

CHESAPEAKE BAY TMDL ACTION PLAN

PHASE 3

NASA Langley Research Center

MS4 Permit #VAR040092

Table of Contents

Purpose.....	1
LaRC Background	1
Current Program and Existing Legal Authority	1
New or Modified Legal Authority	3
Means and Methods to Address Discharges from New Sources	3
Means and Methods to offset Grandfathered projects after July 1, 2014	4
Existing Source Loads and Calculated Total Pollutant of Concern (POC) Required Reductions	4
Previous Permit Cycle Reduction Achievements	6
Permit Cycle 1 (July 1, 2009 to June 30, 2018) and 2 (July 1, 2018 to October 31, 2023).....	6
List of Implemented BMPs through Permit Cycle 2 (July 1, 2009 to October 31, 2023).....	7
Post Construction BMPs	10
Aerial Land Use Changes	10
Future Means and Methods to Meet the Required Reductions and Schedule, Permit Cycle 3	11
Summary Table: Load Reductions Planned through Permit Cycle 3 (to October 31, 2028).....	15
Real and Projected Costs	16
Public Participation.....	19
Signed Certification Statement	20

Purpose

The Chesapeake Bay Total Maximum Daily Load (TMDL) condition within the General Permit for Discharges of Stormwater from Small Municipal Separate Storm Sewer Systems (VAR040092) requires the National Aeronautics and Space Administration (NASA) Langley Research Center (LaRC) to submit a TMDL Action Plan (“Action Plan”) to the Virginia Department of Environmental Quality (DEQ). This submittal is the third phase of the Action Plan and satisfies the Special Condition requirements covering the period of November 1, 2023 to October 31, 2028. This Action Plan demonstrates LaRC’s ability to ensure compliance with the Special Condition and includes the means/methods to meet or exceed an additional 60% of Level 2 (L2) scoping run reductions for existing development by the end of this permit cycle (2028). In combination with the 40% reduction of L2 achieved, 100% of the total L2 reduction will be achieved by October 31, 2028. L2 implementation equates to an average reduction of 9.0% of nitrogen loads, 16% of phosphorus loads, and 20% of sediment loads from impervious regulated acres and 6.0% of nitrogen loads, 7.25% of phosphorus loads, and 8.75% of sediment loads from pervious regulated acres beyond 2009 progress loads and beyond urban nutrient management reductions for pervious regulated acreage.

LaRC Background

NASA LaRC is situated near the southern end of the lower Virginia Peninsula, approximately 150 miles south of Washington, D.C. and 50 miles southeast of Richmond, Virginia. The cities of Hampton, Poquoson, Newport News, and York County form a major metropolitan statistical area around LaRC. The Center houses several wind tunnels, research facilities, and administrative offices. The Center owns and operates 764 acres of property. LaRC is located within proximity to several surface water bodies within the tidal zone of the Chesapeake Bay.

LaRC is in the York River drainage basin, specifically river segment YLO_7370_0000. This river segment is part of the Mobjack Bay, in the overall York River basin. The Brick Kiln Creek runs along the western boundary of LaRC, joining the northwest branch of the Back River, and drains approximately 40 percent of the Center. Tabbs Creek, which drains much of the rest of the Center, flows in a northerly direction to join the Back River near the confluence of its northwest and southwest branches. A small portion of the property in the south drains to Tides Mill Creek. The local waterways are influenced by tides in the Chesapeake Bay. The waters in the local streams are designated by the State as Class IIa, estuarine waters where shellfish can be found.

Current Program and Existing Legal Authority

LaRC has a robust stormwater management program that has the required regulatory mechanisms in place to ensure compliance with the MS4 General Permit, the Chesapeake Bay TMDL Special Condition, and this Action Plan. The following is a list of applicable mechanisms and a brief description:

- **Langley Procedural Requirements (LPR) 8500.1 “Environment and Energy Program Manual”** – This document sets forth procedural requirements and responsibilities to ensure that LaRC personnel comply with the Center’s environmental and energy management program. This is the closest document LaRC has to a traditional “ordinance.” Chapter 5 of LPR 8500.1 includes LaRC policy to comply with the Chesapeake Bay TMDL and to reduce pollutant loadings to the maximum extent practicable. The document also details responsibilities for Center personnel to ensure water quality regulations and goals are met.
- **DEQ-approved NASA LaRC Standards and Specifications for Virginia Erosion and Stormwater Management Program (VESMP)** – This is the foundation of LaRC’s stormwater program. LaRC has Annual Standards and Specifications for erosion and sediment control (ESC) and stormwater management (SWM) that are integral components of LaRC’s design, construction, maintenance, and management of the Center’s facilities and operations. The primary regulatory driver for NASA LaRC Annual Standards and Specifications is the Virginia Erosion and Stormwater Management (VESM) regulations (9 VAC 25-875), the General VPDES Permit for Discharges of Stormwater from Construction Activities (9 VAC 25-880/VAR10), and LaRC’s MS4 permit (VAR040092). The NASA LaRC Annual Standards and Specifications for ESC and SWM has been developed to provide detailed information regarding LaRC’s compliance with all regulatory requirements. This program guide discusses staffing, design standards, how LaRC reviews and approves all plan submittals, and program enforcement.
- **LaRC Master Plan and Revitalization Plan** – LaRC’s Master Plan outlines a concept for the future, including significant demolition of older facilities. LaRC has planned to demolish over 100 structures throughout this process and is on target to meet this goal. Many of these demolished impervious areas are being transitioned back to green space and the overall LaRC footprint is being pulled into a central campus concept. These reductions in impervious surface are an essential element to TMDL compliance for LaRC. Additionally, any new construction under this revitalization program is required to be environmentally sustainable with a Leadership in Energy and Environmental Design (LEED) silver or greater rating, and compliant with Energy Independence and Security Act (EISA) Section 438 and Virginia state requirements.
- **Environmental Management System (EMS)** – LaRC has an active EMS that accomplishes the following: (1) incorporates people, procedures, and work practices into a formal structure to ensure that the important environmental impacts of the organization are identified and addressed; (2) promotes continual improvement, including periodically evaluating environmental performance; (3) involves all members of the organization, as appropriate; and (4) actively involves senior management in support of the EMS. LaRC senior management approved the creation of the Environmental Management Committee (EMC) in July 2009. The EMC meets quarterly and reports annually to the Center Leadership Council regarding the status, progress, and challenges of LaRC’s Environmental Management System. The EMS is an excellent tool to assist in Chesapeake Bay TMDL compliance and continues to be used to bring TMDL visibility to senior management.

- **Additional Guidance Documents – (NASA LaRC Design Standards FES-ENVENE; NASA LaRC Environmental Master SPEC Section 01 35 40.00 99; NASA LaRC Seeding SPEC Section 32 92 19.00 99)** – These three documents are incorporated by reference into the NASA LaRC Annual Standards and Specifications for ESC and SWM. The NASA LaRC Environmental Design Standards FES-ENVENE primarily apply to design aspects of projects. They are implemented into project requirements and into contract award packages to ensure projects are designed in accordance with all applicable requirements. The NASA LaRC Master Specification Section 01 35 40.00 99 and NASA LaRC Specification Section 32 92 19.00 99 primarily apply to construction and land disturbance activities to ensure projects are completed in compliance with all applicable requirements and that best management practices for erosion and stormwater management are utilized throughout the duration of the project.
- **EISA Section 438** – Section 438 states that federal projects exceeding 5,000 square feet shall use site planning, design, construction, and maintenance strategies for the property to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature rate, volume, and duration of flow. This is another driver for projects that help achieve compliance with the Chesapeake Bay TMDL.

New or Modified Legal Authority

No new legal authorities are needed to ensure implementation of the Action Plan or compliance with the Chesapeake Bay TMDL. LaRC has implemented the necessary regulatory controls to ensure compliance.

Means and Methods to Address Discharges from New Sources

LaRC has determined that there are no needed offsets for increased loads from new sources that initiated construction on or after July 1, 2009.

There have been five (5) redevelopment construction projects that have held a DEQ Construction General Permit (CGP) since July 1, 2009: four (4) projects have been completed and terminated their CGP, with one (1) ongoing redevelopment construction project. *Outside of the five (5) redevelopment projects discussed above, there were several regulated demolition projects that were over one (1) acre in size. These sites complied with EISA and state standards by converting impervious condition to either a Mixed Open or Managed Turf condition.*

NASA's DEQ-approved Annual Standards and Specifications for ESC and SWM detail the means and methods to address discharges from new sources and ensure compliance with SWM regulations. LaRC has a specific Environmental Construction Specification (Section 01 35 40.00 99) that ensures all construction contracts on Center are compliant with the most current state stormwater regulations. The construction specification requires sites with over an acre of land disturbance to submit an ESC Plan, SWM Plan, Stormwater Pollution Prevention Plan (SWPPP) and Construction

General Permit (CGP) coverage (when applicable). Lastly, LaRC policies do not allow any land disturbing activities to occur until all required Plan submittals are reviewed and approved by NASA's certified Dual Combined Administrator for ESC and SWM.

Means and Methods to offset Grandfathered projects after July 1, 2014

LaRC made a management decision to not grandfather any projects that began construction after July 1, 2014. All applicable projects that started after July 1, 2014 met or will meet Technical Criteria Part II B design requirements per LaRC's Annuals Standards and Specifications for ESC and SWM.

Existing Source Loads and Calculated Total Pollutant of Concern (POC) Required Reductions

The first step in determining source loads POC reductions was to perform an in-depth analysis of the size and extent of the regulated MS4 as of June 30, 2009. LaRC utilized extensive GIS resources to accurately determine the total regulated urban pervious and impervious surface acres. Forested acres were excluded from the land use totals through GIS. Many of the buildings that were present in 2009 had been demolished. As such, great effort was given to "rebuild" the impervious state for the 2009 TMDL Base map. Demolished buildings and structure "polygons" in the GIS system were added back in and compared against previous year aerial photos to ensure that an adequate picture of the Center on June 30, 2009 was developed. LaRC's GIS team also built an impervious surfaces tool that allows staff to easily visualize the types of impervious surfaces in each outfall drainage basin. The tool generates automatic data reports. A breakdown of LaRC's 764 acreage is summarized in the table below:

Size and Extent of the MS4	
Regulated Urban Impervious	217.66
Regulated Urban Pervious	250.77
Excluded Forested Lands	295.57
Total	764 Acres

Table 1. LaRC Land Cover

The POC loads and required reductions have been calculated using the tools described in the TMDL Guidance document.

The sections below cover load and cumulative reductions calculations in accordance with Part II A3, A4, and A5. NASA LaRC has confirmed that only Part II A 3 applies.

The following table showcases the existing source loads:

NASA Langley - Source Loads and Reduction Requirements (York River and Poquoson Coastal Basin)							
Sub source	Pollutant	Existing developed lands as of 6/30/09 served by the MS4 within the 2010 CUA (acres)	2009 Loading Rate (lbs/acre/yr)	Total POC Load Based on 2009 Progress Run (lbs/yr)	Percentage of MS4 required Chesapeake Bay total L2 loading reduction (%)	100% cumulative reduction required by 10/31/2028 (lbs/yr)	Sum of 100% cumulative reduction required (lbs/yr)
Regulated Urban Impervious	Total Nitrogen (TN)	217.66	7.31	1591.09	9.00%	143.2	258.3
Regulated Urban Pervious		250.77	7.65	1918.39	6.00%	115.1	
Regulated Urban Impervious	Total Phosphorous (TP)	217.66	1.51	328.67	16.00%	52.6	61.9
Regulated Urban Pervious		250.77	0.51	127.89	7.25%	9.3	
Regulated Urban Impervious	Total Suspended Solids (TSS)	217.66	456.68	99400.97	20.00%	19880.2	21477.2
Regulated Urban Pervious		250.77	72.78	18251.04	8.75%	1597.0	

Table 2. LaRC Source Loads and Reduction Requirements

Previous Permit Cycle Reduction Achievements

Permit Cycle 1 (July 1, 2009 to June 30, 2018) and 2 (July 1, 2018 to October 31, 2023)

Table 3 below summarizes the total reductions achieved as of the end of Permit Cycle 1 and Permit Cycle 2. NASA LaRC achieved significantly more than the required 5% reduction during the first cycle, and significantly more than the 40% reduction during the second cycle. The data included in the table identifies permanent BMPs only; annual credits are not applied in Table 3. A listing of implemented BMPs that generated these load reductions is in the subsection below.

Sub source	Pollutant	Required Reduction (lbs)	Permit Cycle 1, Permanent Load Reductions Achieved	Permit Cycle 2, Permanent Load Reductions Achieved	Redevelopment BMPs, 2009-2023	Cumulative Load Reduction Achieved by end of Permit Cycle 2 (lbs/yr)	Combined Progress, Permanent BMPs, Cycles 1 & 2 (%)
Regulated Urban Impervious	TN	143.2	64.06	24.1	118.4	206.6	127%
Regulated Urban Pervious		115.1	78.61	31.4	11.3	121.3	
Regulated Urban Impervious	TP	52.6	0.59	0.6	15.4	16.7	60%
Regulated Urban Pervious		9.3	13.85	5.5	1.2	20.6	
Regulated Urban Impervious	TSS	19880.2	5164.35	1178.5	2656.3	8999.1	50%
Regulated Urban Pervious		1597.0	1076.90	619.5	135.0	1831.4	

Table 3. LaRC TMDL Reductions, Permanent BMPs only, 2009-2023

List of Implemented BMPs through Permit Cycle 2 (July 1, 2009 to October 31, 2023)

Summary Narrative:

Several management practices were utilized and implemented during the first two permit cycles to achieve the required 40% reductions for existing sources. No nutrient trading was used.

In summary, a total of fifty-three (53) impervious structures were demolished and returned to a grass condition. While these areas are mowed periodically, they do not receive nutrient applications. The demolished structures equate to a total of 12.47 acres of impervious areas converted to turf, mixed open, or forest conditions. Street sweeping was utilized during all years of both permit cycles including all roads and parking surfaces on Center were swept on a quarterly basis. Additionally, 5.6 acres were converted to a forested condition. Stormwater retrofits were also completed via the installation of four tree-box filters around the Center during Permit Cycle 1. A total of 7.63 acres were naturally converted from turf to meadow (mixed open) due to opportunities to return the area to a natural vegetated state and/or reduced needs in grounds maintenance. Annual credits are shown for informational purposes but are not included in the permanent reduction calculations for Permit Cycles 1 and 2.

List of implemented projects, dates of implementation and load reduction achieved:

Practice Implemented	Date of Implementation	TN Impervious Load Reduced (lbs/yr)	TN Pervious Load Reduced (lbs/yr)	TP Impervious Load Reduced (lbs/yr)	TP Pervious Load Reduced (lbs/yr)	TSS Impervious Load Reduced (lbs/yr)	TSS Pervious Load Reduced (lbs/yr)
Land Use Change - Impervious to Turf	7/1/2009 - 6/30/2010	9.39	0.00	0.00	0.00	763.19	0.00
Land Use Change - Impervious to Turf	7/1/2010 - 6/30/2011	1.69	0.00	0.00	0.00	137.10	0.00
Land Use Change/Impervious to Forest AND Forest Buffer	4/30/2011	3.71	1.16	0.23	0.14	209.70	21.68
Land Use Change - Impervious to Turf	7/1/2011 - 6/30/2012	0.56	0.00	0.00	0.00	45.70	0.00
Land Use Change - Impervious to Turf	7/1/2012 - 6/30/2013	2.68	0.00	0.00	0.00	242.21	0.00
Land Use Change - Impervious to Turf	7/1/2013 - 6/30/2014	3.20	0.00	0.00	0.00	260.49	0.00

Practice Implemented	Date of Implementation	TN Impervious Load Reduced (lbs/yr)	TN Pervious Load Reduced (lbs/yr)	TP Impervious Load Reduced (lbs/yr)	TP Pervious Load Reduced (lbs/yr)	TSS Impervious Load Reduced (lbs/yr)	TSS Pervious Load Reduced (lbs/yr)
Land Use Change/Turf to Forest AND Forest Buffer	4/23/2014	0.00	3.19	0.00	0.55	0.00	94.28
Land Use Change - Impervious to Turf	7/1/2014 - 6/30/2015	3.71	0.00	0.00	0.00	301.62	0.00
Tree Box Filter #1	3/11/2015	0.25	0.24	0.22	0.07	31.79	4.54
Tree Box Filter #2	3/11/2015	0.10	0.32	0.05	0.05	12.33	5.90
Tree Box Filter #3	3/11/2015	0.06	0.37	0.02	0.04	6.66	6.91
Tree Box Filter #4	3/11/2015	0.11	0.04	0.07	0.01	13.97	0.74
Land Use Change - Impervious to Turf	7/1/2015 - 6/30/2016	29.67	0.00	0.00	0.00	2412.96	0.00
Land Use Change / Turf to Mixed Open (0.36 acre field behind B1159 reforested plot)**	7/1/2015 - 6/30/2016	0.00	2.24	0.00	0.41	0.00	0.00
Land Use Change/Turf to Forest AND Forest Buffer	7/1/2015 - 6/30/2016	0.00	10.62	0.00	1.82	0.00	314.28
Land Use Change / Turf to Mixed Open (6.31 acres identified via GIS aerial comparisons)**	2010 – 2016	0.00	39.19	0.00	7.13	0.00	0.00
Land Use Change - Impervious to Turf	7/1/2016 - 6/30/2017	8.94	0.00	0.00	0.00	726.63	0.00
Land Use Change/Turf to Forest AND Forest Buffer	7/1/2016 - 6/30/2017	0.00	10.62	0.00	1.82	0.00	314.28
Land Use Change/Turf to Forest AND Forest Buffer	7/1/2017 - 6/30/2018	0.00	10.62	0.00	1.82	0.00	314.28
Land Use Change - Impervious to Turf	7/1/2018 - 6/30/2019	3.09	0.00	0.00	0.00	251.35	0.00
Land Use Change / Turf to Mixed Open	7/1/2019 – 6/30/2020	0.00	1.93	0.00	0.35	0.00	0.00

Practice Implemented	Date of Implementation	TN Impervious Load Reduced (lbs/yr)	TN Pervious Load Reduced (lbs/yr)	TP Impervious Load Reduced (lbs/yr)	TP Pervious Load Reduced (lbs/yr)	TSS Impervious Load Reduced (lbs/yr)	TSS Pervious Load Reduced (lbs/yr)
(0.31 acres identified via GIS aerial comparisons)**							
Land Use Change / Turf to Mixed Open (0.65 acres ditch restoration)**	7/1/2020 – 6/30/2021	0.00	4.04	0.00	0.73	0.00	0.00
Land Use Change - Impervious to Turf	7/1/2020 - 6/30/2021	6.86	0.00	0.00	0.00	557.54	0.00
Land Use Change/Pervious to Forest AND Forest Buffer	7/1/2021 - 6/30/2022	0.00	13.28	0.00	2.28	0.00	392.85
Land use change - Impervious to Mixed Open	7/1/2022-6/30/2023	14.20	0.00	0.65	0.00	369.60	0.00
Land use change - Turf to Forest AND forest buffer	7/1/2022-6/30/2023	0.00	7.48	0.00	1.31	0.00	226.68
Land use change- Turf to Mixed Open	7/1/2022 - 6/30/2023	0.00	3.73	0.00	0.68	0.00	0.00
Land use change- Turf to Mixed Open	7/1/2022 - 6/30/2023	0.00	0.93	0.00	0.17	0.00	0.00
Catch Basin Cleaning*	Annual Credit	52.56	0.00	9.46	0.00	0.00	0.00
Street Sweeping (Loading Rate Pre-2019 Guidance; Permit Cycle 1)	Annual Credit	166.43	0.00	66.57	0.00	19971.00	0.00
Street Sweeping * (Loading Rate Post-2019 Guidance; Permit Cycle 2)	Annual Credit	0.00	0.00	1.54	0.00	932.00	0.00

Table 4. LaRC Implemented BMPs, 2009-2023

*Catch Basin Cleaning and Street Sweeping values were revised to follow the procedures described in *Guidance Memo No. 20-2003 – Chesapeake Bay TMDL Special Condition Guidance (GM20-2003)*. NASA implemented the *GH20-2003* methods in 2019.

**Additional land use change activities were identified in April 2025 via aerial GIS comparisons. See Table 6 and the subsection below for additional information. All associated tables have been updated to incorporate these reductions.

Post Construction BMPs

Appendix V.E of GM20-2003 states that “*permittees will receive full credit for any pollutant of concern reduction that result from redevelopment projects.*” Since 2011, LaRC has had five (5) redevelopment projects that were administered under the DEQ Construction General Permit (CGP) program, listed below.

LaRC extracted nutrient credits from approved Virginia Runoff Reduction Method (VRRM) sheets. LaRC had not previously claimed pollutant reduction credit from these BMPs in PY1 and 2 due to an oversight. Tables 3 and 15 have been updated to include the nutrient reduction credit.

CGP Redevelopment BMPs					
Building	CGP#	Notice of Termination (NOT) Date	TP (lbs/yr)	TN (lbs/yr)	TSS (lbs/yr)
B2101	VAR10-10-103092	Aug-11	3.42	40.14	622.01
B2102	VAR108257	Mar-17	6.5	57.82	1073.47
B2103	VAR10G999	Feb-19	4.17	22.08	455.94
B2104	VAR10J220	Apr-22	1.98	9.64	639.88
B2105	VAR10Q866*	Dec-25 (anticipated for permit cycle 3)	0.58	4.71	99.25
Total			16.7	134.4	2890.5

Table 5. LaRC CGP Redevelopment BMPs

***The reduction information for B2105 (VAR10Q866) is included in Table 5 for informational purposes. This reduction will be applied in Permit Cycle 3 and is accounted for in Table 15.**

Aerial Land Use Changes

During TMDL Plan reviews in 2025, LaRC identified several land use change BMPs using the GIS database and aerial comparisons where brush and trees are now growing in place of managed turf. The land use change credited at these locations is thus based on the turf to mixed-open land use, and the credit reductions were calculated in accordance with the TMDL guidance document. A summary of land use change credits is presented in Table 6. A total of 7.63 acres were naturally converted from turf to meadow (mixed open) due to opportunities to return the area to a

natural vegetated state and/or reduced needs in grounds maintenance. Records of exact locations and acreage is maintained by the LaRC Environmental Management Office (EMO).

Land Use Changes via GIS Aerial Comparisons, Turf to Mixed Open Land-Use Change					
Location Identifier	Implementation Date, by permit cycle (PC)	Acres	TN Impervious Load Reduced (lbs/yr)	TP Impervious Load Reduced (lbs/yr)	TSS Impervious Load Reduced (lbs/yr)
CDL Site	2010, PC1	4.68	29.07	5.29	0
Gantry Field	2012, PC1	0.46	2.86	0.52	0
Field Behind Reforestation Plot	2015, PC1	0.36	2.24	0.41	0
“Skip” Pile	2016, PC1	1.01	6.27	1.14	0
B1159	2016, PC1	0.16	0.99	0.18	0
B1262 West and North Ditches	2020, PC2	0.65	4.04	0.73	0
Water Tower	2020, PC2	0.31	1.93	0.35	0

Table 6. LaRC Identified Land Use Changes, 2010-2020; All acres identified are converting from turf to mixed-open.

Future Means and Methods to Meet the Required Reductions and Schedule, Permit Cycle 3

This Action Plan describes the management practices and programs that will be implemented between November 1, 2023 and October 31, 2028 to achieve the remaining 60% reduction for existing sources. LaRC will use the following types of practices and reductions for this permit cycle (2023 through 2028).

1) Project/BMP: Land Use Change - Impervious to Turf/Mixed Open Credit

From November 1, 2023, to October 31, 2028, a total of eight (8) impervious structure are listed in the Center’s Demolition Plan. All areas will be returned to at least a lawn condition, and some areas are being considered to convert to mixed open space. These land use changes will equate to a total of 12.04 acres of impervious area converted to green space.

The conversions used for these projects are listed in Table 7. Additionally, Table 8 identifies each project name and location, preliminary schedule for implementation, acreage, and a calculation of load reductions expected. Some projects are grouped based on their proximity to one another and how construction will be executed.

Land Use from	Conversion	TN (lbs/ac/year)	TP (lbs/ac/year)	TSS (lbs/ac/year)
Impervious	Forest	12.35	0.77	699
Impervious	Mixed Open	11.83	0.54	308
Impervious	Turf	5.62	0.00	457
Turf	Forest	6.74	1.36	242
Turf	Mixed open	6.21	1.13	0.00
Mixed Open	Forest	0.53	0.23	391

Table 7. Land Use Change Conversion Efficiency Table, York River Basin

Planned Demolitions 2023-2028, Impervious to Turf Land-Use Change						
Building #	Building Name	Planned Date of Implementation, by permit year cycle	Acres	TN Impervious Load Reduced (lbs/yr)	TP Impervious Load Reduced (lbs/yr)	TSS Impervious Load Reduced (lbs/yr)
1256 Complex	Combined Loads Test (COLTS) Facility	7/1/2023-6/30/2024; <i>Completed 12/2024</i>	1.31	7.36	0	598.67
1202	Research Lab	7/1/2023-6/30/2024; <i>In progress</i>	3.92	22.03	0	1791.44
1202A	Pearl Young Conference Center					
1299	Research Complex					
1209	Office Facility and Parking Lots	7/1/2024-6/30-2026; <i>In progress</i>	5.3	29.79	0	2422.1
1220	Research Lab	7/1/2026-6/30/2027	1.05	5.9	0	479.85
1188	Component Cleaning Facility	7/1/2026-6/30/2027	0.46	2.59	0	210.22
1189	Contractor Support Facility					
Total				67.67	0	5502.28

Table 8. LaRC Projected Building Demolitions 2023-2028. All acres identified are converting from impervious to turf.

2) Project/BMP: Street Sweeping Program – Annual Credit

LaRC has an established street sweeping program that is accomplished through a Grounds Maintenance contract. All roads and parking surfaces (102 acres) on Center are swept on a quarterly basis (one pass every twelve weeks). The data below was developed using the qualifying street lanes method in *GM20-2003*.

BMP efficiency can be found in the table and information on the description and practice can be found in the referenced final report.

Lane Miles/Acres	Practice #	Description	Passes	TSS Removal % Efficiency	TN Removal % Efficiency	TP Removal % Efficiency
102	SCP-6	AST – 1P12W	4	2	0	1
<i>**Assume annual load from impervious cover of 456.68 lbs/ac/year (sediment), 7.31 lbs/ac/yr (nitrogen) and 1.51 lbs/ac/yr (phosphorus) (York River basin loading rates)</i>				TSS Removed (lbs)	TN Removed (lbs)	TP Removed (lbs)
				931.63	0	1.54

Table 9. LaRC Street Sweeping Calculations, per *GM20-2003*

3) Project/BMP: Storm Drain Cleaning Credit

Loads were developed using the storm drain cleaning credit method to match *GM20-2003*. LaRC has an established catch basin cleaning program that is completed through a Grounds Maintenance contract. All 761 catch basins at LaRC are cleaned twice annually. BMP efficiency can be found in the table and information on the description and practice can be found in the referenced final reports.

The credit was computed in three steps:

Step 1: Determine pounds of solids/organic matter collected within catch basins, storm drain pipes, at the outfall, or removed from concrete-lined conveyance channels on an annual basis.

Step 2: Convert the initial wet mass captured into dry weight using the following conversion factors, depending on the type of material collected. The conversion factors are 0.7 for wet sediments (CSN, 2011) and 0.2 for wet organic matter (Stack et al, 2013). Based on historical data, NASA LaRC has determined that about 1/3 of the material is wet organic matter, with the remainder composed of wet sediments.

Step 3: Multiply the dry weight mass by a default nutrient enrichment factor depending on whether the material captured is sediment or organic in nature.

Type of Solid Material	Weight of initial wet material (lbs)	Conversion Factor	Dry Weight (lbs)	% Composition of total material
Wet sediments	17520	0.7	12264	66%
Wet organic matter	8760	0.2	1752	33%

Table 10. Storm Drain Cleaning Dry Weight Calculation

Type of Material Captured	Nutrient %	Enrichment Factor	Dry Weight (lbs)	Nutrient Credit (lbs/year)
BMP and catch basin Sediments	% P	0.06	12264	7.36
	% N	0.27	12264	33.11
Organic matter/leaf material	% P	0.12	1752	2.10
	% N	1.11	1752	19.45

Table 11. Mean Nutrient Enrichment Factor to Apply to Dry Weight Mass of Solids Physically Removed from Storm Drains

TP Removed (lbs/year)	9.46
TN Removed (lbs/year)	52.56

Table 12. Total Nutrient Credits from Storm Drain Cleaning

4) Project/BMP: Land Conversions (Land Use Change - Turf to Mixed Open)

LaRC will evaluate acreage across the Center, focusing on areas away from the core campus that are not suitable for reforestation but are good candidates for conversion to Mixed Open space. LaRC does not apply nutrients to any vegetated areas. To fulfil remaining reduction needs, LaRC has identified over thirteen (13.85) acres of Managed Turf to convert to Mixed Open space and will pursue additional opportunities as they arise.

POC	York River Basin Loading Rate for Land Conversion (Efficiency) (lbs/ac/year)	Acres for loading rate	Reduction Credit (pounds unit/year)
TN	6.21	13.85	86.0
TP	1.13	13.85	15.7
TSS	0	13.85	0

Table 13. Summary of all Proposed Land-Use Areas Change Calculation (Turf to Mixed Open); York River Basin

Planned Land Conversions 2023-2028, Turf to Mixed Open Land-Use Change					
Location Identifier	Planned Date of Implementation, by permit year	Acres	TN Impervious Load Reduced (lbs/yr)	TP Impervious Load Reduced (lbs/yr)	TSS Impervious Load Reduced (lbs/yr)
B1202 Field	7/1/2025-6/30/2026	3.66	22.7	4.1	0
B1158 Field	7/1/2026-6/30/2027	4.14	25.7	4.7	0
B1175 Field	7/1/2026-6/30/2027	2.12	13.2	2.4	0
B1181 Field	7/1/2026-6/30/2027	3.93	24.4	4.4	0
Total		13.85	86.0	15.7	0

Table 14. LaRC Projected Land Use Conversions 2023-2028; All acres identified are converting from turf to mixed open

Summary Table: Load Reductions Planned through Permit Cycle 3 (to October 31, 2028)

Table 15 summarizes the progress toward pollutant load reductions required by the end of Permit Cycle 3, noting that the state of Virginia has already exceeded its Total Suspended Solids (TSS) reduction goals, leading to the guidance that entities no longer need to focus on further TSS reductions beyond maintaining the 40% reduction. For Total Nitrogen (TN), the cumulative reduction achieved by the end of Cycle 2 already exceeds the total reduction required by Cycle 3. Total Phosphorus (TP) has a remaining reduction requirement of 24.6 lbs/yr, with planned reductions in Cycle 3 expected to bring the cumulative reduction to at least 100% of the required amount. While TSS has the largest remaining reduction requirement, the state's achievement of its overall TSS goals means entities primarily need to ensure they maintain at least a 40% reduction in TSS. In Cycle 3, NASA will maintain its permanent BMPs to ensure it is meeting these reductions.

POC	Reduction Required by end of Permit Cycle 3 (lbs/yr)	Cumulative Reduction Achieved, end of Permit Cycle 2 (lbs/yr)	Remaining Permit Cycle 3 Reduction Requirements (lbs/yr)	Planned Load Reductions, Permit Cycle 3 (lbs/yr)					Reduction Planned in Permit Cycle 3 (lbs/yr)	Cumulative Reduction Achieved (%)
				Impervious - Turf Land Conversion	Turf - Mixed Open Land Conversion	Catch Basin Cleaning	Street Sweeping	Redevelopment BMP		
TN	258.3	327.9	0.0	67.7	86.0	52.6	0.0	4.7	211	209%
TP	61.9	37.3	24.6	0.0	15.7	9.5	1.5	0.6	27.3	104%
TSS	21477.2	10830.6	10646.6	5502.3	0.0	0.0	932.0	99.3	6533.6	81%

Table 15. LaRC Permit Progress Planned through Cycle 3

Real and Projected Costs

The following table depicts costs (rounded) for TMDL compliance-related projects that have been implemented since July 1, 2009:

Time Period	Project	Cost (\$K)	Notes
July 1, 2009 – June 30, 2010	Demolition – Land Use Conversion of Impervious to Grass (total of 28 facilities)	1,336	This cost includes all demolition costs, contract fees, and site restoration work.
July 1, 2009 – June 30, 2010	Street Sweeping Program	5	Annual cost for street sweeping via contract.

Time Period	Project	Cost (\$K)	Notes
July 1, 2010 – June 30, 2011	Demolition – Land Use Conversion of Impervious to Grass (total of 2 facilities)	20	This cost includes all demolition costs, contract fees, and site restoration work.
July 1, 2010 – June 30, 2011	Street Sweeping Program	5	Annual cost for street sweeping via contract.
July 1, 2011 – June 30, 2012	Demolition – Land Use Conversion of Impervious to Grass (total of 2 facilities)	46	This cost includes all demolition costs, contract fees, and site restoration work.
July 1, 2011 – June 30, 2012	Street Sweeping Program	5	Annual cost for street sweeping via contract.
July 1, 2012 – June 30, 2013	Demolition – Land Use Conversion of Impervious to Grass (total of 10 facilities)	231	This cost includes all demolition costs, contract fees, and site restoration work.
July 1, 2012 – June 30, 2013	Street Sweeping Program	5	Annual cost for street sweeping via contract.
July 1, 2013 – June 30, 2014	Demolition – Land Use Conversion of Impervious to Grass (total of 2 facilities)	350	This cost includes all demolition costs, contract fees, and site restoration work.
July 1, 2013 – June 30, 2014	Street Sweeping Program	5	Annual cost for street sweeping via contract.
July 1, 2013 – June 30, 2014	Forest Buffer	0.45	Labor was in-house Environmental staff. Only the costs of the trees.
July 1, 2014 – June 30, 2015	Demolition – Land Use Conversion of Impervious to Grass (total of 1 facility)	400	This cost includes all demolition costs, contract fees, and site restoration work.
July 1, 2014 – June 30, 2015	Street Sweeping Program	5	Annual cost for street sweeping via contract.
July 1, 2014 – June 30, 2015	Tree Boxes x4	180	This included design and installation of 4 units.

Time Period	Project	Cost (\$K)	Notes
July 1, 2015 – June 30, 2016	Demolition – Land Use Conversion of Impervious to Grass (total of 3 facilities)	1,005	This cost includes all demolition costs, contract fees, and site restoration work.
July 1, 2015 – June 30, 2016	Street Sweeping Program	5	Annual cost for street sweeping via contract.
July 1, 2015 – June 30, 2016	Land Use Conversion of Pervious to Forest	5.5	1-acre reforestation (hardwood)
July 1, 2016 – June 30, 2017	Demolition – Land Use Conversion of Impervious to Grass (total of 2 facilities)	580	This cost includes all demolition costs, contract fees, and site restoration work.
July 1, 2016 – June 30, 2017	Street Sweeping Program	5	Annual cost for street sweeping via contract.
July 1, 2016 – June 30, 2017	Land Use Conversion of Pervious to Forest	0.89	1-acre reforestation (pines and hardwood)
July 1, 2017 – June 30, 2018	Street Sweeping Program	5	Annual cost for street sweeping via contract.
July 1, 2017 – June 30, 2018	Land Use Conversion of Pervious to Forest	2.4	1-acre reforestation (pines and hardwood)
July 1, 2018 – June 30, 2019	Demolition – Land Use Conversion of Impervious to Grass (total of 1 facility)	637	This cost includes all demolition costs, contract fees, and site restoration work.
July 1, 2018 – June 30, 2019	Street Sweeping Program	5	Annual cost for street sweeping via contract.
July 1, 2019 – June 30, 2020	Street Sweeping Program	7	Annual cost for street sweeping via contract.
July 1, 2020 – June 30, 2021	Street Sweeping Program	7	Annual cost for street sweeping via contract.
July 1, 2021 – June 30, 2022	Land Use Conversion of Pervious to Forest	8	1.25-acre reforestation (hardwood)
July 1, 2021 – June 30, 2022	Street Sweeping Program	7	Annual cost for street sweeping via contract.

Time Period	Project	Cost (\$K)	Notes
July 1, 2022 – June 30, 2023	Demolition – Land Use Conversion of Impervious to Grass	2,480	This cost includes all demolition costs, contract fees, and site restoration work.
July 1, 2022 – June 30, 2023	Street Sweeping Program	7	Annual cost for street sweeping via contract.
Total cost paid		7,360	

The following table depicts estimated costs (rounded) for projects planned from November 1, 2023 to the close of the MS4 permit cycle 3 (October 31, 2028):

Time Period	Project	Cost (\$K)	Notes
2023-2028	Street Sweeping Program	35	Annual cost for street sweeping via contract for five years.
2023-2028	Facility Demolitions (Land Use Change)	16,440	Eight (8) structures
2023-2028	Land Use Conversion of Turf to Mixed Open	0	No added cost

Public Participation

Prior to the submittal of the action plan required in Part II A 11 of 9VAC25-890-40 (General Permit), LaRC provided an opportunity for public comment on the LaRC's Stormwater Program and Chesapeake Bay TMDL Action Plan. The opportunity for public comment was provided no less than 15 days prior to the submittal of the plan to the DEQ and was completed via the communication website for LaRC employees and the public environmental website. This announcement page is viewable and accessible to all LaRC employees.

NASA LaRC did not receive any comment on the plan.

Signed Certification Statement

“I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.”

Kristen Poultney, Head, Environmental Management Office