALLEY ANALYTICAL LABORATORY, INC.

1413 Old Taneytown Rd. Westminster, MD (410) 848-1014 (410) 876-4554

REPORT OF ANALYSIS

Laboratory ID #:	152399		Account #:	1875
Reference:	Michael Durbano		Client:	EA Engineering, Science & Tech.
Location:	Little Catoctin Creek Project		Requested By:	Michael Durbano
			Source:	Storm Water
Date/ Time Collected:	6/6/2022	1015	Site:	LCC22-BF01-U
Date/Time Rec'd:	6/6/2022	1335	Submitted By:	M. Durbano

PARAMETERS	RESULTS	UNITS	DL *	METHOD	DATE/TIME/ANALYST
Bacteria, E. coli, MPN	3,255	MPN/ 100 ml	1.0	SM20 9223B	6/7/2022 / 0830 / CRS

NOTES:

1 MPN/ 100 ml = Most Probable Number [of viable bacteria] per 100 ml of sample.

2 Thio Check Negative

3 Sample collected by client, analyzed as received

Reason for Test : Client's Information

* DL: Detection Limit

Date Reported: 6/7/2022

Reviewed By: ______________________

MD State Certification # 133

FOUNTAIN VALLEY ANALYTICAL LABORATORY, INC.

1413 Old Taneytown Rd. Westminster, MD (410) 848-1014 (410) 876-4554

REPORT OF ANALYSIS

Laboratory ID #:	152400		Account #:	1875
Reference:	Michael Durbano		Client:	EA Engineering, Science & Tech.
Location:	Little Catoctin Creek Project		Requested By:	Michael Durbano
			Source:	Storm Water
Date/ Time Collected:	6/6/2022	1145	Site:	LCC22-BF01-D
Date/Time Rec'd:	6/6/2022	1335	Submitted By:	M. Durbano

PARAMETERS	RESULTS	UNITS	DL *	METHOD	DATE/TIME/ANALYST
Bacteria, E. coli, MPN	908	MPN/ 100 ml	1.0	SM20 9223B	6/7/2022 / 0830 / CRS

NOTES:

1. MPN/ 100 ml = Most Probable Number [of viable bacteria] per 100 ml of sample.
2. Thio Check Negative
3. Sample collected by client, analyzed as received

Reason for Test : Client's Information

* DL: Detection Limit

Date Reported: 6/7/2022 Reviewed By: ______________________________

MD State Certification # 133

FOUNTAIN VALLEY ANALYTICAL LABORATORY, INC.
1413 Old Taneytown Road, Westminster, MD 21158
410-848-1014 * 410-876-4554

REPORT TO:	**Contact:** Michael Durbano	**Phone:** 410-527-2479, **Mobile:** 609-332-0534
EA Engineering, Science & Tech.	**Project:** Little Catoctin Creek Project	**Physical Address:**
225 Schilling Circle	**Sampler Name:** Michael Durbano	**Email Results to:** mdubano@eaest.com (with COC) & Invoice
Hunt Valley, MD 21031		
PAID INVOICE TO:		
EA Engineering, Science & Tech.		
225 Schilling Circle		
Hunt Valley, MD 21031		

ANALYSES TO BE PERFORMED

#	SAMPLE DESCRIPTION/LOCATION	Date Sampled	Time Sampled	Total # of Containers		Chlorine tested in lab		E.coli/MPN/Quantitative SM9223B	Enterococcus, MPN/Quantitative							LAB ID #
1	LCC22-BF01-U	6/6/22	1015	2				✓								152399
2	LCC22-BF01-D	6/6/22	1145	2				✓								152400
3																
4																
5																
6																
7																
8																
9																
10																
11																

REMARKS: PR# 45979 - LCC -FVAL Lab Services - E.coli

19.5°C

	INITIALS	DATE	TIME		INITIALS	DATE	TIME		INITIALS	DATE	TIME
RELINQUISHED BY:	MD	6/6/22	1335	**RECEIVED BY:**	SV/CS	6/6/22	1335	**RELINQUISHED BY:**			
RECEIVED BY:				**RELINQUISHED BY:**				**RECEIVED BY:**			

FOUNTAIN VALLEY ANALYTICAL LABORATORY, INC.

1413 Old Taneytown Rd. Westminster, MD (410) 848-1014 (410) 876-4554

REPORT OF ANALYSIS

Laboratory ID #:	152873		Account #:	1875
Reference:	Michael Durbano		Client:	EA Engineering, Science & Tech.
Location:	Little Catoctin Creek Project		Requested By:	Michael Durbano
			Source:	Storm Water
Date/ Time Collected:	6/27/2022	1025	Site:	LCC22-RI-01
Date/Time Rec'd:	6/27/2022	1652	Submitted By:	M. Durbano

PARAMETERS	RESULTS	UNITS	DL *	METHOD	DATE/TIME/ANALYST
Bacteria, E. coli, MPN	3,873	MPN/ 100 ml	10.0	SM20 9223B	6/28/2022 / 1215 / CRS

NOTES:

1 MPN/ 100 ml = Most Probable Number [of viable bacteria] per 100 ml of sample.

2 Thio Check Negative

3 Sample collected by client, analyzed as received

Reason for Test : Client's Information

* DL: Detection Limit

Date Reported: 6/29/2022 Reviewed By: ______________________

MD State Certification # 133

FOUNTAIN VALLEY ANALYTICAL LABORATORY, INC.

1413 Old Taneytown Rd. Westminster, MD (410) 848-1014 (410) 876-4554

REPORT OF ANALYSIS

Laboratory ID #:	152874		Account #:	1875
Reference:	Michael Durbano		Client:	EA Engineering, Science & Tech.
Location:	Little Catoctin Creek Project		Requested By:	Michael Durbano
			Source:	Storm Water
Date/ Time Collected:	6/27/2022	1330	Site:	LCC22-P-01-U
Date/Time Rec'd:	6/27/2022	1652	Submitted By:	M. Durbano

PARAMETERS	RESULTS	UNITS	DL *	METHOD	DATE/TIME/ANALYST
Bacteria, E. coli, MPN	20,640	MPN/ 100 ml	100.0	SM20 9223B	6/28/2022 / 1215 / CRS

NOTES:

1 MPN/ 100 ml = Most Probable Number [of viable bacteria] per 100 ml of sample.
2 Thio Check Negative
3 Sample collected by client, analyzed as received

Reason for Test : Client's Information

* DL: Detection Limit

Date Reported: 6/29/2022

Reviewed By: Brad Dutton

MD State Certification # 133

FOUNTAIN VALLEY ANALYTICAL LABORATORY, INC.

1413 Old Taneytown Rd. Westminster, MD (410) 848-1014 (410) 876-4554

REPORT OF ANALYSIS

Laboratory ID #:	152875		Account #:	1875
Reference:	Michael Durbano		Client:	EA Engineering, Science & Tech.
Location:	Little Catoctin Creek Project		Requested By:	Michael Durbano
			Source:	Storm Water
Date/ Time Collected:	6/27/2022	1535	Site:	LCC22-RE-01-U
Date/Time Rec'd:	6/27/2022	1652	Submitted By:	M. Durbano

PARAMETERS	RESULTS	UNITS	DL *	METHOD	DATE/TIME/ANALYST
Bacteria, E. coli, MPN	12,033	MPN/ 100 ml	10.0	SM20 9223B	6/28/2022 / 1215 / CRS

NOTES:

1 MPN/ 100 ml = Most Probable Number [of viable bacteria] per 100 ml of sample.

2 Thio Check Negative

3 Sample collected by client, analyzed as received

Reason for Test : Client's Information

* DL: Detection Limit

Date Reported: 6/29/2022 Reviewed By: Brad Dutton

MD State Certification # 133

FOUNTAIN VALLEY ANALYTICAL LABORATORY, INC.

1413 Old Taneytown Rd. Westminster, MD (410) 848-1014 (410) 876-4554

REPORT OF ANALYSIS

Laboratorv ID #:	152876		Account #:	1875
Reference:	Michael Durbano		Client:	EA Engineering, Science & Tech.
Location:	Little Catoctin Creek Project		Requested By:	Michael Durbano
			Source:	Storm Water
Date/ Time Collected:	6/27/2022	1115	Site:	LCC22-RI-01-D
Date/Time Rec'd:	6/27/2022	1652	Submitted By:	M. Durbano

PARAMETERS	RESULTS	UNITS	DL *	METHOD	DATE/TIME/ANALYST
Bacteria, E. coli, MPN	959	MPN/ 100 ml	10.0	SM20 9223B	6/28/2022 / 1215 / CRS

NOTES:

1. MPN/ 100 ml = Most Probable Number [of viable bacteria] per 100 ml of sample.
2. Thio Check Negative
3. Sample collected by client, analyzed as received

Reason for Test : Client's Information

* DL: Detection Limit

Date Reported: 6/29/2022

Reviewed By:

MD State Certification # 133

FOUNTAIN VALLEY ANALYTICAL LABORATORY, INC.

1413 Old Taneytown Rd. Westminster, MD (410) 848-1014 (410) 876-4554

REPORT OF ANALYSIS

Laboratorv ID #:	152877		Account #:	1875
Reference:	Michael Durbano		Client:	EA Engineering, Science & Tech.
Location:	Little Catoctin Creek Project		Requested By:	Michael Durbano
			Source:	Storm Water
Date/ Time Collected:	6/27/2022	1440	Site:	LCC22-P-01-D
Date/Time Rec'd:	6/27/2022	1652	Submitted By:	M. Durbano

PARAMETERS	RESULTS	UNITS	DL *	METHOD	DATE/TIME/ANALYST
Bacteria, E. coli, MPN	776	MPN/ 100 ml	10.0	SM20 9223B	6/28/2022 / 1215 / CRS

NOTES:

1 MPN/ 100 ml = Most Probable Number [of viable bacteria] per 100 ml of sample.

2 Thio Check Negative

3 Sample collected by client, analyzed as received

Reason for Test : Client's Information

* DL: Detection Limit

Date Reported: 6/29/2022 Reviewed By: Brad Dutton

MD State Certification # 133

FOUNTAIN VALLEY ANALYTICAL LABORATORY, INC.

1413 Old Taneytown Rd. Westminster, MD (410) 848-1014 (410) 876-4554

REPORT OF ANALYSIS

Laboratory ID #:	152878		Account #:	1875
Reference:	Michael Durbano		Client:	EA Engineering, Science & Tech.
Location:	Little Catoctin Creek Project		Requested By:	Michael Durbano
			Source:	Storm Water
Date/ Time Collected:	6/27/2022	1515	Site:	LCC22-RE-01-D
Date/Time Rec'd:	6/27/2022	1652	Submitted By:	M. Durbano

PARAMETERS	RESULTS	UNITS	DL *	METHOD	DATE/TIME/ANALYST
Bacteria, E. coli, MPN	723	MPN/ 100 ml	10.0	SM20 9223B	6/28/2022 / 1215 / CRS

NOTES:

1 MPN/ 100 ml = Most Probable Number [of viable bacteria] per 100 ml of sample.

2 Thio Check Negative

3 Sample collected by client, analyzed as received

Reason for Test : Client's Information

* DL: Detection Limit

Date Reported: 6/29/2022

Reviewed By: Brad Dutton

MD State Certification # 133

FOUNTAIN VALLEY ANALYTICAL LABORATORY, INC.
1413 Old Taneytown Road, Westminster, MD 21158
410-848-1014 * 410-876-4554

REPORT TO:	**Contact: Michael Durbano**	**Phone: 410-527-2479, Mobile: 609-332-0534**
EA Engineering, Science & Tech.	**Project: Little Catoctin Creek Project**	**Physical Address:**
225 Schilling Circle	**Sampler Name:** Michael Durbano	**Email Results to: mdurbano@eaest.com (with COC) & Invoice**
Hunt Valley, MD 21031		
PAID INVOICE TO:		
EA Engineering, Science & Tech.		
225 Schilling Circle		
Hunt Valley, MD 21031		

ANALYSES TO BE PERFORMED

	SAMPLE DESCRIPTION/LOCATION	Date Sampled	Time Sampled	Total # of Containers		Chlorine tested in lab		E.coli/MPN/Quantitative SM9223B	Enterococcus, MPN/Quantitative							LAB ID #
1	LCC22-RI-01	6/27/22	1035	2				X								152873
2	LCC22-P-01-U	6/27/22	1330	2				X								152874
3	LCC22-RE-01-U	6/27/22	1535	2				X								152875
4	LCC22-RI-01-D	6/27/22	1115	2				X								152876
5	LCC22-P-01-D	6/27/22	1440	2				X								152877
6	LCC22-RE-01-D	6/27/22	1515	2				X								152873
7																
8																
9																
10																
11																

REMARKS: PR# 45979 - LCC -FVAL Lab Services - E.coli

4,6°C

	INITIALS	DATE	TIME		INITIALS	DATE	TIME		INITIALS	DATE	TIME
RELINQUISHED BY:	MRD	6/27/22	1652	**RECEIVED BY:**	SV/CS	6/27/22	1652	**RELINQUISHED BY:**			
RECEIVED BY:				**RELINQUISHED BY:**				**RECEIVED BY:**			

ATTACHMENT B: BIOLOGICAL & PHYSICAL HABITAT MONITORING DATA

UT Little Catoctin Creek (PRFR-107-X)


Post-Restoration Upstream 2019


Post-Restoration Downstream 2019

Land Cover & Physical Habitat

The area surrounding this site contained paved road, residential areas, pasture, cropland, and old fields, as well as deciduous and coniferous forest. The stream buffer was on average 1 to 5 meters wide and was broken by a tractor and cattle crossing area of moderate severity at the middle of the site. A 5-meter portion of the stream channel exhibited channelization using concrete, with a smaller portion channelized with riprap.

Table 1A. Upstream Land Use				
Urban	Agricultural	Forest	Other	Source
3.18%	60.68%	30.17%	5.97%	NCLD 2011
5.50%	66.77%	27.52%	0.21%	NLCD 2019

Table 2A. Physical Habitat Scores
Not sampled

Indices of Biotic Integrity & Species

Taxa richness was 21 in 2016, 13 in 2017, 21 in 2019, and 22 in 2020. The BIBI scores were 2.00 (Poor), 1.50 (Very Poor), 2.00 (Poor), and 2.00 (Poor), respectively.

Table 3A. IBI Scores		
Year	BIBI	FIBI
2016	2.00	Not sampled
2017	1.50	Not sampled
2019	2.00	Not sampled
2020	2.00	Not sampled

4A. Benthic Macroinvertebrates (100-count subsample)					
Year		2016	2017	2019	2020
Taxon	Order				
Stenelmis	Coleoptera			1	4
Chironomidae	Diptera				9e
Chironomini	Diptera		1e		
Corynoneura	Diptera	1		1	
Cricotopus	Diptera	13			
Diamesa	Diptera		12	1	1
Diamesinae	Diptera	1e	5e		
Dicrotendipes	Diptera			1	
Eukiefferiella	Diptera			3	5
Hemerodromia	Diptera	4		1	
Larsia	Diptera				1
Limnophyes	Diptera	2		3	
Micropsectra	Diptera	3		12	
Microtendipes	Diptera	1			
Nanocladius	Diptera			2	
Orthocladiinae	Diptera	1e	17e	2e	
Orthocladius	Diptera	10	45	28	20
Pagastia	Diptera	1			
Parakiefferiella	Diptera	1			
Parametriocnemus	Diptera	6			5
Paraphaenocladius	Diptera			2	
Polypedilum	Diptera	2	3	1	6
Potthastia	Diptera		1		2
Prosimulium	Diptera		3		
Rheocricotopus	Diptera		4		
Rheotanytarsus	Diptera		3		1
Simulium	Diptera	46	2	25	10
Tanypodinae	Diptera	4e			
Tanytarsus	Diptera		4		
Thienemanniella	Diptera	2		1	15
Thienemannimyia Group	Diptera	9	5	4	2
Tvetenia	Diptera	3		5	5
Acentrella	Ephemeroptera	1			
Baetis	Ephemeroptera	7		21	5
Caenis	Ephemeroptera	2	1	4	1
Plauditus	Ephemeroptera				1
Naididae	Haplotaxida	3	3	15	59
Argia	Odonata	1			
Cheumatopsyche	Trichoptera				1
Calopteryx	Odonata			1	
Hydropsyche	Trichoptera				2
Lype	Trichoptera				1
Girardia	Tricladida	3	13	1	1
Tubificidae	Tubificida				10

Table 5A. Fish Species Presence
Not sampled

6A. Other Taxa Present			
Year	Crayfish	Herpetofauna	Exotic Plants
2016	Faxonius virilis	Northern two-lined salamander	Not sampled
2017	No crayfish observed	No herpetofauna observed	Not sampled
2019	No crayfish observed	No herpetofauna observed	Not sampled
2020	Not sampled	Not Sampled	Not sampled

Little Catoctin Creek (PRFR-201-X)

Post-Restoration Upstream 2022

Post-Restoration Downstream 2022

Land Use/Land Cover & Physical Habitat

During the summer evaluation, the site was surrounded by cropland, old fields, and deciduous forest. The buffer extended at least 50 meters on the left bank and 30 meters on the right bank, and was uninterrupted for the 75-meter length of the site. No road culverts or channelization were present in the site. Both banks of the stream exhibited minimal erosion in 2016, but the left bank erosion was scored as moderate severity in 2017. Both banks were moderately eroded in 2019 and 2022. Bar formation was severe in 2016 and 2017, with substrate consisting of cobble, gravel and sand sized particles, but lessened to moderate severity in 2019, and to minor severity in 2022.

Table 1B. Upstream Land Use

Urban	Agricultural	Forest	Other	Source
7.75%	69.08%	19.84%	3.33%	NLCD 2011
5.95%	72.22%	20.30%	1.53%	NLCD 2016
6.98%	72.78%	18.81%	1.43%	NLCD 2019

Table 2B. Physical Habitat Scores

Year	Instream Habitat Score	Epifaunal Substrate Score	Velocity /Depth Diversity Score	Pool/Glide/ Eddy Quality Score	Extent of Pool/Glide/ Eddy Habitat (m)	Riffle/Run Quality Score	Extent of Riffle/Run Habitat (m)	Bar Formation Severity	Embeddedness (%)	Shading (%)	Aesthetic Score
2016	15	15	14	15	54	16	23	3	40	60	18
2017	12	15	12	13	66	13	16	3	50	70	15
2019	12	13	12	12	55	11	20	2	40	50	8
2022	14	14	12	13	54	13	21	1	55	75	12

Indices of Biotic Integrity & Species

There were 30 benthic macroinvertebrate taxa present in the 2016 subsample, 20 taxa in the 2017 subsample, 24 taxa in the 2019 subsample, and 21 taxa in the 2020 subsample. The BIBI scores were calculated to be 2.00 (Poor) in 2016, 1.75 (Very Poor) in 2017, 2.75 (Poor) in 2019, and 2.00 (Poor) in 2020.

Electrofishing efforts detected 17 fish taxa in 2016, 15 fish taxa in 2017, 17 fish taxa in 2019 and in 2022, which resulted in FIBI scores of 4.33, 4.00, 4.00, and 4.00, respectively, with narrative ratings of Good. The fish community was made up of mostly minnow and sunfish species.

Table 3B. IBI Scores

Year	BIBI	FIBI
2016	2.00	4.33
2017	1.75	4.00
2019	2.75	4.00
2020	2.00	Not sampled
2022	Not sampled	4.00

4B. Benthic Macroinvertebrates (100-count subsample)

Year		2016	2017	2019	2020
Taxon	Order				
Crangonyx	Amphipoda			1	
Ferrissia	Basommatophora		1		
Stagnicola	Basommatophora			1	
Gyrinidae	Coleoptera			1	
Optioservus	Coleoptera				1
Psephenus	Coleoptera				1
Stenelmis	Coleoptera	8	1	5	
Ablabesmyia	Diptera				1
Chaetocladius	Diptera	1		1	
Chironomidae	Diptera				12e
Chironominae	Diptera		1	2e	
Chironomus	Diptera			1	
Corynoneura	Diptera		1		
Cricotopus	Diptera	1		2	
Diamesa	Diptera	2			
Ephydridae	Diptera	1			
Eukiefferiella	Diptera			2	5
Hemerodromia	Diptera		1		3
Hydrobaenus	Diptera	1			
Limnophyes	Diptera			1	
Micropsectra	Diptera	1		31	
Nanocladius	Diptera	1	1		
Orthocladiinae	Diptera	7e	4e	5e	
Orthocladius	Diptera	27	21	9	34
Parakiefferiella	Diptera	4			
Parametriocnemus	Diptera	12	1		5
Paratanytarsus	Diptera		1	4	
Paratendipes	Diptera	1	1		
Polypedilum	Diptera	1	9	5	5
Prosimulium	Diptera	1	2		
Rheocricotopus	Diptera		34	1	
Rheotanytarsus	Diptera	1	39		5
Simulium	Diptera	4	4	25	
Stempellinella	Diptera				1
Stictochironomus	Diptera			1	
Synorthocladius	Diptera	1			5
Tanypodinae	Diptera				2e
Tanytarsini	Diptera				1e
Tanytarsus	Diptera		4		1
Thienemanniella	Diptera	3			
Thienemannimyia Group	Diptera	6			3
Tvetenia	Diptera	39		3	15
Baetidae	Ephemeroptera	1e	1	1	2e
Baetis	Ephemeroptera			17	10
Caenis	Ephemeroptera			1	1
Plauditus	Ephemeroptera	2			
Naididae	Haplotaxida	6	2	9	9
Prostoma	Hoplonemertea			1	
Caecidotea	Isopoda	1		1	4
Corydalus	Megaloptera			1	1
Argia	Odonata	2			
Enallagma	Odonata	1			
Amphinemura	Plecoptera	1			
Cheumatopsyche	Trichoptera	2	4		2
Chimarra	Trichoptera	2	16		1
Diplectrona	Trichoptera	1			
Ironoquia	Trichoptera	1			

5B. Fish Species Presence

Year			2016	2017	2019	2022
Taxon	Scientific Name	Family				
White Sucker	Catostomus commersoni	Catostomidae	7	11	36	
Rock Bass	Amblopites rupestris	Centrarchidae	2			
Redbreast Sunfish	Lepomis auritus	Centrarchidae	44	28	4	42
Green Sunfish	Lepomis cyanellus	Centrarchidae	36	14	34	56
Bluegill	Lepomis macrochirus	Centrarchidae	15	139	1	9
Largemouth Bass	Micropterus salmoides	Centrarchidae	3	10	11	
Smallmouth Bass	Micropterus dolomieu	Centrarchidae			2	4
Central Stoneroller	Campostoma anomalum	Cyprinidae	5	18	140	85
Common Shiner	Luxilus cornutus	Cyprinidae				28
Rosyside Dace	Clinostomus funduloides	Cyprinidae				1
Bluehead Chub	Nocomis leptocephalus	Cyprinidae	64	46	136	41
Silverjaw Minnow	Notropis buccatus	Cyprinidae	70	16	217	65
Bluntnose Minnow	Pimephales notatus	Cyprinidae	62	26	228	197
Longnose Dace	Rhinichthys cataractae	Cyprinidae	97	83	51	11
Blacknose Dace	Rhinichthys obtusus	Cyprinidae	58	107	194	105
Creek Chub	Semotilus atromaculatus	Cyprinidae	15	31	47	16
Banded Killifish	Fundulus diaphanus	Fundulidae	2		7	9
Yellow Bullhead	Ameiurus natalis	Ictaluridae	41	20	67	19
Greenside Darter	Etheostoma blennioides	Percidae				1
Fantail Darter	Etheostoma flabellare	Percidae	21	10	22	17

6B. Other Taxa Present

Year	Crayfish	Herpetofauna	Exotic Plants
2016	Faxonius virilis	Northern green frog Eastern snapping turtle	Garlic mustard Japanese honeysuckle Japanese hops Japanese stiltgrass, Mile-a-minute Multiflora rose, Shrub honeysuckle, Wineberry
2017	Faxonius virilis	Eastern snapping turtle	Bush honeysuckle Japanese honeysuckle Japanese hops Japanese stiltgrass Multiflora rose, Tree of heaven
2019	Faxonius virilis	Northern green frog	Multiflora rose, Wineberry, Japanese hops, Garlic mustard, Japanese honeysuckle, Japanese stiltgrass, Mile-a-minute
2022	Faxonius virilis	Northern green frog (heard) Gray tree frog (heard)	Multiflora rose, Mile-a-minute , Wineberry, Japanese honeysuckle, Japanese stiltgrass, Japanese hops, Garlic mustard, Beefsteak plant

Little Catoctin Creek (PRFR-202-X)

Post-Restoration Upstream 2022

Post-Restoration Downstream 2022

Land Use/Land Cover & Physical Habitat

The area surrounding the site was observed to have cropland, old fields, pasture, and residential uses. An uninterrupted buffer extended at least 50 meters on the left bank and between seven and 30 meters on the right bank, and consisted of cropland, grasses, and deciduous forest. No channelization was evident. In 2016 and 2017, there was minimal erosion on each bank of the stream and minimal bar formation, consisting largely of cobble and gravel. Erosion increased to moderate severity for both banks in 2019 and 2022. Bar formation increased to moderate in 2019 but returned to minimal in 2022, consisting of cobble, gravel, and sand.

Table 1C. Upstream Land Use

Urban	Agricultural	Forest	Other	Source
7.39%	68.88%	20.30%	3.42%	NLCD 2011
5.61%	71.98%	20.80%	1.61%	NLCD 2016
7.00%	72.44%	19.06%	1.49%	NLCD 2019

Table 2C. Physical Habitat Scores

Year	Instream Habitat Score	Epifaunal Substrate Score	Velocity /Depth Diversity Score	Pool/Glide/ Eddy Quality Score	Extent of Pool/Glide/ Eddy Habitat (m)	Riffle/Run Quality Score	Extent of Riffle/Run Habitat (m)	Bar Formation Severity	Embeddedness (%)	Shading (%)	Aesthetic Score
2016	18	17	14	17	55	16	23	1	25	40	18
2017	15	12	12	15	62	12	17	1	55	35	16
2019	12	13	12	12	30	11	45	2	40	50	10
2022	16	16	13	14	27	15	48	1	40	70	12

Indices of Biotic Integrity & Species

There were 32 taxa in the 2016 subsample, 15 taxa in the 2017 subsample, 27 taxa in the 2019 subsample, and 28 taxa in the 2020 subsample. The BIBI scores of 2.25 (Poor) in 2016, 1.75 (Very Poor) in 2017, 2.50 (Poor) in 2019, and 2.25 (Poor) in 2020, are not significantly different from each other.

When sampled in the summer, electrofishing resulted in 18 taxa in 2016, 15 taxa in 2017, 19 taxa in 2019, and 17 taxa in 2022. Most species detected were from the sunfish and minnow families. FIBI scores were 3.33 (Fair), 3.67 (Fair), 4.00 (Good), and 4.00 (Good), respectively.

Table 3C. IBI Scores

Year	BIBI	FIBI
2016	2.25	3.33
2017	1.75	3.67
2019	2.50	4.00
2020	2.25	Not sampled
2022	Not sampled	4.00

4C. Benthic Macroinvertebrates (100-count subsample)

Year		2016	2017	2019	2020
Taxon	Order				
Crangonyx	Amphipoda			2	1
Physa	Basommatophora			8	
Ancyronyx	Coleoptera			1	
Microcylloepus	Coleoptera			1	
Dytiscidae	Coleoptera	1			
Psephenus	Coleoptera	1			1
Stenelmis	Coleoptera	6	3	3	1
Ablabesmyia	Diptera	1	1		
Antocha	Diptera	3			
Cardiocladius	Diptera				4
Chaetocladius	Diptera	1			
Chironomidae	Diptera				13e
Chironominae	Diptera			1e	
Chironomus	Diptera			1	
Corynoneura	Diptera	3			
Cricotopus	Diptera			9	
Cryptochironomus	Diptera				1
Cryptotendipes	Diptera				1
Diamesa	Diptera	2	2		1
Diamesinae	Diptera			1	
Dicrotendipes	Diptera		1		
Ephydridae	Diptera	1			
Eukiefferiella	Diptera	3		1	22
Micropsectra	Diptera	3		48	
Micropsectra/Tanytarsus	Diptera				1
Nanocladius	Diptera	3			
Orthocladiinae	Diptera	4e		3e	4e
Orthocladius	Diptera	58	52	3	19
Pagastia	Diptera	1			
Parachironomus	Diptera			1	
Parakiefferiella	Diptera				4
Parametriocnemus	Diptera	3		1	9
Paraphaenocladius	Diptera			1	
Paratanytarsus	Diptera		6		1
Paratendipes	Diptera	2			
Phaenopsectra	Diptera		1		
Polypedilum	Diptera		2	2	4
Potthastia	Diptera				1
Prosimulium	Diptera		2		
Rheocricotopus	Diptera		7	1	4
Rheotanytarsus	Diptera	1	30	11	5
Simulium	Diptera	2	1	22	16
Sublettea	Diptera	1			
Tanypodinae	Diptera			1e	
Tanytarsus	Diptera		36		1
Thienemanniella	Diptera	1			14
Thienemannimyia Group	Diptera	12	4	4	6
Tvetenia	Diptera	7		1	9
Baetidae	Diptera				3e
Baetis	Ephemeroptera	3		6	17
Caenis	Ephemeroptera	2			1
Plauditus	Ephemeroptera	1			
Naididae	Haplotaxida	7		1	129
Corydalus	Megaloptera	1			
Argia	Odonata	1		1	
Coenagrionidae	Odonata	2e		1	
Taeniopteryx	Plecoptera				1
Cheumatopsyche	Trichoptera	6		1	
Chimarra	Trichoptera	2	2	2	
Hydropsyche	Trichoptera	2			
Triaenodes	Trichoptera				1
Musculium	Veneroida	1			
Pisidiidae	Veneroida			1	
Pisidium	Veneroida				1

5C. Fish Species Presence

Year			2016	2017	2019	2022
Taxon	Scientific Name	Family				
White Sucker	Catostomus commersoni	Catostomidae	22	31	75	
Redbreast Sunfish	Lepomis auritus	Centrarchidae	81	60	8	13
Green Sunfish	Lepomis cyanellus	Centrarchidae	48	44	41	52
Bluegill	Lepomis macrochirus	Centrarchidae	89	170	14	19
Redear Sunfish	Lepomis microlophus	Centrarchidae	2			
Largemouth Bass	Micropterus salmoides	Centrarchidae	6	17	11	1
Smallmouth Bass	Micropterus dolomieu	Centrarchidae				1
Central Stoneroller	Campostoma anomalum	Cyprinidae	23	79	112	80
Spotfin Shiner	Cyprinella spiloptera	Cyprinidae			2	1
Common Shiner	Luxilus cornutus	Cyprinidae	69	110	56	2
Bluehead Chub	Nocomis leptocephalus	Cyprinidae	59	54	135	24
Silverjaw Minnow	Notropis buccatus	Cyprinidae	11	6	276	169
Mimic Shiner	Notropis volucellus	Cyprinidae			1	
Bluntnose Minnow	Pimephales notatus	Cyprinidae	374	72	499	225
Longnose Dace	Rhinichthys cataractae	Cyprinidae	31	40	208	38
Blacknose Dace	Rhinichthys obtusus	Cyprinidae	46	75	121	90
Creek Chub	Semotilus atromaculatus	Cyprinidae	2	12	41	9
Banded Killifish	Fundulus diaphanus	Fundulidae	3		16	2
Yellow Bullhead	Ameiurus natalis	Ictaluridae	20	27	33	23
Greenside Darter	Etheostoma blennioides	Percidae	1		2	
Fantail Darter	Etheostoma flabellare	Percidae	6	5	47	11

6C. Other Taxa Present

Year	Crayfish	Herpetofauna	Exotic Plants
2016	Faxonius virilis	No herpetofauna observed	Garlic mustard, Japanese honeysuckle, Japanese hops, Japanese stiltgrass, Mile-a-minute, Multiflora rose, Tree of heaven, Wineberry
2017	No crayfish observed	Eastern snapping turtle Northern two-lined salamander	Garlic mustard, Japanese barberry, Japanese stiltgrass, Mile-a-minute, Multiflora rose, Tree of heaven, Wineberry
2019	Cambarus bartonii Faxonius virilis	Northern water snake, Eastern snapping turtle, Northern green frog, American bullfrog	Wineberry, Japanese hops, Japanese stiltgrass, Multiflora rose
2022	Faxonius virilis	Northern green frog	Mile-a-minute, Japanese honeysuckle, Multiflora rose, Beefsteak plant, Japanese stiltgrass

Little Catoctin Creek (PRFR-203-X)

Post-Restoration Upstream 2022

Post-Restoration Downstream 2022

Land Use/Land Cover & Physical Habitat

The riparian buffer around the site extended at least 50 meters along both banks and consists largely of grass on the left bank and cropland on the right bank prior to construction. Beyond the buffer zone, old fields, cropland, pasture, deciduous forest, and residential areas were observed. No channelization of the stream was present within the site. Both banks of the stream exhibited erosion in 2016, with the left bank rated severe and the right bank rated moderate. Bar formation was moderate, with bar substrate consisting of cobble, gravel and sand.

Following construction, in 2019, the area immediately surrounding the site had changed to soil without a vegetative buffer. In 2022, herbaceous vegetation covered both banks and riparian areas, consisting primarily of tall grass and emergent vegetation. Only very minor erosion on the right bank and no bar formation was observed in 2022.

Table 1D. Upstream Land Use

Urban	Agricultural	Forest	Other	Source
6.60%	68.50%	21.37%	3.53%	NLCD 2011
4.90%	71.84%	21.57%	1.69%	NLCD 2016
6.77%	72.28%	19.41%	1.54%	NLCD 2019

Table 2D. Physical Habitat Scores

Year	Instream Habitat Score	Epifaunal Substrate Score	Velocity /Depth Diversity Score	Pool/Glide/ Eddy Quality Score	Extent of Pool/Glide/ Eddy Habitat (m)	Riffle/Run Quality Score	Extent of Riffle/Run Habitat (m)	Bar Formation Severity	Embeddedness (%)	Shading (%)	Aesthetic Score
2016	16	15	14	16	61	16	28	2	25	20	18
2017	14	12	12	15	61	14	26	2	25	35	16
2019	10	11	11	11	37	15	38	0	35	5	13
2022	12	15	13	11	32	16	43	0	60	30	16

Indices of Biotic Integrity & Species

Subsamples contained 24 taxa in 2016, 20 taxa in 2017, 22 taxa in 2019, and 20 taxa in 2020, leading to BIBI scores of 2.00 (Poor), 1.75 (Very Poor), 2.25 (Poor), and 2.25 (Poor), respectively.

Summer electrofishing revealed 15 fish species in 2016, 18 fish species in 2017, 16 fish species in 2019, and 14 fish species in 2022, with the fish community dominated by minnow and sunfish species. The FIBI score was calculated to be 3.33 (Fair) in 2016, 3.67 (Fair) in 2017, 4.33 (Good) in 2019, and 3.33 (Fair) in 2022.

Table 3D. IBI Scores

Year	BIBI	FIBI
2016	2.00	3.33
2017	1.75	3.67
2019	2.25	4.33
2020	2.25	Not sampled
2022	Not sampled	3.33

4D. Benthic Macroinvertebrates (100-count subsample)

Taxon	Order	2016	2017	2019	2020
Crangonyx	Amphipoda			1	
Physa	Basommatophora			6	
Agabus	Coleoptera				1
Dubiraphia	Coleoptera				1
Microcylloepus	Coleoptera		1		
Macronychus	Coleoptera				2
Psephenus	Coleoptera			1	
Stenelmis	Coleoptera	2	6	1	9
Antocha	Diptera	1			
Chironomidae	Diptera				5e
Chironominae	Diptera			3e	
Chironomini	Diptera			1e	
Cricotopus	Diptera		5	15	
Diamesa	Diptera		7	1	
Dicrotendipes	Diptera			4	2
Eukiefferiella	Diptera	1		4	10
Hemerodromia	Diptera	2		1	2
Hexatoma	Diptera	1			
Limnophyes	Diptera			1	
Micropsectra/Tanytarsus	Diptera				9
Micropsectra	Diptera			50	
Microtendipes	Diptera				1
Nanocladius	Diptera	1	1		
Nilotanypus	Diptera			1	
Orthocladiinae	Diptera	3e	3e	13e	5e
Orthocladius	Diptera	45	45	22	48
Parakiefferiella	Diptera	3			
Parametriocnemus	Diptera	2			10
Paraphaenocladius	Diptera	1			
Paratanytarsus	Diptera		12		
Polypedilum	Diptera		1	7	
Potthastia	Diptera	1	1		
Prosimulium	Diptera		1		
Rheocricotopus	Diptera		5		
Rheotanytarsus	Diptera	5	75		4
Simulium	Diptera	19	2	34	3
Tanypodinae	Diptera	2		2e	
Tanytarsini	Diptera		1e		
Tanytarsus	Diptera		17		4
Thienemanniella	Diptera	4		1	
Thienemannimyia group	Diptera	6	5	2	3
Tvetenia	Diptera	8			5
Baetis	Ephemeroptera	5		17	
Caenis	Ephemeroptera	1			
Maccaffertium	Ephemeroptera			1	
Enchytraeidae	Haplotaxida			1	
Naididae	Haplotaxida	11	2	6	99
Calopteryx	Odonata				1
Amphinemura	Plecoptera				1
Cheumatopsyche	Trichoptera	8	8		
Chimarra	Trichoptera		6		
Hydropsyche	Trichoptera	2	1	1	
Hydroptila	Trichoptera	2			
Girardia	Tricladida	1	1		10

5D. Fish Species Presence

Taxon	Scientific Name	Family	2016	2017	2019	2022
White Sucker	Catostomus commersoni	Catostomidae	5	16	20	2
Bluegill	Lepomis macrochirus	Centrarchidae	22	18		7
Green Sunfish	Lepomis cyanellus	Centrarchidae	45	24	48	27
Largemouth Bass	Micropterus salmoides	Centrarchidae	5	5	3	
Redbreast Sunfish	Lepomis auritus	Centrarchidae	38	55	15	14
Smallmouth Bass	Micropterus dolomieu	Centrarchidae		1		
Blacknose Dace	Rhinichthys obtusus	Cyprinidae	130	204	61	32
Bluehead Chub	Nocomis leptocephalus	Cyprinidae	101	48	42	46
Bluntnose Minnow	Pimephales notatus	Cyprinidae	118	165	95	29
Central Stoneroller	Campostoma anomalum	Cyprinidae	79	186	134	82
Common Shiner	Luxilus cornutus	Cyprinidae	206	134	162	46
Creek Chub	Semotilus atromaculatus	Cyprinidae	15	15	20	13
Longnose Dace	Rhinichthys cataractae	Cyprinidae	83	66	322	9
Mimic Shiner	Notropis volucellus	Cyprinidae			1	
Rosyside Dace	Clinostomus elongatus	Cyprinidae	5	3		
Silverjaw Minnow	Notropis buccatus	Cyprinidae	65	22	60	1
Banded Killifish	Fundulus diaphanus	Fundulidae		12	6	7
Yellow Bullhead	Ameiurus natalis	Ictaluridae	16	52	33	47
Fantail Darter	Etheostoma flabellare	Percidae			15	
Greenside Darter	Etheostoma blennioides	Percidae		1		

6D. Other Taxa Present

Year	Crayfish	Herpetofauna	Exotic Plants
2016	Faxonius virilis	Northern green frog, Eastern snapping turtle	Garlic mustard Japanese honeysuckle Japanese hops Japanese stiltgrass Mile-a-minute Multiflora rose, Shrub honeysuckle, Wineberry
2017	Faxonius virilis	Eastern snapping turtle	Bush honeysuckle Japanese honeysuckle Japanese hops Japanese stiltgrass Multiflora rose, Tree of heaven
2019	Faxonius virilis	Northern green frog	Japanese hops
2022	No crayfish observed	Northern green frog, Eastern snapping turtle	Carpet grass

Little Catoctin Creek (PRFR-204-X)

Post-Restoration Upstream 2022

Post-Restoration Downstream 2022

Land Use/Land Cover & Physical Habitat

During the spring evaluation of the surrounding land use and stream buffer, the area immediately surrounding the site consisted primarily of pasture prior to construction. The buffer extended about 30 meters on either bank, and was uninterrupted for the 75-meter length of the site in 2016 and 2017. No road culverts or channelization were present in the site. Both banks of the stream exhibited moderate erosion, and bar formation was minimal, with bar substrate shifting from sand and silt in 2016 to cobble and gravel in 2017.

Following construction, in 2019, the area immediately surrounding the site had changed to soil without a vegetative buffer. In 2022, herbaceous vegetation covered both banks and riparian areas, consisting primarily of tall grass and emergent vegetation. The riparian buffer width remained at 30 meters on both banks in 2022.

Table 1E. Upstream Land Use

Urban	Agricultural	Forest	Other	Source
5.47%	68.41%	22.43%	3.69%	NLCD 2011
3.91%	71.29%	23.03%	1.77%	NLCD 2016
6.04%	71.91%	20.44%	1.60%	NLCD 2019

Table 2E. Physical Habitat Scores

Year	Instream Habitat Score	Epifaunal Substrate Score	Velocity /Depth Diversity Score	Pool/Glide/ Eddy Quality Score	Extent of Pool/Glide/ Eddy Habitat (m)	Riffle/Run Quality Score	Extent of Riffle/Run Habitat (m)	Bar Formation Severity	Embeddedness (%)	Shading (%)	Aesthetic Score
2016	13	16	13	12	36	17	51	1	15	20	18
2017	11	12	13	12	44	12	33	1	25	35	12
2019	8	10	9	8	24	10	51	1	40	5	13
2022	10	10	9	7	44	11	31	0	75	45	13

Indices of Biotic Integrity & Species

There were 22 taxa in the 2016 subsample, 16 taxa in the 2017 subsample, 20 taxa in the 2019 subsample, and 26 taxa in the 2020 subsample. The BIBI scores were 1.75 (Very Poor), 1.75 (Very Poor), 2.00 (Poor), and 2.50 (Poor), respectively.

When sampled in the summer, electrofishing resulted in 13 taxa in 2016 and in 2017, 16 taxa in 2019, and 12 taxa in 2022. Most species detected were from the minnow family. FIBI scores were 3.33 (Fair), 3.00 (Fair), 4.33 (Good), and 3.33 (Fair), respectively.

Table 3E. IBI Scores

Year	BIBI	FIBI
2016	1.75	3.33
2017	1.75	3.00
2019	2.00	4.33
2020	2.50	Not sampled
2022	Not sampled	3.33

4E. Benthic Macroinvertebrates (100-count subsample)

Taxon	Order	2016	2017	2019	2020
Physa	Basommatophora				1
Agabus	Coleoptera				1
Elmidae	Coleoptera				1e
Optioservus	Coleoptera				1
Psephenus	Coleoptera				1
Stenelmis	Coleoptera	2	1	1	15
Ceratopogonidae	Diptera			1	2
Chironomidae	Diptera				13e
Chironomus	Diptera			1	
Cladotanytarsus	Diptera	1			
Corynoneura	Diptera	2			
Cricotopus	Diptera			36	
Diamesinae	Diptera		1e		
Dicrotendipes	Diptera	2	1	7	
Eukiefferiella	Diptera	2			
Hemerodromia	Diptera	2			
Hydrobaenus	Diptera			1	
Limnophyes	Diptera			1	
Micropsectra	Diptera			35	5
Microtendipes	Diptera	1			
Orthocladiinae	Diptera	8e	3e	10e	
Orthocladius	Diptera	46	75	15	79
Pagastia	Diptera				1
Parakiefferiella	Diptera	2			
Parametriocnemus	Diptera	1		2	
Paratanytarsus	Diptera	4	2	5	5
Polypedilum	Diptera	2	4	5	14
Potthastia	Diptera	1	1		
Prosimulium	Diptera		1		
Rheocricotopus	Diptera		1		
Rheotanytarsus	Diptera		2	1	6
Simulium	Diptera	13		13	40
Sublettea	Diptera				11
Tabanidae	Diptera		1		
Tanytarsus	Diptera		5		
Thienemanniella	Diptera	2		1	
Thienemannimyia group	Diptera	7	9	4	7
Tvetenia	Diptera	2		2	10
Baetis	Ephemeroptera			26	2
Caenis	Ephemeroptera			2	1
Ephemerella	Ephemeroptera				1
Teloganopsis	Ephemeroptera				1
Enchytraeidae	Haplotaxida				9
Naididae	Haplotaxida	7	18	2	40
Caecidotea	Isopoda	3			
Argia	Odonata	1			
Hydropsyche	Trichoptera	1			1
Dugesiidae	Tricladida		1		
Girardia	Tricladida				5
Tubificidae	Tubificida		4		2
Pisidiidae	Veneroida	1	1		1

5E. Fish Species Presence

Taxon	Scientific Name	Family	2016	2017	2019	2022
White sucker	Catostomus commersoni	Catostomidae			4	
Redbreast Sunfish	Lepomis auritus	Centrarchidae	8	12	7	7
Green Sunfish	Lepomis cyanellus	Centrarchidae	57	42	16	18
Bluegill	Lepomis macrochirus	Centrarchidae	4	12		13
Largemouth Bass	Micropterus salmoides	Centrarchidae	6	6	5	
Central Stoneroller	Campostoma anomalum	Cyprinidae	2	10	152	9
Rosyside Dace	Clinostomus elongatus	Cyprinidae		1		
Common Shiner	Luxilus cornutus	Cyprinidae	11	6	142	28
Bluehead Chub	Nocomis leptocephalus	Cyprinidae	36	3	28	23
Silverjaw Minnow	Notropis buccatus	Cyprinidae			99	5
Rosyface Shiner	Notropis rubellus	Cyprinidae			1	
Bluntnose Minnow	Pimephales notatus	Cyprinidae	142	114	283	5
Longnose Dace	Rhinichthys cataractae	Cyprinidae	33	39	424	1
Blacknose Dace	Rhinichthys obtusus	Cyprinidae	37	42	198	3
Creek Chub	Semotilus atromaculatus	Cyprinidae	7	18	80	8
Banded killifish	Fundulus diaphanus	Fundulidae			12	
Yellow Bullhead	Ameiurus natalis	Ictaluridae	25	38	89	15
Fantail Darter	Etheostoma flabellare	Percidae	1		17	

6E. Other Taxa Present

Year	Crayfish	Herpetofauna	Exotic Plants
2016	Faxonius virilis	Northern two-lined salamander	Japanese stiltgrass, Multiflora rose, Tree of heaven, Wineberry
2017	No crayfish observed	Eastern painted turtle, Eastern snapping turtle	Japanese hops, Japanese stiltgrass, Multiflora rose, Tree of heaven
2019	Faxonius virilis, Cambarus bartonii	Gray treefrog, Northern green frog, Eastern snapping turtle, Northern two-lined salamander	Japanese hops, Tree of heaven, Wineberry
2022	No crayfish observed	No herpetofauna observed	No Exotic Plants Observed

Little Catoctin Creek (PRFR-205-X)

Post-Restoration Upstream 2022

Post-Restoration Downstream 2022

Land Use/Land Cover & Physical Habitat

The land use for the area surrounding the site was primarily pasture. The uninterrupted buffer extended only four to eight meters on either bank, and consisted of grasses. No channelization was evident. There was moderate erosion on each bank of the stream in all years surveyed. Minimal bar formation in 2016, consisting of sand and silt, was no longer present in 2017 but increased to moderate severity in 2019 and was minor in 2022.

Table 1F. Upstream Land Use

Urban	Agricultural	Forest	Other	Source
6.35%	72.55%	18.57%	2.53%	NLCD 2011
4.47%	75.32%	19.09%	1.11%	NLCD 2016
5.38%	71.89%	21.05%	1.67%	NLCD 2019

Table 2F. Physical Habitat Scores

Year	Instream Habitat Score	Epifaunal Substrate Score	Velocity /Depth Diversity Score	Pool/Glide/ Eddy Quality Score	Extent of Pool/Glide/ Eddy Habitat (m)	Riffle/Run Quality Score	Extent of Riffle/Run Habitat (m)	Bar Formation Severity	Embeddedness (%)	Shading (%)	Aesthetic Score
2016	15	12	13	13	41	16	38	1	30	10	14
2017	10	11	9	9	49	15	35	0	20	25	13
2019	11	9	9	8	42	13	43	2	40	5	11
2022	13	14	10	10	43	13	32	1	50	17	11

Indices of Biotic Integrity & Species

There were 16 taxa present in the 2016 subsample, 16 taxa in the 2017 subsample, 21 taxa in the 2019 subsample, and 16 taxa present in 2020 subsample. The BIBI scores were calculated to be 1.50 (Very Poor) in 2016, 1.75 (Very Poor) in 2017, 2.25 (Poor) in 2019, and 2.00 (Poor) in 2020.

Electrofishing resulted in 16 fish taxa in 2016, 15 fish taxa in 2017, 17 fish taxa in 2019, and 14 fish taxa in 2022, which resulted in a FIBI score of 3.00, 3.33, 3.33, and 3.67 respectively, all with FIBI ratings of Fair. The fish community was made up of mostly minnow and sunfish species.

Table 3F. IBI Scores

Year	BIBI	FIBI
2016	1.50	3.00
2017	1.75	3.33
2019	2.25	3.33
2020	2.00	Not sampled
2022	Not sampled	3.67

4F. Benthic Macroinvertebrates (100-count subsample)

Year		2016	2017	2019	2020
Taxon	Order				
Nematoda	-				2
Crangonyx	Amphipoda		2	1	
Erpobdellidae	Arhynchobdellida		1		
Physa	Basommatophora		3		
Psephenus	Coleoptera				1
Stenelmis	Coleoptera				2
Ablabesmyia	Diptera			1	
Chironomidae	Diptera				7e
Chironominae	Diptera			1e	
Chironomus	Diptera			2	
Corynoneura	Diptera	1			
Cricotopus	Diptera		3	10	4
Diamesa	Diptera		12		
Diamesinae	Diptera		4e		
Dicrotendipes	Diptera	1	3	1	
Empididae	Diptera				1
Eukiefferiella	Diptera			2	14
Limnophyes	Diptera			6	
Micropsectra	Diptera	2		10	
Orthocladiinae	Diptera	5e	4e	6e	
Orthocladius	Diptera	46	25	25	33
Parakiefferiella	Diptera	2			
Parametriocnemus	Diptera	3			5
Paratanytarsus	Diptera		1	1	
Polypedilum	Diptera	3	3	2	1
Prosimulium	Diptera		1		
Rheotanytarsus	Diptera		1	1	
Simulium	Diptera	16		42	5
Synorthocladius	Diptera	1			
Tanytarsini	Diptera				3
Tanytarsus	Diptera		4		
Thienemanniella	Diptera	6		2	5
Thienemannimyia group	Diptera	1	4	1	
Tvetenia	Diptera	4		2	
Baetidae	Ephemeroptera			1	1e
Baetis	Ephemeroptera			9	5
Caenis	Ephemeroptera	2		1	
Plauditus	Ephemeroptera				1
Naididae	Haplotaxida	24	21	11	295
Cheumatopsyche	Trichoptera			1	
Hydropsyche	Trichoptera				1
Girardia	Tricladida	6	15		
Tubificidae	Tubificida	4	1		

5F. Fish Species Presence

Year			2016	2017	2019	2022
Taxon	Scientific Name	Family				
White Sucker	Catostomus commersoni	Catostomidae		3	3	
Redbreast Sunfish	Lepomis auritus	Centrarchidae	45	41	6	29
Green Sunfish	Lepomis cyanellus	Centrarchidae	79	44	29	81
Bluegill	Lepomis macrochirus	Centrarchidae	11	7	25	45
Largemouth Bass	Micropterus salmoides	Centrarchidae	1	12	1	1
Central Stoneroller	Campostoma anomalum	Cyprinidae	8	34	188	31
Rosyside Dace	Clinostomus elongatus	Cyprinidae	6		10	
Common Shiner	Luxilus cornutus	Cyprinidae	43	77	170	11
Bluehead Chub	Nocomis leptocephalus	Cyprinidae	72	79	64	36
River Chub	Nocomis micropogon	Cyprinidae	5			
Silverjaw Minnow	Notropis buccatus	Cyprinidae	19	27	53	
Bluntnose Minnow	Pimephales notatus	Cyprinidae	109	86	870	138
Longnose Dace	Rhinichthys cataractae	Cyprinidae	19	14	388	20
Blacknose Dace	Rhinichthys obtusus	Cyprinidae	8	16	241	59
Creek Chub	Semotilus atromaculatus	Cyprinidae	12	21	32	2
Fantail Darter	Etheostoma flabellare	Percidae			7	1
Banded Killifish	Fundulus diaphanus	Fundulidae	3	1	7	13
Yellow Bullhead	Ameiurus natalis	Ictaluridae	48	27	92	32

6F. Other Taxa Present

Year	Crayfish	Herpetofauna	Exotic Plants
2016	Faxonius virilis	Eastern snapping turtle, Northern two-lined salamander	Japanese honeysuckle
2017	No crayfish observed	No herpetofauna observed	Japanese honeysuckle
2019	Faxonius virilis	No herpetofauna observed	Japanese hops
2022	Faxonius virilis	No herpetofauna observed	Callery/Bradford Pear, Japanese honeysuckle, Canadian thistle, teasel, multiflora rose

Little Catoctin Creek (PRFR-206-X)


Post-Restoration Upstream 2022


Post-Restoration Downstream 2022

Land Use/Land Cover & Physical Habitat

The riparian buffer around the site extends about five meters out from each bank and consists of grass, mature deciduous trees, and regenerating deciduous trees and shrubs on the left bank and grass and regenerating deciduous trees and shrubs on the right bank. A storm drain interrupts the buffer on the left bank. Beyond the buffer zone, deciduous forest, coniferous forest, residential areas, old field, and pasture were observed. The stream was channelized with concrete for 24 meters on the left bank and three meters on the right bank, with an additional six meters of rip-rap on the right bank within the site.

Both banks of the stream exhibited moderate erosion in 2016, but no erosion in 2017, returning to moderate bank erosion on both banks in 2022. Bar formation was minimal in 2016, with bar substrate consisting of gravel, sand, and silt particle sizes, but no bar formation was observed in 2017. In 2019, bar formation was observed to be moderate, and was minor in 2022.

Table 1G. Upstream Land Use

Urban	Agricultural	Forest	Other	Source
6.24%	72.59%	18.69%	2.47%	NLCD 2011
4.50%	75.32%	19.02%	1.16%	NLCD 2016
5.06%	74.60%	18.03%	2.32%	NLCD 2019

Table 2G. Physical Habitat Scores

Year	Instream Habitat Score	Epifaunal Substrate Score	Velocity /Depth Diversity Score	Pool/Glide/ Eddy Quality Score	Extent of Pool/Glide/ Eddy Habitat (m)	Riffle/Run Quality Score	Extent of Riffle/Run Habitat (m)	Bar Formation Severity	Embeddedness (%)	Shading (%)	Aesthetic Score
2016	12	11	12	11	41	11	35	1	40	15	15
2017	8	11	11	11	38	13	41	0	25	20	15
2019	13	9	11	12	54	10	24	2	30	5	10
2022	11	13	12	12	37	12	38	1	50	20	11

Indices of Biotic Integrity & Species

Subsamples contained 17 taxa in 2016, 12 taxa in 2017, 13 taxa in 2019, and 23 taxa in 2020, leading to BIBI scores of 1.50 (Very Poor), 1.25 (Very Poor), 1.75 (Very Poor), and 2.00 (Poor).

Summer electrofishing detected 13 fish species in 2016 and in 2017, 19 fish species in 2019, and 13 fish species in 2022 with the fish community dominated by minnow and sunfish species. The FIBI score was calculated to be 3.33 in 2016, 3.00 in 2017, 3.67 in 2019, and 3.00 in 2022, all considered Fair, with the difference in scores not considered to be significant.

Table 3G. IBI Scores

Year	BIBI	FIBI
2016	1.50	3.33
2017	1.25	3.00
2019	1.75	3.67
2020	2.00	Not sampled
2022	Not sampled	3.00

4G. Benthic Macroinvertebrates (100-count subsample)

Year		2016	2017	2019	2020
Taxon	Order				
Crangonyx	Amphipoda			4	
Menetus	Basommatophora		1		
Physa	Basommatophora		1		
Elmidae	Coleoptera				1e
Macronychus	Coleoptera				1
Stenelmis	Coleoptera	1			5
Bezzia	Diptera	1			
Cardiocladius	Diptera			1	
Chironomidae	Diptera				4e
Corynoneura	Diptera				10
Cricotopus	Diptera	38		7	
Diamesa	Diptera		7		2
Diamesinae	Diptera		2e		
Dicrotendipes	Diptera	1	1	3	1
Eukiefferiella	Diptera	1		2	
Micropsectra	Diptera	2		24	
Micropsectra/Tanytarsus	Diptera				1
Orthocladiinae	Diptera	2e	2e	2e	
Orthocladius	Diptera	5	63	25	40
Pagastia	Diptera				1
Parakiefferiella	Diptera	3			
Parametriocnemus	Diptera	4			5
Polypedilum	Diptera	1	2	3	4
Prosimulium	Diptera		1		
Rheotanytarsus	Diptera				1
Simulium	Diptera	28		33	15
Sublettea	Diptera				2
Tanytarsini	Diptera			1e	
Tanytarsus	Diptera		4		1
Thienemanniella	Diptera	2			
Thienemannimyia group	Diptera		3	2	3
Tvetenia	Diptera	1		1	5
Baetis	Ephemeroptera	1		22	6
Enchytraeidae	Haplotaxida				1
Naididae	Haplotaxida	19	31	16	251
Corydalus	Megaloptera				1
Hydropsyche	Trichoptera				2
Girardia	Tricladida	15	19		6
Tubificidae	Tubificida		10		1
Pisidium	Veneroida	1			

5G. Fish Species Presence

Year			2016	2017	2019	2022
Taxon	Scientific Name	Family				
American Eel	Anguilla rostrata	Anguillidae	1			
White Sucker	Catostomus commersoni	Catostomidae			3	
Redbreast Sunfish	Lepomis auritus	Centrarchidae	14	17	25	36
Green Sunfish	Lepomis cyanellus	Centrarchidae	18	26	51	33
Bluegill	Lepomis macrochirus	Centrarchidae	10	8	63	63
Largemouth Bass	Micropterus salmoides	Centrarchidae	3	8	9	
Smallmouth Bass	Micropterus dolomieu	Centrarchidae			1	
Rosyside Dace	Clinostomus elongatus	Cyprinidae			1	
Central Stoneroller	Campostoma anomalum	Cyprinidae	4	28	54	32
Common Shiner	Luxilus cornutus	Cyprinidae	22	130	131	39
Bluehead Chub	Nocomis leptocephalus	Cyprinidae	32	59	35	45
Silverjaw Minnow	Notropis buccatus	Cyprinidae	1	14	38	22
Rosyface Shiner	Notropis rubellus	Cyprinidae			1	
Bluntnose Minnow	Pimephales notatus	Cyprinidae	13	192	268	92
Longnose Dace	Rhinichthys cataractae	Cyprinidae	7	15	115	14
Blacknose Dace	Rhinichthys obtusus	Cyprinidae		2	47	7
Creek Chub	Semotilus atromaculatus	Cyprinidae	12	21	22	13
Banded Killifish	Fundulus diaphanus	Fundulidae			14	15
Yellow Bullhead	Ameiurus natalis	Ictaluridae	36	15	32	19
Fantail Darter	Etheostoma flabellare	Percidae			8	

6G. Other Taxa Present

Year	Crayfish	Herpetofauna	Exotic Plants
2016	Faxonius virilis	Northern green frog, Northern red salamander	Japanese honeysuckle
2017	Faxonius virilis	Eastern snapping turtle	Japanese honeysuckle, Japanese stiltgrass
2019	Faxonius virilis	No herpetofauna observed	Japanese hops, Callery/bradford pear, Japanese stiltgrass
2022	No crayfish observed	No herpetofauna observed	Callery/bradford pear