1991 - Town of Christiansburg College Street Drainage Project

Application Details

Funding Opportunity:	1447-Virginia Community Flood Preparedness Fund - Project Grants - CY23 Round 4
Funding Opportunity Due Date:	Nov 12, 2023 11:59 PM
Program Area:	Virginia Community Flood Preparedness Fund
Status:	Under Review
Stage:	Final Application
Initial Submit Date:	Nov 12, 2023 6:24 PM
Initially Submitted By:	Virginia Snead
Last Submit Date:	
Last Submitted By:	

Contact Information

Primary Contact Information

Active User*:	Yes
Type:	External User
Name*:	Ms. (Salutation) Virginia (First Name) Middle Name Snead (Last Name)
Title:	Consultant to Town of Christiansburg
Email*:	gsnead@amtengineering.com
Address*:	1166 Jamestown Road Suite D Williamsburg (City) Virginia (State/Province) 23185 (Postal Code/Zip)
Phone*:	410-299-4433 (Phone) Ext. (###-###-####)
Fax:	###-###-####
Comments:	

Organization Information

Status*:	Approved
Name*:	Town of Christiansburg
Organization Type*:	City Government
Tax ID*:	510101
Unique Entity Identifier (UEI)*:	510101

Organization Website: https://www.christiansburg.org/

Address*: 100 Main Street

Christiansburg (City) Virginia (State/Province) 24073- (Postal Code/Zip)

Phone*: 540-382-6128 1119
###-###-#### Ext.

Fax: ###-###-####

Benefactor:

Vendor ID:

Comments:

VCFPF Applicant Information

Project Description

Name of Local Government*: Town of Christiansburg

Your locality's CID number can be found at the following link: Community Status Book Report

NFIP/DCR Community Identification Number (CID)*: 51010

If a state or federally recognized Indian tribe,

Name of Tribe:

Authorized Individual*: Randy (First Name) Wingfield (Last Name)

Mailing Address*: 100 Main Street (Address Line 1)

Address Line 2

Christiansburg (City) Virginia (State) 24073 (Zip Code)

Telephone Number*: 540-382-6128

Cell Phone Number*: 540-382-6128

Email*: rwingfield@christiansburg.org

Is the contact person different than the authorized individual?

Contact Person*: Yes

Contact: Mike (First Name) Kelley (Last Name)

100 Main Street (Address Line 1)

Address Line 2

Christiansburg (City) Virginia (State) 24073 (Zip Code)

Telephone Number: 540-382-6128

Cell Phone Number: 540-382-6128

Email Address: mkelley@christiansburg.org

Enter a description of the project for which you are applying to this funding opportunity

Project Description*:

College Street Drainage Project was developed in response to flooding on College Street in the Town of Christiansburg. A drainage study was conducted to evaluate potential solutions and the best alternative was the College Street Drainage Project Phase I and Phase II.

Low-income geographic area means any locality, or community within a locality, that has a median household income that is not greater than 80 percent of the local median household income, or any area in the Commonwealth designated as a qualified opportunity zone by the U.S. Secretary of the Treasury via his delegation of authority to the Internal Revenue Service. A project of any size within a low-income geographic area will be considered.

Is the proposal in this application intended to benefit a low-income geographic area as defined above?

Benefit a low-income geographic area*: Yes

Information regarding your census block(s) can be found at census.gov

Census Block(s) Where Project will Occur*: see attached

Is Project Located in an NFIP Participating Community?*: Yes

Is Project Located in a Special Flood Hazard Area?*: No

Flood Zone(s) (if applicable):

Flood Insurance Rate Map Number(s) (if applicable):

Eligibility CFPF - Round 4 - Projects

Eligibility

Is the applicant a local government (including counties, cities, towns, municipal corporations, authorities, districts, commissions, or political subdivisions created by the General Assembly or pursuant to the Constitution or laws of the Commonwealth, or any combination of these)?

Local Government*: Yes

Yes - Eligible for consideration
No - Not eligible for consideration

Does the local government have an approved resilience plan and has provided a copy or link to the plan with this application?

Resilience Plan*: Yes

Yes - Eligible for consideration under all categories
No - Eligible for consideration for studies, capacity building, and planning only

If the applicant is not a town, city, or county, are letters of support from all affected local governments included in this application?

Letters of Support*: N/A

Yes - Eligible for consideration
No - Not eligible for consideration
N/A - Not applicable

Has this or any portion of this project been included in any application or program previously funded by the Department?

Previously Funded*: No

Yes - Not eligible for consideration
No - Eligible for consideration

Has the applicant provided evidence of an ability to provide the required matching funds?

Evidence of Match Funds*: Yes

Yes - Eligible for consideration
No - Not eligible for consideration
N/A - Match not required

Scoring Criteria for Flood Prevention and Protection Projects - Round 4

Scoring

Category Scoring:
Hold CTRL to select multiple options

Project Category*: All hybrid approaches whose end result is a nature-based solution,Floodplain restoration

Is the project area socially vulnerable? (based on ADAPT Virginia?s Social Vulnerability Index Score)

Social Vulnerability Scoring:

Very High Social Vulnerability (More than 1.5)
High Social Vulnerability (1.0 to 1.5)
Moderate Social Vulnerability (0.0 to 1.0)
Low Social Vulnerability (-1.0 to 0.0)
Very Low Social Vulnerability (Less than -1.0)

Socially Vulnerable*: High Social Vulnerability (1.0 to 1.5)

Is the proposed project part of an effort to join or remedy the community?s probation or suspension from the NFIP?

NFIP*: Yes

Is the proposed project in a low-income geographic area as defined below?

"Low-income geographic area" means any locality, or community within a locality, that has a median household income that is not greater than 80 percent of the local median household income, or any area in the Commonwealth designated as a qualified opportunity zone by the U.S. Secretary of the Treasury via his delegation of authority to the Internal Revenue Service. A project of any size within a low-income geographic area will be considered.

Low-Income Geographic Area*: Yes

Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?

Reduction of Nutrient and Sediment Pollution*: Yes

Does this project provide ?community scale? benefits?

Community Scale Benefits*: 50-100% of census block

Expected Lifespan of Project

Expected Lifespan of Project*: Over 20 Years

Comments:

See attached documentation in File CID50101
This project includes acquisition of developed property, floodplain reconnection, and a hybrid approach that includes green infrastructure.

Scope of Work - Projects - Round 4

Scope of Work

Upload your Scope of Work

Please refer to Part IV, Section B. of the grant manual for guidance on how to create your scope of work

Scope of Work*: Christiansburg Grant Project Narrative - CFPF Nov 8 23.docx

Comments:

The College Street Drainage Phase I and Phase II project will employ several green infrastructure aspects as well as some grey infrastructure to reconnect the floodplain and to alleviate flooding in the area.

Budget Narrative

Budget Narrative Attachment*: Budget Narrative CS Phase I and II.docx

Comments:

The College Street Drainage Project Phase I and Phase II engineering and construction cost estimate is $4,081,906. The Phase I estimate is provided below and is at 90% design. The Phase II estimate is also provided below and is at 60% design at the

Scope of Work Supporting Information - Projects

Supporting Information - Projects

Provide population data for the local government in which the project is taking place

Population*: 21805.00

Provide information on the flood risk of the project area, including whether the project is in a mapped floodplain, what flood zone it is in, and when it was last mapped. If the property or area around it has been flooded before, share information on the dates of past flood events and the amount of damage sustained

Historic Flooding data and Hydrologic Studies*: CollegeSt Drainage Alternative Analysis.pdf

Include studies, data, reports that demonstrate the proposed project minimizes flood vulnerabilities and does not create flooding or increased flooding (adverse impact) to other properties

No Adverse Impact*: CID510101_TownOfChristiansburg_CFPF.pdf

Include supporting documents demonstrating the local government's ability to provide its share of the project costs. This must include an estimate of the total project cost, a description of the source of the funds being used, evidence of the local government's ability to pay for the project in full or quarterly prior to reimbursement, and a signed pledge agreement from each contributing organization

Ability to Provide Share of Cost*: Grant Request Letter.pdf

A benefit-cost analysis must be submitted with the project application

Benefit-Cost Analysis*: FEMA BCA College Street Phase I and Phase II.pdf

Provide a list of repetitive loss and/or severe repetitive loss properties. Do not provide the addresses for the properties, but include an exact number of repetitive loss and/or severe repetitive loss structures within the project area

Repetitive Loss and/or Severe Repetitive Loss Properties*: CID510101_TownOfChristiansburg_CFPF.pdf

Describe the residential and commercial structures impacted by this project, including how they contribute to the community such as historic, economic, or social value. Provide an exact number of residential structures and commercial structures in the project area

Residential and/or Commercial Structures*:

The attached College Street Drainage Alternatives Analyses provides specifics on the project including the number of structures and properties impacted directly by the project to alleviate flood risk.

If there are critical facilities/infrastructure within the project area, describe each facility

Critical Facilities/Infrastructure*:

None

Explain the local government's financial and staff resources. How many relevant staff members does the local government have? To what relevant software does the local government have access? What are the local government's capabilities?

Financial and Staff Resources*:

The project will be overseen by the Town Engineer. The design and construction will be contracted out to consultants and construction contractors. The ongoing maintenance will be provided by the Town's Department of Public Works.

Identify and describe the goals and objectives of the project. Include a description of the expected results of the completed project and explain the expected benefits of the project. This may include financial benefits, increased awareness, decreased risk, etc.

Goals and Objectives*:

The primary goal of the project is to alleviate flooding and to mitigate flood risk in the project area and downstream. Additional benefits include increased awareness and financial benefits to the property owners in and around the project area.

Outline a plan of action laying out the scope and detail of how the proposed work will be accomplished with a timeline identifying expected completion dates. Determine milestones for the project that will be used to track progress. Explain what deliverables can be expected at each milestone, and what the final project deliverables will be. Identify other project partners

Approach, Milestones, and Deliverables*: CID510101_TownOfChristiansburg_CFPF.pdf

Where applicable, briefly describe the relationship between this project and other past, current, or future resilience projects. If the applicant has received or applied for any other grants or loans, please identify those projects, and, if applicable, describe any problems that arose with meeting the obligations of the grant and how the obligations of this project will be met

Relationship to Other Projects*:

This project was initially evaluated in the drainage study for conducted for the area after a 2020 flood event. The Town has since developed a Flood Resilience Plan that incorporated CFPF goals and objectives to rank potential projects throughout the Town. This project was prioritized in that plan.

For ongoing projects or projects that will require future maintenance, such as infrastructure, flood warning and response systems, signs, websites, or flood risk applications, a maintenance, management, and monitoring plan for the projects must be provided

Maintenance Plan*: Maintenance and Management.docx

Describe how the project meets each of the applicable scoring criteria contained in Appendix B. Documentation can be incorporated into the Scope of Work Narrative

Criteria*:

Please see attached pdf application and Flood Resilience Plan in Appendix D.

Budget

Budget Summary

Grant Matching Requirement*: LOW INCOME - Projects that will result in nature-based solutions - Fund 95%/Match 5%

I certify that my project is in a low-income geographic area: Yes

Total Project Amount*: $4,097,246.00

REQUIRED Match Percentage Amount: $204,862.30

BUDGET TOTALS

Before submitting your application be sure that you meet the match requirements for your project type.

Match Percentage: 5.05%
Verify that your match percentage matches your required match percentage amount above.

Total Requested Fund Amount: $3,890,381.00

Total Match Amount: $206,865.00

TOTAL: $4,097,246.00

Personnel

Description	Requested Fund Amount	Match Amount	Match Source
No Data for Table			

Fringe Benefits

Description	Requested Fund Amount	Match Amount	Match Source
No Data for Table			

Travel

Description	Requested Fund Amount	Match Amount	Match Source
No Data for Table			

Equipment

Description	Requested Fund Amount	Match Amount	Match Source
No Data for Table			

Supplies

Description	Requested Fund Amount	Match Amount	Match Source
No Data for Table			

Construction

Description	Requested Fund Amount	Match Amount	Match Source
No Data for Table			

Contracts

Description	Requested Fund Amount	Match Amount	Match Source
Engineering and Construction	$3,877,811.00	$204,095.00	Town
	$3,877,811.00	**$204,095.00**	

Maintenance Costs

Description	Requested Fund Amount	Match Amount	Match Source
No Data for Table			

Pre-Award and Startup Costs

Description	Requested Fund Amount	Match Amount	Match Source
No Data for Table			

Other Direct Costs

Description	Requested Fund Amount	Match Amount	Match Source
Project Execution Support	$12,570.00	$2,770.00	Town
	$12,570.00	**$2,770.00**	

Long and Short Term Loan Budget - Projects - VCFPF

Budget Summary

Are you applying for a short term, long term, or no loan as part of your application?

If you are not applying for a loan, select "not applying for loan" and leave all other fields on this screen blank

Long or Short Term*:	Not Applying for Loan
Total Project Amount:	$0.00
Total Requested Fund Amount:	$0.00
TOTAL:	$0.00

Salaries

Description	Requested Fund Amount
No Data for Table	

Fringe Benefits

Description	Requested Fund Amount
No Data for Table	

Travel

Description	Requested Fund Amount
No Data for Table	

Equipment

Description	Requested Fund Amount
No Data for Table	

Supplies

Description	Requested Fund Amount
No Data for Table	

Construction

Description	Requested Fund Amount
No Data for Table	

Contracts

Description	Requested Fund Amount
No Data for Table	

Other Direct Costs

Description	Requested Fund Amount
No Data for Table	

Supporting Documentation

Supporting Documentation

Named Attachment	Required	Description	File Name	Type	Size	Upload Date
Detailed map of the project area(s) (Projects/Studies)						
FIRMette of the project area(s) (Projects/Studies)						
Historic flood damage data and/or images (Projects/Studies)						
A link to or a copy of the current floodplain ordinance						
Maintenance and management plan for project						
A link to or a copy of the current hazard mitigation plan						
A link to or a copy of the current comprehensive plan						
Social vulnerability index score(s) for the project area						
Authorization to request funding from the Fund from governing body or chief executive of the local government						
Signed pledge agreement from each contributing organization						
Maintenance Plan						
Benefit-cost analysis must be submitted with project applications over $2,000,000. in lieu of using the FEMA benefit-cost analysis tool, applicants may submit a narrative to describe in detail the cost benefits and value. The narrative must explicitly indicate the risk reduction benefits of a flood mitigation project and compares those benefits to its cost-effectiveness.						
Benefit Cost Analysis						
Other Relevant Attachments						

Letters of Support

Description	File Name	Type	Size	Upload Date
No files attached.				

Resilience Plan

Resilience Plan

Description	File Name	Type	Size	Upload Date
Agenda Cover Town Council Meeting	Cover - Town Flood Resilience Plan.pdf	pdf	25 KB	11/11/2023 11:37 PM
Final Approved Christiansburg Flood Resilience Plan	Final Christiansburg Resilience Plan_10-10-23.pdf	pdf	1 MB	11/11/2023 11:36 PM
Town Council Agenda 10 2023	10-24-23 Agenda.pdf	pdf	105 KB	11/11/2023 11:37 PM

TOWN OF CHRISTIANSBURG

Flood Resilience Plan

October 10, 2023

Town of Christiansburg

100 E Main Street
Christiansburg, VA 24073
540.382.6128

A. Morton Thomas and Associates, Inc.

1166 Jamestown Road, Suite D
Williamsburg, VA 23185
757.345.3851
amtengineering.com

Table of Contents

Definitions

General Definitions

Gray Infrastructure – "Gray infrastructure is traditional stormwater infrastructure in the built environment such as gutters, drains, pipes, and retention basin" (EPA, 2023).

Green Infrastructure – "A strategically planned and managed network of natural lands, working landscapes, and other open spaces that conserves ecosystem values and functions and provides associated benefits to human populations" (Benedict, Allen, and McMahon, 2006). "Green infrastructure planning involves the coordination of "conservation values and actions in concert with land development and growth management" (Benedict, Allen, and McMahon, 2004). Examples include raingardens, rainwater harvesting systems, permeable pavement, and constructed wetlands.

Heat Island Effect – "Urbanized areas that experience higher temperatures than outlying areas. Structures such as buildings, roads, and other infrastructure absorb and re-emit the sun's heat more than natural landscapes such as forests and water bodies. Urban areas, where these structures are highly concentrated and greenery is limited, become "islands" of higher temperatures relative to outlying areas" (EPA, 2023-c).

Nature Based Approach/Solution – "An approach that reduces the impacts of flood and storm events through environmental processes and natural systems. A nature-based solution may provide additional benefits beyond flood control, including recreational opportunities and improved water quality. This includes a project that reduces these impacts by protecting, restoring, or emulating natural features (DCR.gov, n.d.).

Rainfall-derived infiltration and inflow – "is the increased portion of water flow in a sanitary sewer system that occurs during and after a rainfall as a source of operation problems in sanitary sewer systems. RDII is the main cause of sanitary sewer overflows" (EPA, 2023-b).

Resilience / Resiliency – Resilience is the ability of citizens and the institutions that shape our communities to identify risks, positively adapt, and build the capacity to respond to environmental stressors that impact our built infrastructure. Successful implementation of resilience efforts allows communities to rapidly regain functionality and vitality in the face of chronic stressors or severe disturbances.

Town / the Town – The Town of Christiansburg, Virginia

FEMA Definitions

The following definitions are derived from FEMA.gov if residential properties are added to the project list in the future:

Property Damage – Damage to personal property resulting from flooding. "Damage caused by falling water and wind is not considered flood damage" (FEMA.org, 2010).

Repetitive Loss Property – "Any insurable building for which two or more claims of more than $1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. A RL property may or may not be currently insured by the NFIP. Currently there are over 122,000 RL properties nationwide," (FEMA.gov, 2005).

Roadway Flooding – Flooding of "The portion of roads designed to carry traffic. Roads are paved or unpaved. Other public facilities may include bike paths, pedestrian ways, sidewalks and maintained trails" (FEMA.org, 2022).

Severe Repetitive Loss Property – "A single family property (consisting of 1 to 4 residences) that is covered under flood insurance by the NFIP and has incurred flood-related damage for which 4 or more separate claims payments have been paid under flood insurance coverage, with the amount of each claim payment exceeding $5,000 and with cumulative amount of such claims payments exceeding $20,000; or for which at least 2 separate claims payments have been made with the cumulative amount of such claims exceeding the reported value of the property"(FEMA.gov, 2005).

Matrix Definitions

The following definitions are derived from DCR's 2021 Criteria for ranking community projects for flood funding:

Acquisition of Property – "Acquisition of property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures" (DCR.gov, n.d.).

Community Scale Benefit/ Community Scale Project – "A project that provides demonstrable flood reduction benefits at the US census block level or greater" (DCR.gov, n.d.).

Impact NFIP Participation – (NFIP = Nation Flood Insurance Program) - This criterion answers the question, "Is this proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?" (DCR.gov, n.d.).

Low-income Geographic Area – "Any locality, or community within a locality, that has a median household income that is not greater than 80 percent of the local median household income, or any area in the Commonwealth designated as a qualified opportunity zone by the U.S. Secretary of the Treasury via his delegation of authority to the Internal Revenue Service. A project of any size within a low-income geographic area will be considered" (DCR.gov, n.d.).

Project Area Socially Vulnerable – (Based on ADAPT VA's Social Vulnerability Index Score.) (DCR.gov, n.d.). Alternatively, socially vulnerable can be defined as "the susceptibility of social groups to the adverse impacts of natural hazards, including disproportionate death, injury, loss, or disruption of livelihood" (FEMA, n.d).

TMDL Benefit – (TMDL = Total Maximum Daily Load) Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan? (DCR.gov, n.d.).

Acronyms

CFPF	Community Flood Preparedness Fund
CIP	Capital Improvement Plan
CMP	Corrugated Metal Pipe
DCR	Virginia Department of Conservation and Recreation
DEQ	Virginia Department of Environmental Quality
ESC	Erosion and Sediment Control
EPA	United States Environmental Protection Agency
GI	Green Infrastructure
GIS	Geographic Information System
MS4	Municipal Separate Storm Sewer System
n.d.	"No Date" (an abbreviation used for citations when a source does not contain a publication date).
RCP	Reinforced Concrete Pipe
RDII	Rainfall-derived infiltration and inflow
SWM	Stormwater Management
TMDL	Total Maximum Daily Load
VDOT	Virginia Department of Transportation
WLA	Waste Load Allocation

Executive Summary

This Flood Resilience Plan for the Town of Christiansburg (Plan) provides an overview of the flood resilience planning efforts undertaken by the Town of Christiansburg, Virginia (Town). The Plan examines historical flooding in the Town and reviews current and proposed strategies for flood prevention and resilience. Flooding in the Town poses significant threats to public safety, infrastructure, and local economy. An increase of storm events with greater rainfall intensity and duration compounds these impacts. This Plan aims to reduce vulnerabilities and promote flood resilience in the Town through policy and sound engineering practices and maintenance.

Recognition of the need to implement flood resilience in communities across the Commonwealth has increased. The increasing frequency, intensity and duration of rainfall has proven to hinder the functionality of current infrastructure and flood prevention measures within the Town. Prior to 2014, stormwater runoff regulations were limited or nonexistent. Limited past stormwater regulations, geological conditions, and more frequent rain events are all concerns for flood resilience and prevention.

Assessment of current defenses within the Town found opportunities for improvement of stormwater quantity and quality. Rehabilitation and maintenance to gray infrastructure within Town watersheds can alleviate or prevent flooding. It is anticipated that the Town's Comprehensive Plan can recommend policies and practices for promoting flood resilience will be updated in the 2023-2024 edition. Some of these policies will include increased use of green techniques and infrastructure; operation and maintenance of SWM and sewer infrastructure; and construction of new stormwater management infrastructure that helps to reduce run-off and pollution. Increased use of green techniques and green infrastructure will promote stormwater quantity and quality. The Plan also explores future projects to promote or improve the Town's flood resilience.

Current and prospective projects were reviewed, scored, and placed in a ranking matrix. Gray infrastructure project recommendations will help mitigate or prevent flooding events, create more connectedness to a greater stormwater system, and ensure that engineered solutions are maintained for functionality. In addition, green infrastructure should be utilized as often as possible to enhance gray infrastructure capabilities. Incorporating other green infrastructure techniques will assist in flood prevention and resilience.

The Town, like many other communities will continue to experience the impacts of severe weather and frequent rainfall events. This Plan provides opportunities for improvement to current defenses and assesses the suitability of new projects and policies for the Town.

Chapter 1: Introduction

Flooding caused by rainfall events combined with inadequate stormwater infrastructure can cause damage to life and property. The Town of Christiansburg (Town) is undertaking this flood resilience planning effort to gain a better understanding of flooding and related infrastructure impacts in its watersheds to better protect its citizens and their property from flooding. The goal of this plan is to promote flood resilience. Resilience is the ability of citizens and the institutions that shape our communities to identify risks, positively adapt, and build the capacity to respond to environmental stressors that impact our built infrastructure. Successful implementation of flood resilience efforts allows communities to rapidly regain functionality and vitality in the face of chronic stressors or severe disturbances such as severe or frequent rainfall events.

A flood resilience plan provides an assessment of current or potential future projects and policies that promote effective solutions and future prevention measures, tailored to geographical region, climate, infrastructure, and available resources. Well-developed flood resilience plans not only provide current and future flood reduction and prevention, but with the implementation of these strategies, can reduce the degradation of infrastructure, preserve habitat for species that live within the floodplain, and in some cases, increase the aesthetic beauty of the Town through green infrastructure and streetscape design.

Christiansburg, like many localities in the Commonwealth, is looking to flood resilience planning to aid in measures to not only mitigate current flooding and stormwater issues, but to alleviate potential future flood events due to increased rainfall frequencies and durations that are occurring in Virginia (ASCE, 2021).

Plan Development Process

This Flood Resilience Plan for the Town of Christiansburg (Plan) will first discuss regional and state efforts made towards flood resilience. This Plan will then discuss the history of the Town in relation to flooding and rainfall events, and previous resilience coverage measures set in place for reduction or prevention.

Following this chapter, the Plan will discuss the measures that the Town is currently taking to address their stormwater and flooding issues. Current flood resilience measures have been evaluated through the analysis of current Town plans, studies, and policies.

For the final chapter of this Plan, suggested green and gray infrastructure projects from Town documents will be extracted and ranked in accordance with overall flood resilience effectiveness, determined by a score card/matrix system. Recommendations of the most effective projects will be accompanied with implementation details, and other helpful resources.

Regional and State Efforts

Recognition of the need to implement flood resilience in communities has been increasing in recent years in the United States as there has been an increase in storm duration and frequency. The Commonwealth of Virginia has undertaken some specific and intentional initiatives to better prepare the state and its communities for increased rainfall frequency and other various factors of climate change. One such initiative is the Department of Conservation and Recreation (DCR) Community Flood Preparedness Fund (CFPF) that funds studies, planning efforts (including this one) and projects that are implemented to mitigate flooding and to enable more resilient communities.

Another state initiative is the Coastal Resilience Master Plan developed by the Commonwealth in 2022. This plan was developed based on a Master Planning Framework which was produced in December 2021. While this effort focused on coastal areas, both this plan and the DCR CFPF recognized the threats of flooding at a statewide level. The CFPF funds are available and utilized throughout the Commonwealth and are partially funding the development of the Town's Plan.

Most recently, the Virginia Department of Transportation (VDOT) released the VDOT Resilience Plan at the end of 2022. In addition to the VDOT Resilience Plan and the Coastal Resilience Plan development efforts, the Commonwealth also partially funded an Environmental Protection Agency (EPA) initiative to better assess storm frequency and duration across the state. This study provides specific numeric comparisons to the currently used data set (ATLAS 14) at the County level.

Christiansburg's Flood History

One of the major events that kick-started the discussion for water management planning initiatives within the Town in recent years was the flooding event that occurred in September of 2015. Phlegar and Chrisman Streets, and Reading Road were especially affected, as they are located along the Town Branch Watershed. As a result, approximately $1.5 million was budgeted towards developing improved drainage in the downtown area (AMT, 2018).

Figure 1: Historic Flooding in the Town

However, the Town Branch Watershed and its confluence with Crab Creek are not the only watersheds that influence the flooding in Christiansburg. Various watersheds in and surrounding the Town are also components that contribute to and affect the Town's flooding issues. Historically, standing water, flooding issues with public drainage systems, and overtopping of streets have been prevalent issues at various times and locations in the Town.

Even earlier, a flood event occurred in Christiansburg in May of 2009; this event was one of the worst historically for the Town's historical district of Cambria. A local tributary of Crab Creek flooded the area after consistent rain events over a series of weeks. Unfortunately, this event occurred before many of the Town's stormwater flood mitigation projects had been implemented. This flood caused damages to the Oak Tree Townhomes area, College Street, and several other surrounding areas. The rainfall intensity was estimated to be a 200-year event.

To better understand these events, the Town has undertaken several studies to assess areas of flood concern in the Town's watersheds. The map on the following page depicts the areas where these efforts have concentrated. Of note, the Town has assessed each watershed within its boundaries in recent years. These studies have led the Town to have a strong understanding of potential flood concerns within the entire community.

History of Stormwater Management in Virginia

In recent years, laws and regulations in Virginia have undergone significant changes aimed at improving the management of stormwater runoff and reducing negative environmental impacts. These updated regulations went into effect in 2014 and impose more stringent criteria for the management of stormwater after construction to better protect properties adjacent to and downstream from development. Development that occurred before 2014 had less stringent or no requirement to manage runoff from created impervious surfaces, resulting in stormwater infrastructure that is inadequate to handle significant rainfall events. These issues with older infrastructure are compounded today through the occurrence of more frequent storms with increased rainfall intensity and duration.

Virginia's 2014 regulations also have more stringent criteria for new development projects compared to older development. The primary reason for this discrepancy lies in the fact that older properties were typically built before these modern environmental concerns became a priority. Therefore, they were not subject to the same level of scrutiny regarding storm drainage systems and potential flooding.

Retrofitting existing properties to meet the new criteria or to add in additional flood mitigation can be a complex and costly process. As a result, the focus has primarily been on implementing more stringent storm drainage requirements for new developments to ensure they adhere to the latest standards and mitigate potential adverse effects on property, water quality and local ecosystems.

Specifically, Christiansburg experiences increased risk to flooding after the construction of the interstate highway system where drainage was primarily designed to remove runoff from the roadway surface as quickly as possible. At the time, there were no regulations to address the additional runoff volume and rate onto adjacent properties and downstream facilities. As such, during heavy rain events, downstream channels and systems are currently at or beyond their capacity.

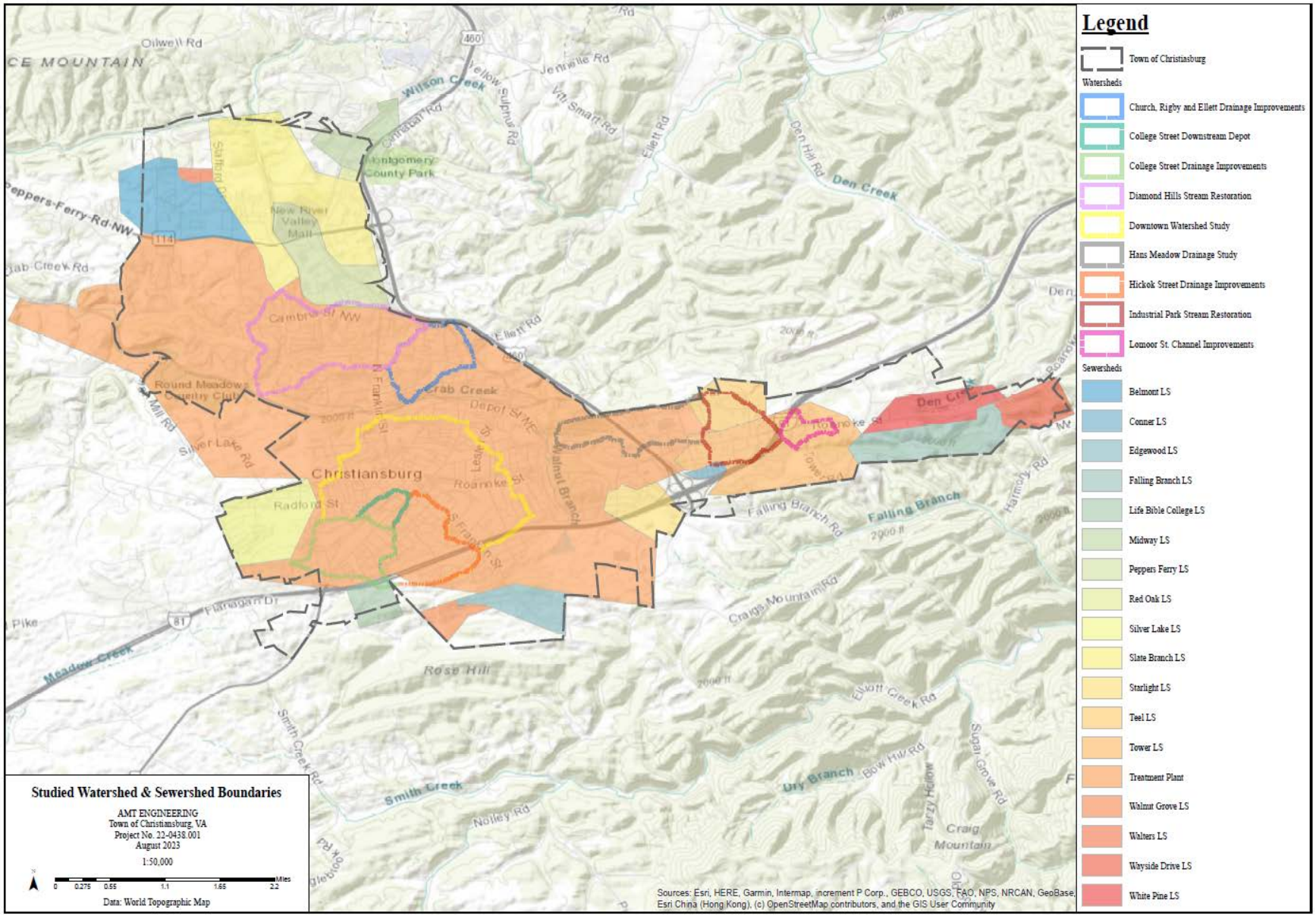


Figure 2: Studied Watershed & Sewershed Boundaries

Chapter 2: Current vs. Future Flood Prevention and Flood Resilience Efforts

Throughout the Commonwealth, including the Town of Christiansburg, Virginians have experienced the increase of storms events with greater rainfall intensity and duration. In addition, the landscape specific to Christiansburg can be characterized by its karst topography, steep slopes and prevalence of shallow soils which limits rain permeability (Town of Christiansburg, 2017). Combining these elements with heavy rains not only increases the concentration of flooding which leads to the clogging and overflowing of Town drainage infrastructure. These elements also lead to a cascading effect of other issues such as water contamination and impaired water bodies), but it can also lead to landslides and the formation or further degradation of sinkholes.

These hazards to infrastructure and human well-being have been pinpointed in areas of Christiansburg through continuous studies and improvement projects issued by the Town. Many of these projects have been associated with the greater downtown area and its associated streets and residential communities. More socially vulnerable populations living within this flood prone area are faced with the aftermath of damaged homes, sometimes on a reoccurring basis. Not all citizens can recuperate from these kinds of losses and may even be forced to move out of their homes and leave their communities.

Figure 3: Downtown Christiansburg Flooding

In recent years, the Town has increased their focus on flood reduction/prevention efforts in the form of projects and policies. Types of projects that help define the Town's flooding reduction/prevention efforts can be categorized as green infrastructure (natural-based solutions such as stream restorations, wetland installations, rainwater harvesting, etc.) and gray infrastructure (solutions such as inlets, outlets, culverts, and drainage solutions). These two types of projects are most effective when implemented in tandem with one another. Christiansburg's policies that mitigate/prevent flooding can often fall under the green

and/or gray infrastructure categories as well. These policies are framed as general goals and strategies that underline the Town's strong stance on policy goals- for both current strategies and future goals.

These current projects and policies can be found within the numerous Town documents and data files reviewed in preparation for this Plan. These documents include comprehensive plans; preliminary engineering reports; as-built monitoring reports; Erosion and Sediment Control (ESC) and Stormwater Management (SWM) plans and assessments; Stormwater Local Assistance Fund applications; drainage improvement studies; watershed studies; and all associated technical specifications, modeling, and Geographic Information System (GIS) data that come with these documents.

Current projects and policies can help to provide data for what flood prevention defenses are in use, and their effectiveness. The Town documents also provide project recommendations for future projects ("prospective projects") and suggests "goals" or policies to be expanded upon. The objective of the following section is to analyze current efforts in the form of current projects and policies, and then to compare these current defenses to future/prospective projects and future goals/policies.

Current Defenses – Studies, Projects, and Policies

Sewershed Studies

The Town's sewer system evaluation studies conducted for Arrowhead, College Street and Phlegar Street Sewersheds, and the Crab Creek Inceptor were aimed at reducing rainfall-derived infiltration and inflow (RDII) through evaluating which sewer systems had high RDII rates, and then providing rehabilitation recommendations (Town of Christiansburg, 2019). This evaluation resulted in the detection of high RDII rates for every sewer system in the study. Recommendations included manhole rehabilitation and replacement; sewer line and lateral rehabilitation; maintenance rehabilitation and on-going monitoring. Alleviating high rates of inflow can reduce the likelihood of a flood event, making these sewershed studies an important part of understanding Christiansburg's current flood resilience defenses.

Watershed Studies

Two major watershed studies conducted by the Town includes the Downtown Watershed Study (2018), and the Diamond Hills Basin Watershed Study (2013). The purpose of these studies was to analyze the current conditions of these watersheds and to provide potential outcomes of different stormwater solutions for the watersheds. The Diamond Hills Basin Watershed Study provided 2-year and 10-year storm event data that confirmed the water quantity and water quality benefits of the Diamond Hills Park Stream Restoration project, and the Diamond Hills Upper Basin Stormwater Management Facility (Balzer and Associates, 2013). The Downtown Watershed Study focused specifically on drainage and flooding concerns issues along the Town Branch Tributary that flows through Christiansburg's Downtown area. Based on review of previous Town drainage improvement studies, surveys, community meetings, and the addition of a new hydrology analysis of the watershed, 10 drainage improvement projects were recommended, prioritized, and scored.

Targeted Drainage Studies

Like the Town's watershed studies, targeted drainage Improvements projects and studies have been ramping up over the past decade to help assess specific "hotspots" where flooding occurs most often. These study areas include College Street, W. Main Street (Hickock Street), Sleepy Hollow Road, and Hans Meadow Drive. These studies have assessed current conditions, followed by recommendations derived

from projected hydrology calculations, and include design/conceptual plans with projected cost estimates. These drainage and watershed studies resulted in a variety of recommended improvements ranging from native vegetation installation, demolition of drainage infrastructure, installation of drainage infrastructure, earthwork and ESC measures, BMP installations and upgrades.

Run-Off /Pollution Studies

Identifying and recommending flooding solutions is instrumental in flood resilience planning, but further assessment of these approved projects may be needed to ensure water quality and flow functionality. Follow up studies involving approved (but not yet built) stream restorations, floodplain/overbank wetlands installations and detention ponds installations, confirm the proposed-BMP's effectiveness of keeping the local watersheds clean, which can also indicate improved stormwater overflow prevention and floodplain management. Three of the Town's drainage basins: Diamond Hills, Towne Branch (Depot Street), and Christiansburg Industrial Park were studied for their effectiveness in runoff and pollution reduction (EEE, 2013). These studies determined that these approved improvements would be effective in reducing Waste Load Allocations for the Crab Creek and New River Basins, which also indicated improved flow functionality.

Projects as a Result of the Towns Studies

As a result of the Town's plans and studies, several of the project recommendations were approved and are at various stages of design and construction. The project recommendations derived from the Hickok Street and College Street Drainage Improvement studies are still being implemented as well as several of the recommended projects from the Downtown Watershed Study. (Town of Christiansburg, n.d.). Construction for Hans Meadow Drainage Project (Phase II) and Diamond Hills Park Stream Restoration was completed in 2019, and Town Branch Stream Restoration was completed in 2018 (Town of Christiansburg, n.d.).

Figure 4: College Street Flooding

Other recently completed drainage improvements and stream restoration projects includes Church, Rigby, and Ellett Storm Drainage Improvements (completed in 2019); Blue Leaf Stream Restoration Project (2017); Brown, Church and Lucas Streets Storm Drain Improvements (2017); and North Franklin Street Drainage Improvements (2017).

Figure 5: Church Street - Drainage Issues

These projects provide a start to achieve long-lasting results that will continue to improve flooding resilience for the Town. However, other identified projects lack funding to move forward, but would further the Town's goal of increasing flood resilience if implemented.

Current Policies

Periodically, the Town of Christiansburg outlines their flooding-related policies in their Comprehensive Plan. The current 2013 version will soon be replaced by a revised edition. For brevity, below is a summary of policy themes within the 2013 Comprehensive Plan that assist in the promotion of flooding resilience, currently being implemented by the Town:

- Increased use of green techniques and infrastructure
- Water quality improvement
- Operation and maintenance of SWM and sewer infrastructure
- Execution of the MS4 plan
- Improvement or replacing of existing SWM and sewer infrastructure
- Construction of new SWM infrastructure that helps to reduce run off and pollution

These policies are designed to fully encompass the various factors that come into play regarding flooding resilience needs.

Future Projects – Studies, Projects, and Policies

Future Studies and Projects

To date, several potential projects identified in the watershed and sewershed plans have not been implemented, for various reasons. This Plan will evaluate and prioritize these potential projects to determine if they can assist the Town in its goal of increasing flood resilience.

Additionally, other projects may be considered that could provide greater flood control capabilities. Proposed mixed-use developments near Uptown Christiansburg (formerly New River Mall), Hickok Street, W. Main Street, Phlegar Street, N. Franklin Street, and College Street as proposed in the Town's Urban Development Areas document (2016) provide several opportunities to implement new and/or improved stormwater or drainage solutions for the Town.

Future Policies

Earlier in this chapter, current policies to promote the Town's flood resilience were summarized. These policies remain general to allow the easy application of flooding resilience action items. This plan will evaluate these current policies for improvement or enhancement, in addition to other policies that have not yet been pursued. For brevity, summaries of Town policies not yet explored or pursued are included in the list below:

- Landscape improvement
- Pollution reduction
- Mitigation of stormwater runoff by increasing tree canopy
- Limiting development on steep slopes (to slow down stormwater flow velocity, and decrease instances of erosion, sedimentation, and landslides)
- Increased awareness of development opportunities and restrictions on varying soil types.
- Protection of floodplains
- Creation, preservation, and maintenance of open space (including parkland)
- Design criteria using more conservative storm intensity, duration, and frequency data (IDF Curves)
- Updated subdivision guidelines encouraging best practices for stormwater collection, conveyance, and infiltration
- Consideration of karst hydrology

Chapter 3: A Plan for Flood Resilience

Methodology of Matrix/Score Card Ranking System

Based on the collection and review of Town literature (i.e., studies, plans, reports, GIS files), flood prevention and mitigation measures currently in place (current projects and policies) were identified. Potential future projects were also identified in this literature review and additional suggestions were added on by the Town Staff. The list of prospective projects and policies were then narrowed down based on optimal effectiveness, determined by the Town, and the consulting engineers assisting with this Resilience Plan.

The list of the Town's resources reviewed for determining current projects, potential projects, and other additional findings, can be found in the Appendix of this plan. Graphical representation of current resilience project coverage is demonstrated on page 9 of Chapter 1. For purposes of this resilience plan, the potential projects evaluated were based on flood and watershed studies and did not focus on sewershed based projects.

These potential projects were then ranked in accordance with a customized resilience matrix with weighted criteria, resulting in a numerical score. The matrix criteria were derived from DCR project ranking criteria that was developed by the state for the Community Flood Preparedness Fund (CFPF). The potential projects with the higher scores demonstrate a greater benefit to the Town's resilience efforts.

Some pre-existing flood prevention and mitigation projects were also evaluated using this prioritization methodology as a way for the Town to conceptualize the matrix process, its criteria, and its weighted scoring system.

Ranking Matrix Clarifications

The following caveats are to be considered when reviewing the Christiansburg Flood Resilience Ranking Matrix:

- It is important to note that the ranking of projects through this matrix scoring does not imply the order in which projects are carried out to completion. The timeline of each project depends on several factors including funding availability and project feasibility.
- Project costs for engineering and construction listed in the matrix have not been re-calculated with consideration to current-day inflation data. The matrix lists the year in which cost data was derived and is subject to change if projects are selected and implemented in the future.
- Project data displaying as "N/A" indicates that the cost to design, or remediate project is undetermined as this time.
- The following projects were not included in the matrix, as each of these involved several sub-projects, rendering the data values in the table as unquantifiable:
    - Public Works ditch work priority list
    - Public Works culvert replacement priority list
    - Other residential properties taking street water
    - Possible urban development areas designed for mixed use developments
- An additional matrix criterion to be considered for the future is the "acquisition of property" category. Acquisition can at times be the most cost-effective solution for reoccurring flooding

issues for residential properties. However, for privacy purposes, properties that specify addresses have been removed from this report.

- FEMA criteria can be added to this matrix for future grant funding consideration regarding residential properties.
    - Categories such as "Severe Repetitive Loss", "Repetitive Loss Property", "Property Damage", "Roadway Flooding", and "Potential Roadway Flooding", accompanied by a maximum point valuation can be added to this matrix, if residential properties are added to the project list in the future.
- Projects listed in the matrix that are currently marked as "*" or "**" (projects located in the floodplain and floodway, respectively) should be separately evaluated for FEMA grant funding.
- Please see the Christiansburg Floodplain/Floodway Map further along in this Chapter in the section titled "Resilience Score Card Results".
- The DCR ranking criteria can be found in Appendix A.
- Additional criteria were added to the final ranking matrix to account for estimated costs and the readiness of the project to proceed. For example, there are projects in the matrix that may score high based on the DCR criteria but do not have engineering and/or construction costs developed or may only be conceptual in design. These projects may need more development to be eligible for consideration for implementation.
- The focused list of recommended projects includes more shovel-ready projects that score highly and will also best address recurring flood issues in the Town based on the drainage studies.

Resilience Score Card Results

Detailed in the table below, are the top-ranked projects accompanied by a brief narrative and their final score. These projects represent shovel-ready projects that have been identified in previous drainage studies as the best options to alleviate recurrent flooding in the Town. An opinion of probable cost was developed for each of the recommended resilience projects based on available data. In each case, soft costs and a 30% contingency were included in the estimates as a conservative approach to budgeting. Details for each estimate can be found in the Appendix.

Potential Project	Project Description	Project Source	Points
Recommended Projects			
Chrisman / Phlegar Street Drainage Improvements: Phase II	Starting at the intersection of Phlegar Street and 3rd Street SW, this project is a series of small box culverts and open channels that convey runoff from the upper watershed to an existing triple 5'x3' box culvert under 1st Street. The channel alignment requires easements across some private properties, and may include stream stabilization measures.	Downtown Watershed Study	**75**

Chrisman / Phlegar Street Drainage Improvements: Phase I	This project collects runoff from existing 30" RCP and 48" RCP pipes under Interstate 81, and conveys the runoff in a closed drainage system along Chrisman Street, then crossing over to Phlegar Street following the alignment of the existing pipes. Recommended pipe sizes increase from 36" initially, to between 48" and 60" in diameter at 3rd Street SW.	Downtown Watershed Study	**73**
College Street Drainage Project - Phase I	Improvements at the nearby school, a reach along the opposite side of College Street, and the Detention Pond with several hundred feet of the outlet pipe downstream which will terminate upstream of the first driveway that crosses the drainage ditch. The installed pipe system below the pond will need to be installed at a flatter grade in Phase I than the final design until Phase II portion may be installed. The drainage will then re-enter the existing drainage ditch behind the residences along College Street.	College Street Drainage Study (scope revised on 06/2023)	**70**
College Street Drainage Project - Phase II	The pipe and structures previously installed below the pond will be re-installed at their originally planned deeper elevations along with the rest of the Phase II construction that extends to Depot St and also captures a large inflow from Main St. This will involve a small amount of redesign for this reach of the pipe installation immediately below the pond.	College Street Drainage Study (scope revised on 06/2023)	**70**
Hickok Street Drainage Improvements	This project conveys runoff in a proposed 10'x4' box culvert under Hickok Street SW to the intersection with Commerce Street, removing a section of drainage conveyance that goes under the existing buildings on West Main Street. Runoff is conveyed either north along Commerce Street to a connection with the existing 72" CMP or west along Hickok Street to College Street, where it connects to the College Street Drainage Improvements (Phase I).	Downtown Watershed Study	**65**

The map on the following page depicts Christiansburg Floodplain/Floodway areas, and a sampling of the top ranked projects per the ranking matrix.

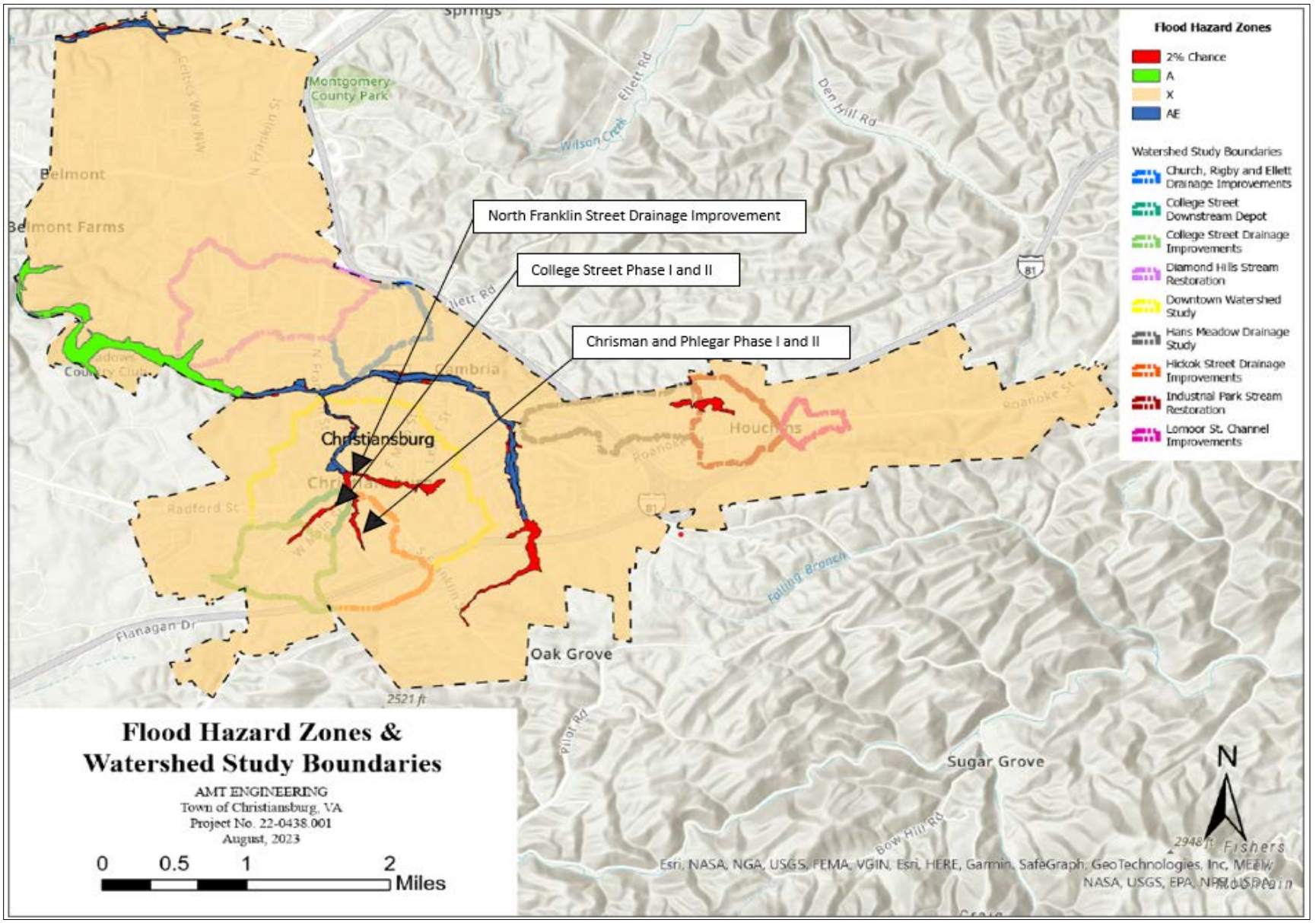


Figure 6: Christiansburg Flood Hazard Zone Map Displaying some Potential Projects and Watershed Study Boundaries

Continuation of Gray Infrastructure Implementation

The resulting gray infrastructure project recommendations from this study will help create more connectedness to a greater stormwater system, preventing or mitigating flooding events. Future new builds and retrofits alike should be designed with specifications that address increased precipitation, intensity and frequency storms, and the potential to mitigate flooding events. Additionally, maintenance protocols should be updated to ensure that these engineered solutions reliably maintain functionality. Lastly, to increase adaptive capacity, gray infrastructure should be designed in tandem with green infrastructure and nature-based solutions.

Continuation of Green Infrastructure Implementation

In addition to the project recommendations in the table above, green infrastructure should be utilized as often as possible to augment gray infrastructures capabilities if time and budgets allow. Green infrastructure is Implementing stream restorations and wetland and riparian buffer installations, and other green infrastructure techniques such as rainwater harvesting systems and pervious pavement will help to extend and reinforce the natural features that assist with flood resilience defense. Making sure our natural environmental is healthy and functional improves human well-being, creating the most immediate benefit to vulnerable communities and providing opportunities for recreation, education, and decreased heat island effect. Included with these implemented green infrastructure solutions should be updated maintenance protocols to ensure that they are functioning as designed.

RESOURCES

A. Morton Thomas and Associates. (AMT). (2018). *Town of Christiansburg Downtown Watershed Study*

American Society of Civil Engineers (ASCE). (2021) Adapting intensity-duration-frequency curves to improve climate resilience. Adapting intensity-duration-frequency curves to improve climate resilience | ASCE

Town of Christiansburg. (2017). *Town of Christiansburg 2013 Comprehensive Plan.* https://christiansburg.app.box.com/s/iqrvxh7e0kbiy6xwgyeyw5q4rvqn7f2a/file/1056208918079

Town of Christiansburg. (2019). *Town of Christiansburg, Virginia Arrowhead Sewer System Evaluation Survey.* https://christiansburg.app.box.com/s/iqrvxh7e0kbiy6xwgyeyw5q4rvqn7f2a/file/1056208918079

Town of Christiansburg. (2016). *Town of Christiansburg Interceptor Model & Preliminary Engineering Report.* https://christiansburg.app.box.com/s/iqrvxh7e0kbiy6xwgyeyw5q4rvqn7f2a/file/1056224097944

Town of Christiansburg. (2014). *Diamond Hills Park As-Built and Year 1 Monitoring.* https://christiansburg.app.box.com/s/iqrvxh7e0kbiy6xwgyeyw5q4rvqn7f2a/file/1056220870760

EEE Consulting (EEE). (2013). Christiansburg Stream Restoration and Stormwater BMP Assessment https://christiansburg.app.box.com/s/iqrvxh7e0kbiy6xwgyeyw5q4rvqn7f2a/file/1056220870760

Balzar and Associates, Inc. (2013). *Diamond Hills Basin Watershed Study.* https://christiansburg.app.box.com/s/iqrvxh7e0kbiy6xwgyeyw5q4rvqn7f2a/file/1056216341472

Town of Christiansburg, Michael Baker International. (2016). *Urban Development Areas.* https://christiansburg.app.box.com/s/iqrvxh7e0kbiy6xwgyeyw5q4rvqn7f2a/file/1056205375704

Town of Christiansburg, (n.d.). *Capital Projects* https://www.christiansburg.org/479/Capital-Project

Water Infrastructure Improvements for the Nation Act (2017)., Public Law 114-322

Benedict, M. A., W. Allen, and E.T. McMahon (2004). Advancing Strategic Conservation in the Commonwealth of Virginia: Using a Green Infrastructure Approach to Conserving and Managing the Commonwealth's Natural Areas, Working Landscapes, Open Space, and Other Critical Resources. Washington, D.C., The Conservation Fund. 2004.

Benedict, M. A. and E.T. McMahon. (2006). Green Infrastructure: Linking Landscapes and Communities. Washington, D.C., Island Press.

Green and Gray Infrastructure Research. (2023). EPA. https://www. epa.gov/water-research/green-and-gray-infrastructure-research#:~:text=Gray%20infrastructure%20is%20traditional%20stormwater,%2C%20pipes%2C%20and%20retention%20basins.

Community Flood Preparedness Fund Grants and Loans. (n.d.). https://www.dcr.virginia.gov/dam-safety-and-floodplains/dsfpm-cfpf

Social Vulnerability | National Risk Index. (n.d.). https://hazards.fema.gov/nri/social-vulnerability

Virginia Department of Conservation & Recreation. (n.d.). 2023 Grant Manual for the Virginia Community Flood Preparedness Fund. https://www.dcr.virginia.gov/dam-safety-and-floodplains/document/Round-4-2023-CFPF-Manual-DRAFT-Final.pdf

Fema.gov. (2022, March). Hurricane and Flood Mitigation Handbook for Public Facilities - Fact Sheet 1.0: Roads. www.fema.gov

Damage to Property? (2020, February). FEMA.gov. https://www.fema.gov/faq/damage-property

National Flood Insurance Program: Frequently Asked Questions - Repetitive Loss. (2005, October).www.fema.gov. https://www.fema.gov/pdf/rebuild/repetitive_loss_faqs.pdf

Sanitary Sewer Overflow Analysis and Planning (SSOAP) Toolbox. EPA. (2023-B). US EPA. https://www.epa.gov/water-research/sanitary-sewer-overflow-analysis-and-planning-ssoap-toolbox

Heat Island Effect. (2023-C). EPA. https://www.epa.gov/heatislands

Appendix

DCR Scoring Criteria

Project Eligible for Consideration		
Scoring Information		
Criterion	**Point Value**	**Points Awarded**
Projects may have components of both a. and b. below; however, only one category may be chosen. The category chosen must be identified as the primary project in the application.		
a. Acquisition of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures (and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition).	30	
☐ Wetland restoration. ☐ Floodplain restoration. ☐ Construction of swales and settling ponds. ☐ Living shorelines and vegetated buffers. ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by ConserveVirginia Floodplain and Flooding Resilience layer or a similar data driven analytic tool. ☐ Dam removal ☐ Stream bank restoration or stabilization. ☐ Restoration of floodplains to natural and beneficial function.	25	
b. any other nature-based approach	20	
Is the project area socially vulnerable? (Based on ADAPT VA's Social Vulnerability Index Score.)		
Very High Social Vulnerability (More than 1.5)	10	
High Social Vulnerability (1.0 to 1.5)	8	
Moderate Social Vulnerability (0.0 to 1.0)	5	
Low Social Vulnerability (-1.0 to 0.0)	0	
Low Social Vulnerability (-1.0 to 0.0)	0	
Is the proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?		
Yes	5	
No	0	
Is the proposed project in a low-income geographic area as defined in the DCR manual?		
Yes	10	

No	0	
Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?		
Yes	5	
No	0	
Does this project provide "community scale" benefits?		
Yes	30	
No	0	
Total Points		

Top Ranking Project Scorecards

Chrisman / Phlegar Street Drainage Improvements: Phase II

Project Eligible for Consideration		
Scoring Information		
Criterion	**Point Value**	**Points Awarded**
Projects may have components of both a. and b. below; however, only one category may be chosen. The category chosen must be identified as the primary project in the application.		
a. Acquisiion of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures (and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition).	30	
☐ Wetland restoration. ☐ Floodplain restoration. ☐ Construction of swales and settling ponds. ☐ Living shorelines and vegetated buffers. ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by ConserveVirginia Floodplain and Flooding Resilience layer or a similar data driven analytic tool. ☐ Dam removal ☐ Stream bank restoration or stabilization. ☐ Restoration of floodplains to natural and beneficial function.	25	**25**
b. any other nature-based approach	20	**5**

Is the project area socially vulnerable? (Based on ADAPT VA's Social Vulnerability Index Score.)		
Very High Social Vulnerability (More than 1.5)	10	
High Social Vulnerability (1.0 to 1.5)	8	
Moderate Social Vulnerability (0.0 to 1.0)	5	
Low Social Vulnerability (-1.0 to 0.0)	0	**0**
Low Social Vulnerability (-1.0 to 0.0)	0	
Is the proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?		
Yes	5	
No	0	**0**
Is the proposed project in a low-income geographic area as defined in the DCR manual?		
Yes	10	**10**
No	0	
Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?		
Yes	5	**5**
No	0	
Does this project provide "community scale" benefits?		
Yes	30	**30**
No	0	
Total Points		**75**

Chrisman / Phlegar Street Drainage Improvements: Phase I

Project Eligible for Consideration		
Scoring Information		
Criterion	**Point Value**	**Points Awarded**
Projects may have components of both a. and b. below; however, only one category may be chosen. The category chosen must be identified as the primary project in the application.		

a. Acquisition of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures (and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition).	30	
☐ Wetland restoration. ☐ Floodplain restoration. ☐ Construction of swales and settling ponds. ☐ Living shorelines and vegetated buffers. ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by ConserveVirginia Floodplain and Flooding Resilience layer or a similar data driven analytic tool. ☐ Dam removal ☐ Stream bank restoration or stabilization. ☐ Restoration of floodplains to natural and beneficial function.	25	**25**
b. any other nature-based approach	20	**5**
Is the project area socially vulnerable? (Based on ADAPT VA's Social Vulnerability Index Score.)		
Very High Social Vulnerability (More than 1.5)	10	
High Social Vulnerability (1.0 to 1.5)	8	
Moderate Social Vulnerability (0.0 to 1.0)	5	
Low Social Vulnerability (-1.0 to 0.0)	0	**0**
Low Social Vulnerability (-1.0 to 0.0)	0	**0**
Is the proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?		
Yes	5	
No	0	**0**
Is the proposed project in a low-income geographic area as defined in the DCR manual?		
Yes	10	**10**
No	0	
Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?		
Yes	5	**3**
No	0	
Does this project provide "community scale" benefits?		
Yes	30	**30**
No	0	

Total Points	73

College Street Drainage Project - Phase I

Project Eligible for Consideration		
Scoring Information		
Criterion	**Point Value**	**Points Awarded**
Projects may have components of both a. and b. below; however, only one category may be chosen. The category chosen must be identified as the primary project in the application.		
a. Acquisition of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures (and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition).	30	
☐ Wetland restoration. ☐ Floodplain restoration. ☐ Construction of swales and settling ponds. ☐ Living shorelines and vegetated buffers. ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by ConserveVirginia Floodplain and Flooding Resilience layer or a similar data driven analytic tool. ☐ Dam removal ☐ Stream bank restoration or stabilization. ☐ Restoration of floodplains to natural and beneficial function.	25	**25**
b. any other nature-based approach	20	**5**
Is the project area socially vulnerable? (Based on ADAPT VA's Social Vulnerability Index Score.)		
Very High Social Vulnerability (More than 1.5)	10	
High Social Vulnerability (1.0 to 1.5)	8	
Moderate Social Vulnerability (0.0 to 1.0)	5	
Low Social Vulnerability (-1.0 to 0.0)	0	**0**
Low Social Vulnerability (-1.0 to 0.0)	0	
Is the proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?		
Yes	5	
No	0	**0**
Is the proposed project in a low-income geographic area as defined in the DCR manual?		
Yes	10	**10**

No	0	
Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?		
Yes	5	
No	0	**0**
Does this project provide "community scale" benefits?		
Yes	30	**30**
No	0	
Total Points		**70**

College Street Drainage Project - Phase II

Project Eligible for Consideration		
Scoring Information		
Criterion	**Point Value**	**Points Awarded**
Projects may have components of both a. and b. below; however, only one category may be chosen. The category chosen must be identified as the primary project in the application.		
a. Acquisition of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures (and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition).	30	
☐ Wetland restoration. ☐ Floodplain restoration. ☐ Construction of swales and settling ponds. ☐ Living shorelines and vegetated buffers. ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by ConserveVirginia Floodplain and Flooding Resilience layer or a similar data driven analytic tool. ☐ Dam removal ☐ Stream bank restoration or stabilization. ☐ Restoration of floodplains to natural and beneficial function.	25	**25**
b. any other nature-based approach	20	**5**
Is the project area socially vulnerable? (Based on ADAPT VA's Social Vulnerability Index Score.)		
Very High Social Vulnerability (More than 1.5)	10	

High Social Vulnerability (1.0 to 1.5)	8	
Moderate Social Vulnerability (0.0 to 1.0)	5	
Low Social Vulnerability (-1.0 to 0.0)	0	**0**
Low Social Vulnerability (-1.0 to 0.0)	0	
Is the proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?		
Yes	5	
No	0	**0**
Is the proposed project in a low-income geographic area as defined in the DCR manual?		
Yes	10	**10**
No	0	
Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?		
Yes	5	
No	0	**0**
Does this project provide "community scale" benefits?		
Yes	30	**30**
No	0	
Total Points		**70**

Hickok Street Drainage Improvements

Project Eligible for Consideration		
Scoring Information		
Criterion	**Point Value**	**Points Awarded**
Projects may have components of both a. and b. below; however, only one category may be chosen. The category chosen must be identified as the primary project in the application.		
a. Acquisition of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures (and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition).	30	

☐ Wetland restoration. ☐ Floodplain restoration. ☐ Construction of swales and settling ponds. ☐ Living shorelines and vegetated buffers. ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by ConserveVirginia Floodplain and Flooding Resilience layer or a similar data driven analytic tool. ☐ Dam removal ☐ Stream bank restoration or stabilization. ☐ Restoration of floodplains to natural and beneficial function.	25	**25**
b. any other nature-based approach	20	
Is the project area socially vulnerable? (Based on ADAPT VA's Social Vulnerability Index Score.)		
Very High Social Vulnerability (More than 1.5)	10	
High Social Vulnerability (1.0 to 1.5)	8	
Moderate Social Vulnerability (0.0 to 1.0)	5	
Low Social Vulnerability (-1.0 to 0.0)	0	**0**
Low Social Vulnerability (-1.0 to 0.0)	0	
Is the proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?		
Yes	5	
No	0	**0**
Is the proposed project in a low-income geographic area as defined in the DCR manual?		
Yes	10	**10**
No	0	
Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?		
Yes	5	
No	0	
Does this project provide "community scale" benefits?		
Yes	30	**30**
No	0	
Total Points		**65**

Project Ranking Matrix - 10/09/2023

Project Ranking Criteria			Acquisition of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures	Nature Based Approach	Project Area Socially Vulnerable	Impact NFIP Participation	Low Income Geographic Area	TMDL Benefit? (e.g., N or P)	Community Scale Benefit		Estimated Engineering Cost	Estimated Construction Cost	Total Cost	Cost Notes (*year of cost estimate, does plan include cost?*)	**Total Points**
Categorical Weight			30	20	10	5	10	5	30						
Potential Project	**Project Description**	**Project Source**													
Recommended Projects															
College Street Drainage Project - Phase I	Improvements at the nearby school, a reach along the opposite side of College Street, and the Detention Pond with several hundred feet of the outlet pipe downstream which will terminate upstream of the first driveway that crosses the drainage ditch. The installed pipe system below the pond will need to be installed at a flatter grade in Phase I than the final design until Phase II portion may be installed. The drainage will then re-enter the existing drainage ditch behind the residences along College Street.	College Street Drainage Study (scope revised on 06/2023)	25	5	0	0	10	0	30		$155,852	$2,188,034	$2,238,034	2023	**70**
College Street Drainage Project - Phase II	The pipe and structures previously installed below the pond will be re-installed at their originally planned deeper elevations along with the rest of the Phase II construction that extends to Depot St and also captures a large inflow from Main St. This will involve a small amount of redesign for this reach of the pipe installation immediately below the pond.	College Street Drainage Study (scope revised on 06/2023)	25	5	0	0	10	0	30		$191,099	$1,457,017	$1,864,981	2023	**70**
Hickok Street Drainage Improvements	This project conveys runoff in a proposed 10'x4' box culvert under Hickok Street SW to the intersection with Commerce Street, removing a section of drainage conveyance that goes under the existing buildings on West Main Street. Runoff is conveyed either north along Commerce Street to a connection with the existing 72" CMP or west along Hickok Street to College Street, where it connects to the College Street Drainage Improvements (Phase I).	Downtown Watershed Study	25	0	0	0	10	0	30		$404,000	$2,271,722	$2,675,722 (stated as $2,700,000 in Watershed study)	2017 and later in watershed study in 2018	**65**
Chrisman / Phlegar Street Drainage Improvements: Phase I	This project collects runoff from existing 30" RCP and 48" RCP pipes under Interstate 81, and conveys the runoff in a closed drainage system along Chrisman Street, then crossing over to Phlegar Street following the alignment of the existing pipes. Recommended pipe sizes increase from 36" initially, to between 48" and 60" in diameter at 3rd Street SW.	Downtown Watershed Study	25	5	0	0	10	3	30		$378,000	$2,413,000	$2,800,000	2018	**73**
Chrisman / Phlegar Street Drainage Improvements: Phase II	Starting at the intersection of Phlegar Street and 3rd Street SW, this project is a series of small box culverts and open channels that convey runoff from the upper watershed to an existing triple 5'x3' box culvert under 1st Street. The channel alignment requires easements across some private properties, and may include stream stabilization measures.	Downtown Watershed Study	25	5	0	0	10	5	30		$187,000	$1,113,000	$1,300,000	2018	**75**
Potential Future Projects															
Gray Infrastructure															
Existing SWM Facility with Independence Boulevard Upgrade - project completed but may need further evaluation	N/A	Diamond Hills Basin Watershed Study	0	0	0	0	10	0	30		N/A	N/A	N/A	N/A	**40**
Radford Street Drainage Improvements	This project is smaller than some others in the downtown area, and addresses clogged inlets and undersized pipes along the north side of Radford Street. By increasing the pipe size from 15" to 24" and adding adequately sized throat lengths on the drainage inlets, runoff can be intercepted and conveyed into the existing 36" RCP at Lee Hy Court, then draining along Radford Street to Depot Street and into the downtown area. New sidewalks may also be considered for this area.	Downtown Watershed Study	25	0	0	0	10	0	30		$158,000	$942,000	$1,100,000	2018	**65**
Alleghany St / Canaan Rd / Epperly Drive: Drainage Improvements	This project helps address surface water and groundwater concerns from the Sunset Cemetery and Alleghany Street in areas along Canaan Road and Epperly Drive, by replacing existing 15" pipes with 24" and 30" pipes. Runoff is then conveyed into the rear yards on the south side of Epperly Drive, behind the First Church of God, with a pipe extension to an existing stormwater management basin (dry detention). During engineering design, the Town may choose to retrofit the existing basin to help proect existing drainage systems downstream and to promote improved water quality in the watershed.	Downtown Watershed Study	25	0	0	0	10	5	30		$105,000	$645,000	$750,000	2018	**70**
Stone Street Culvert Replacement at Town Branch	This project replaces an existing quadruple 48" CMP with a dual 10'x5' box culvert, providing increased capacity to convey the 2-year storm under Stone Street without overtopping onto Depot Street. 10-year and 100-year flood depths are reduced with this culvert replacement. Possible impacts of the larger pipes on the stream restoration project in Depot Park will need to be evaluated, as well as the flood reduction benefits of eliminating the abandoned bridge near Stone Street. Enhanced water quality can also be considered with this project, by developing a stream restoration project from Stone Street to North Franklin Street, creating a linear park or greenway concept	Downtown Watershed Study	30	0	5	0	10	5	30		$114,000	$526,000	$640,000	2018	**80**
Roanoke Street Drainage Improvements (near wades)	This project begins at an existing curb inlet near Wade's Foods which has a small diameter pipe draining to Craig Street. The recommendation is to eliminate runoff from Craig Street into the open channel behind 500 Roanoke Street by installing a storm drain system that conveys runoff from the Wade's Foods parking lot and Craig Street to Roanoke Street, where it ties into the existing storm drain system	Downtown Watershed Study	25	0	5	0	10	5	30		$42,000	$168,000	$210,000	2018	**75**
Sherwood Culvert Replacement	Replacement of existing storm drain culvert under Sherwood Drive which is beyond useful life and causing maintenance issues.	Town's Addition (no document source)	25	0	5	0	10	0	30		$25,000	$100,000	$125,000	2022	**70**
Glade Culvert Replacement	Replacement of existing storm drain culvert along Glade Drive which is beyond useful life and causing maintenance issues.	Town's Addition (no document source)	25	0	0	0	10	0	30		N/A	N/A	N/A	N/A	**65**
Public Works Operation Center	Public Works Operation Center is within the 100 year flood plain since it is the location of the old sewer treatment facility. Relocation is the best alternative.	Town's Addition (no document source)	30	20	5	0	10	0	30		N/A	N/A	N/A	N/A	**95**
Evans Street Drainage	Piping of road drainage through a new storm drain system to prevent drainage between and behind residences.	Town's Addition (no document source)	25	0	5	0	10	0	30		$75,000	$325,000	$400,000	2022	**70**
Overhill Drainage	Piping of road drainage through a new storm drain system to prevent drainage between and behind residences.	Town's Addition (no document source)	25	0	0	0	10	0	30		N/A	N/A	N/A	N/A	**65**
Reading Road Drainage	Research and Public outreach is required to address maintenance of drainage infrastructure and/or larger replacement projects to address capacity may be necessary.	Town's Addition (no document source)	25	0	0	0	10	0	30		N/A	N/A	N/A	N/A	**65**
Teel Street	Piping of road drainage through a new storm drain system to prevent drainage between and behind residences.	Town's Addition (no document source)	25	0	5	0	10	0	30		N/A	N/A	N/A	N/A	**70**
N Franklin Street Drainage near Conston	Roadway flooding occurs here frequently with heavy rains. The system is most likely undersized for the area it drains	Town's Addition (no document source)	25	0	0	0	10	0	30		N/A	N/A	N/A	N/A	**65**
West Main Street Drainage (near 1010 W Main, drainage from Robin Rd / Interstate)	Piping of road drainage through a new storm drain system to prevent drainage between and behind residences.	Hickock Drainage Study	25	0	0	0	10	0	30		$404,000	$2,271,722	$2,675,722	2017	**65**
Infrastructure															
Diamond Hills Basin Evaluation of Ultimate Development (including: Stream Restoration & Independence Blvd Upgrade, and Upstream SWM Facility a BMPs);	there are potential projects to come from this basin, work on various stormwater facilities and conveyance channels	Description provided by Town notes	25	0	0	0	10	5	30		N/A	N/A	N/A	N/A	**70**
Christiansburg Industrial Park Restoration and Stormwater BMP Assessment(Town is at 100% design on this and plans to go to construction in the fall…we have the costs available)	Maintenance / Upsizing of existing stormwater quantity pond and channel improvements upstream of facility.	Stream Benefits Analysis Christiansburg Industrial ParkStream Restoration	25	20	5	0	10	5	30		N/A	N/A	$700,000	N/A	**95**
Sleepy Hollow SWM BMP Modification	Maintance or removal of BMP. The embankment is not constructed properly and would need to be rebuit.	WSSI Sleepy Hollow Powerpoint	25	20	0	0	10	5	30		N/A	N/A	N/A	N/A	**90**
Kiwanas Park	Corrective work to address stream erosion along park.	Town's Addition	25	0	0	0	10	5	30		N/A	N/A	N/A	N/A	**70**
Diamond Hills SWM BMP Modification (Food Lion N Franklin St Facility)	Potential modification to address flow through pond to protect downstream channel and Blue Leaf Stream Restoration	Town's Addition (no document source)	25	0	0	0	10	5	30		N/A	N/A	N/A	N/A	**70**

Table Notes:
Project data displaying as "N/A" indicates that the cost to construct, design, or remediate project is undetermined as this time.
Project Name (* = project that is in the floodplain. ** = a project that is in the floodway)
Preferred projects are based on total points, cost considerations and shovel-ready nature of the proposed project.

TOWN OF CHRISTIANSBURG
TOWN COUNCIL
AGENDA COVER SHEET

AGENDA LOCATION:
Discussion and Action by Mayor and Council

Meeting Date:
October 24, 2023

ITEM TITLE:
Discussion and Approval of the Town of Christiansburg Flood Resilience Plan

DESCRIPTION:
The Flood Resilience Plan for the Town of Christiansburg provides an overview of the flood resilience planning efforts undertaken by the Town of Christiansburg. The Flood Resilience Plan provides opportunities for improvement to current defenses and assesses the suitability of new projects and policies for the Town. The Plan examines historical flooding in the Town and reviews current and proposed strategies for flood prevention and resilience. Current and prospective projects were reviewed, scored, and placed in a ranking matrix. Communities may apply for grant funding for projects through the Virginia Community Flood Preparedness Fund (CFPF). An approved Resilience Plan is a prerequisite for submitting a funding application to the CFPF. Approval of this plan will enable the Town to tap into an additional source of funding for projects that will help to mitigate flooding in the Town.

POTENTIAL ACTION:
Request approval of the Town of Christiansburg Flood Resilience Plan

DEPARTMENT:
Administration

PRESENTER:
Town Manager Randy Wingfield

ITEM HISTORY:
The Virginia Community Flood Preparedness Fund (CFPF) was established in the Code of Virginia during the 2020 session of the General Assembly. In December 2021, the Town received a grant award in the amount of $44,520.30 from the CFPF for the development of a Resilience Plan. This grant award required a Town match of $4,946.70. On August 10, 2022, the Town entered into a contract with A. Morton Thomas and Associates, Inc. (AMT) to develop the Town of Christiansburg Flood Resilience Plan. Town Staff has work with AMT to develop this plan and the draft Flood Resilience Plan was presented to the Water and Waste Committee on August 21, 2023. The Water and Waste Committee has reviewed the Flood Resilience Plan as attached.

INFORMATION PROVIDED:

Flood Resilience Plan

AGENDA

REGULAR MEETING OF TOWN COUNCIL
CHRISTIANSBURG TOWN HALL
100 EAST MAIN STREET
OCTOBER 24, 2023 – 7:00 P.M.

(The meeting will be in-person and streamed on YouTube Live)

The meeting will be streamed live on the Town of Christiansburg's YouTube page at www.christiansburg.org/YouTube and will remain on the Town's YouTube page once the meeting concludes.

If you do not want or cannot attend the meeting in-person, there are several contactless methods for submitting public comment. To submit public comments, please visit www.christiansburg.org/publichearings. You may also leave a voicemail with your comments at 540-382-6128, ext. 1109; mail a letter to Town Hall, ATTN: Town Council, 100 E. Main Street, Christiansburg, VA 24073; use the drop box to the left of the front doors at Town Hall to leave a letter; or email info@christiansburg.org. Regardless of the method you use, please include your full name and address with your comments. Please provide comments prior to 6:00 p.m. on Tuesday, October 24, 2023, for the comments to be distributed to Town Council before the meeting.

REGULAR MEETING

I. CALL TO ORDER

A. Moment of Reflection

B. Pledge of Allegiance

II. ADJUSTMENT OF THE AGENDA

III. PUBLIC HEARINGS

A. FY 2023-24 Budget Amendment #1

B. An Exchange of Property request by the Town of Christiansburg that an approximately 0.2665-acre (11,609 square feet) southwest portion of a certain tract or parcel of land at 1025 W. Main Street (Tax Map 556 – ((A)) – 48A; Parcel ID 020000) situate, lying and being located along W. Main Street in the Town of Christiansburg, Virginia; with an equal Exchange of Property request by Jimmy Martin that the approximately 0.2665 acres (11,609 square feet) northeast portion of a certain tract or parcel of land (Tax Map 556 – ((A)) – 47; Parcel ID 004777) situate, lying and being located along W. Main Street in the Town of Christiansburg, Virginia. The exchange is for the College Street Stormwater Project.

C. 2022 U.S. Department of Housing and Urban Development (HUD) Community Development Block Grant (CDBG) Consolidated Annual Performance and Evaluation Report (CAPER)

IV. CONSENT AGENDA

A. Approval of Minutes of September 26, 2023

B. Monthly Bill List

C. Resolution Recognizing Craig Meadows for his service as Montgomery County Administrator

D. Resolution to recognize October 28, 2023 as National First Responders Day

E. Proclamation to recognize November 1, 2023 as Extra Mile Day

F. Contract Amendment #1 with CHA Consulting, Inc. for the renewal of Water, Sewer, and Wastewater Treatment Term Services in excess of $100,000 not to exceed $500,000 per task order and not to exceed $2,500,000 per annual contract term per Virginia Public Procurement Act

G. Contract Amendment #1 with Hurt and Proffitt for the renewal of Water, Sewer, and Wastewater Treatment Term Services in excess of $100,000 not to exceed $500,000 per task order and not to exceed $2,500,000 per annual contract term per Virginia Public Procurement Act

H. Contract Amendment #1 with Hazen and Sawyer for the renewal of Water, Sewer, and Wastewater Treatment Term Services in excess of $100,000 not to exceed $500,000 per task order and not to exceed $2,500,000 per annual contract term per Virginia Public Procurement Act

I. Contract Amendment #1 with McGill Associates, PA. for the renewal of Water, Sewer, and Wastewater Treatment Term Services in excess of $100,000 not to exceed $500,000 per task order and not to exceed $2,500,000 per annual contract term per Virginia Public Procurement Act

J. Contract Amendment #1 with Whitman, Requardt & Associates, LLP, for the renewal of Water, Sewer, and Wastewater Treatment Term Services in excess of $100,000 not to exceed $500,000 per task order and not to exceed $2,500,000 per annual contract term per Virginia Public Procurement Act

K. Contract with Rummel, Klepper & Kahl, LLP (RK&K) for Professional Services for the Town's North Franklin Sidewalk In-Fill project in the amount of $232,340

V. INTRODUCTIONS AND PRESENTATIONS

A. Ginny Snead, A. Morton Thomas and Associates, Inc., to present the Town of Christiansburg Flood Resilience Plan

B. Police Chief Chris Ramsey to introduce new command staff

VI. CITIZEN COMMENTS

VII. COMMITTEE REPORTS

A. Street Committee Report – Bishop, Hockett

1. Subdivision Plat and Dedication of Easements for NRV Marketplace, LLC at 2705 Market Street, NE showing Parcels G, H, N, O, P, Q, R, S, T, U, and Revised Lot 1 (creating 10 lots)

VIII. DISCUSSION AND ACTION BY MAYOR AND COUNCIL

A. Request for street closures for the Christiansburg High School Veterans Day Parade for Friday, November 10, 2023 with street closures from 8:30 a.m. - noon to include Main Street from Park Street, N.E. to Dunkley, N.W., Roanoke Street from E. Main Street to First Street, Pepper Street, S.E. from E. Main Street to First Street, Pepper Street, N.E. from E. Main Street to Hill Street, Franklin Street from First Street to Commerce Street, N.W., Hickok Street from Commerce Street, N.W. to First Street, S.W.

B. Adoption of Town of Christiansburg Flood Resilience Plan

IX. STAFF REPORTS

A. Town Manager

B. Town Attorney

C. Other Staff

X. COUNCIL REPORTS

XI. OTHER BUSINESS

XII. ADJOURNMENT

Upcoming meetings of Council:
November 14, 2023, 7:00 p.m. – Regular Meeting
November 28, 2023, 7:00 p.m. – Regular Meeting

Town of Christiansburg
College Street
Drainage Alternatives Analysis

June 1, 2021

AMT Project #20-0609.001

Table of Contents

LIST OF APPENDICES

Introduction

The goal of the Town of Christiansburg College Street Drainage Alternatives Analysis is to evaluate long-standing drainage and flooding issues plaguing the College Street corridor, centered within an area generally bounded by Moose Drive to the west, College Street to the North, West Main Street to the south, and Depot Street to the east. This study evaluates feasible alternatives for drainage improvements that will reduce or eliminate flooding concerns. The most feasible alternatives are then ranked to help Town of Christiansburg move forward with capital improvement planning for the required drainage solutions.

The College Street watershed encompasses 198 acres which includes runoff from south of West Main Street up to Interstate 81; upland areas west of Buffalo Drive including the Christiansburg Middle School property and residential areas from the north at Hillcrest Drive. Upper watershed runoff concentrates primarily along a rear yard swale paralleling College Street that flows into a 36-inch diameter CMP culvert at the Masonic Lodge, and then eventually discharges to a dual 66-inch diameter culvert under Depot Street. The overall, total drainage study area is 277-acres which continues from Depot Street to Hickok Street near the downtown area. Exhibit A shows a watershed map of the study area with 20 known or identified drainage problems.

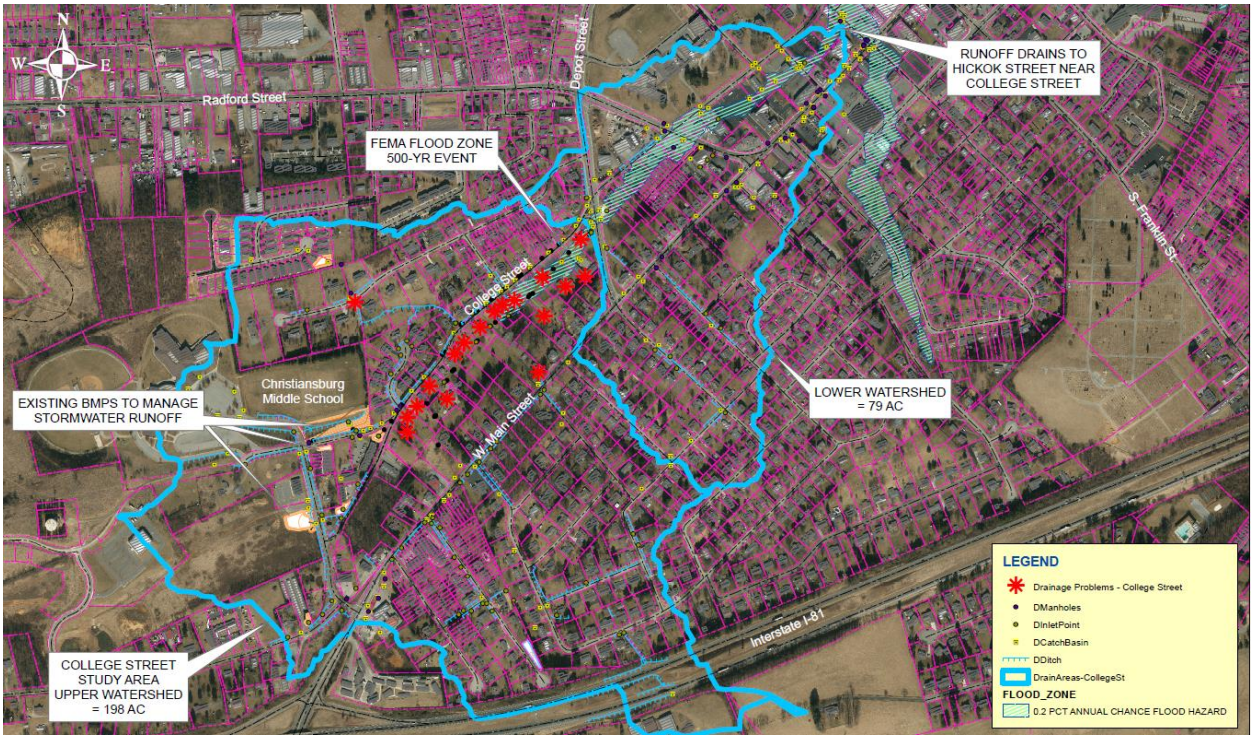


Exhibit A – Watershed Map showing Known Drainage Problems

Flood History

Major flooding occurred in the College Street corridor on February 6, 2020; May 24, 2020; and in August 2020 with inundated roads and driveways, flooded basements, and a collapsed basement wall within impacted homes. The primary area of flooding vulnerability is the 800-block of College Street, a low-lying area where much of the upland runoff collects in a rear yard swale. Exhibit B is a photograph taken the evening of May 24, 2020 from 780 College Street looking towards 800 College Street. In response to the Memorial Day flash flood event, the Town of Christiansburg initiated this engineering study to investigate drainage problems and provide solutions to help reduce future flood risks.

Exhibit B – 780 College Street (May 24, 2020)

Study Approach

This study will help identify and evaluate existing drainage conditions and patterns through a review of available records, desktop analysis, site investigations, field surveying and community input. Using hydrology and hydraulics modeling in PC-SWMM, the study will evaluate the existing drainage conditions and reported drainage problems in order to then develop effective drainage solutions and preliminary sizing of drainage alternatives. Alternatives will include preliminary budgets for project costs and a ranking of the recommended drainage improvements. Results will be presented in this report for review and revision, prior to final recommendations for the College Street drainage problem areas.

Exhibit C – 800 College Street (February 6, 2020)

Task 1 – Data Collection and Review

A. Morton Thomas and Associates, Inc. (AMT) was retained on October 5, 2020 to conduct this College Street Drainage Alternatives Analysis. The first task was to collect and review data and available information about past flooding, and other related baseline information to identify existing drainage problems as summarized below.

Town GIS Data

The Town provided geographical information system (GIS) databases and mapping for the entire study area, including aerial map images, topography, drainage infrastructure, public utilities, floodplains, waterways, roadways, land use mapping and property ownership (parcel data). GIS information was collected through a project FTP site, and then setup for mapping and analysis of the watershed and existing stormwater infrastructure.

Record Drawings (Town & VDOT)

AMT compiled electronic PDF copies of design and record drawings from within the study area, from both VDOT and the Town, depicting roadways, parking lots, stormwater BMP's, and other types of built improvements in areas of concern. These records were utilized to evaluate and close gaps in the Town's GIS database, and to supplement the accuracy of the engineering evaluations and modeling to be developed for this study.

Records of Drainage Complaints

History of drainage complaints including flood photos and videos were obtained and reviewed to help establish the initial GIS mapping for known drainage problem locations. Each drainage complaint was geo-located with a comment as to the type of problem being encountered. Additional information on drainage complaints was also reviewed from a College Street Community Information Group (*Everything Christiansburg*) during the initial community data gathering with a public informational display at the recreation center, and then incorporated into the GIS database of drainage complaints developed for this study.

FEMA Floodplain Data

The FEMA Flood Insurance Study (FIS) for Montgomery County (Community Number 510101) was utilized for this study. The 500-year floodplain limits are shown on FEMA Flood Insurance Rate Map (FIRM Panel #51121C0143C, effective date September 25, 2009) and extend into the College Street study area up to 830 College Street as depicted on Exhibit A – Watershed Map. There is no 100-year floodplain (special flood hazard area), and flood insurance is not required for any properties in the study area as a result, however any homeowners that are concerned about flood risks can purchase private flood insurance.

NRCS Soils Data

Web soils survey data that is available through the Natural Resources Conservation Service (NRCS) online was collected and utilized to augment the Town GIS database, to establish prevailing soil types throughout the watershed and for use in the hydrology modeling to estimate runoff potential for a range of design storm events.

Task 2 – Supplemental Surveying

Based on compiled data for this study under Task 1, AMT developed a plan to conduct field and supplemental surveying of existing drainage systems for this project. Supplemental surveying included the following services for this study.

- Survey notification by the Town as to the planned fieldwork to survey and investigate drainage problems in the watershed.
- Survey Work Maps showing the areas where record drawings for existing drainage systems were unavailable or unclear, requiring supplemental surveying (Appendix A).
- Field Survey Data for the existing storm drain systems, as required for this study. This includes field photos, field sketches and surveying of high-water marks.
- Aerial imagery collected by UAV flights in the upstream and downstream directions along the rear yard ditch, College Street, and side tributaries.

Supplemental survey data collected for this study was geocoded and then provided to the Town in a GIS compatible electronic format, for documentation of the existing drainage systems in the areas of drainage concern, along with UAV aerial imagery.

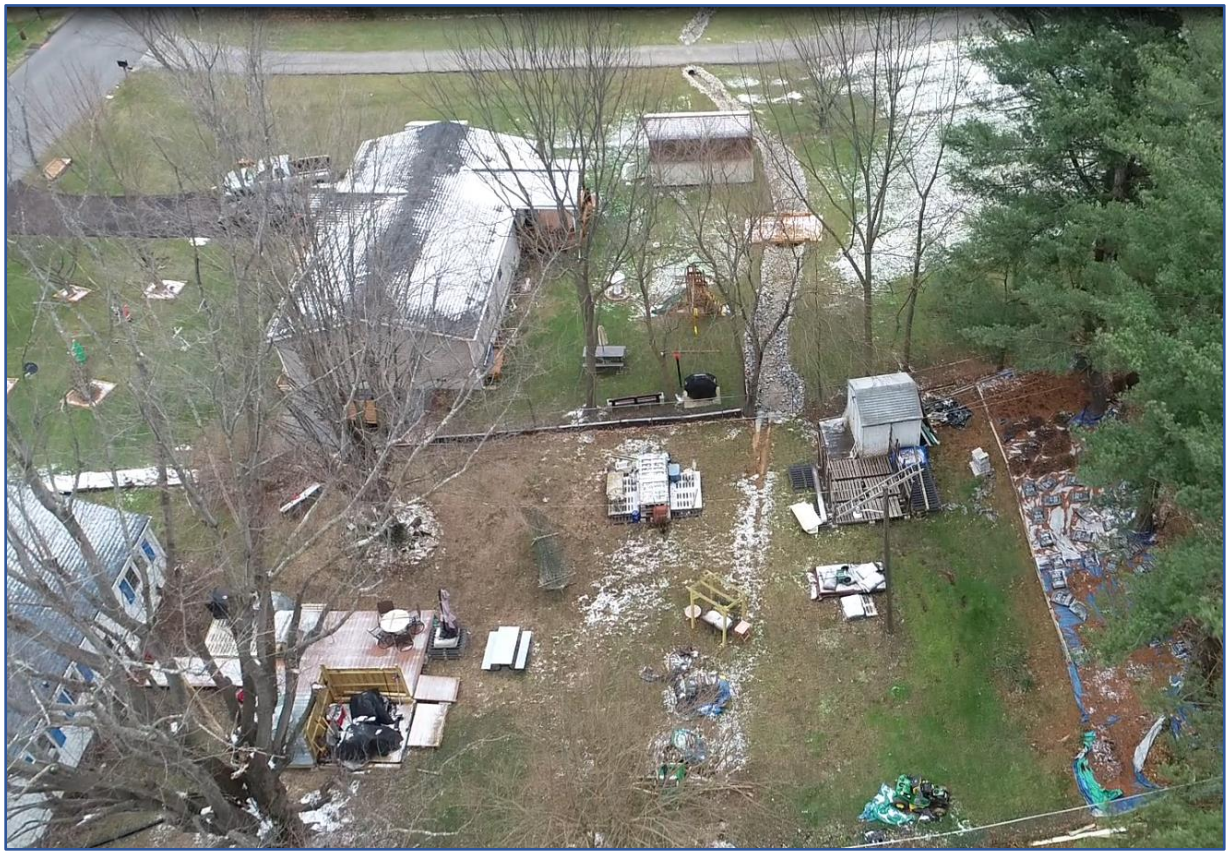


Exhibit D – Aerial Image of rear yards at 800 & 810 College Street (Looking East)

Task 3 – Community Informational Display

Known drainage concerns were initially mapped based on coordination meetings Town staff held with impacted residents prior to this study (including homeowner flood documentation in Appendix G) as well as a review of data compiled and mapped from the Town's Downtown Watershed Study and available record drawings. AMT then worked with the Town to develop a Community Informational Display, including three display boards (example shown below for Exhibit E) with a Public Comment Form and PowerPoint presentation containing flood photos of known issues. The public information was then displayed at the Christiansburg Recreation Center on December 16, 2020, and posted to the Town's Website:

https://www.christiansburg.org/1414/College-Street-Drainage-Alternatives-Ana

Written public comments were encouraged for 30-days, with photos and descriptions posted to stormwater@christiansburg.org. The Town website also provided the option to sign-up to receive future study updates. Handwritten comments on the maps, thumb tacks, and post-it notes were used to show the location and type of known drainage issues reported by residents.

All reported drainage concerns were GIS mapped after the meeting as shown on the Watershed Map (Exhibit A) depicted in the introductory section of this report. Public information, written comment sheets and flood photos that were received are in the report appendices.

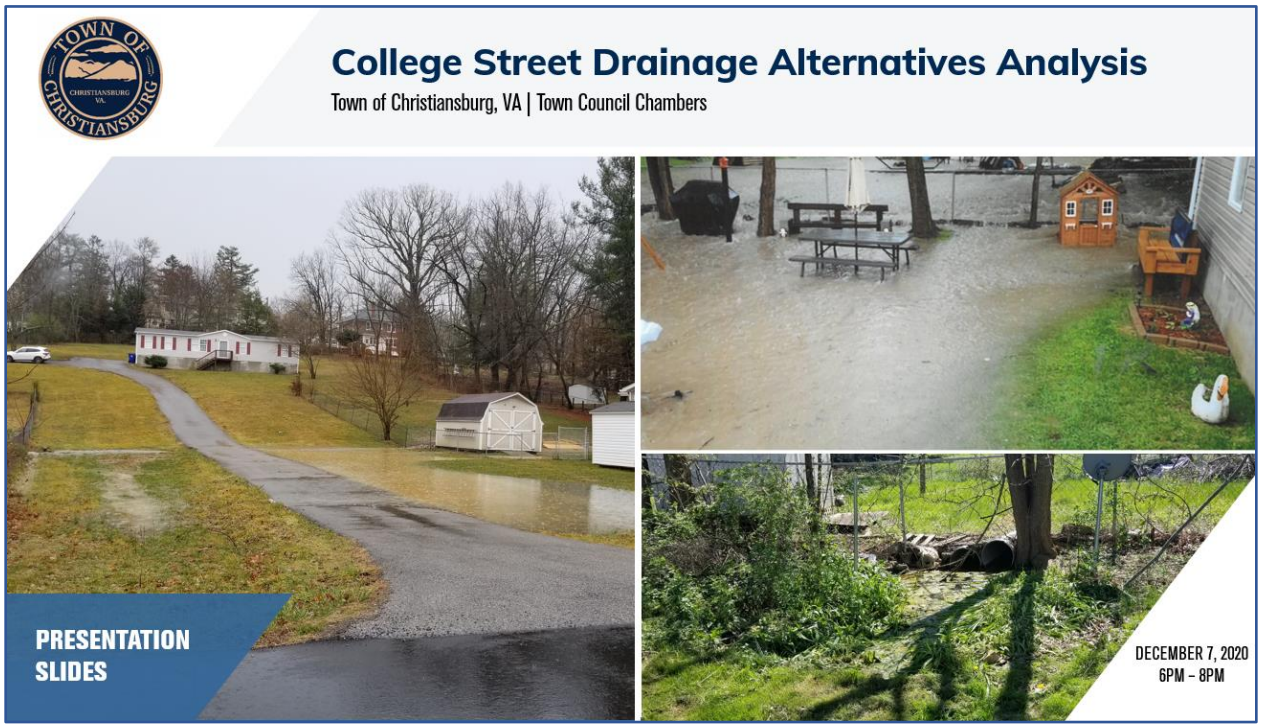


Exhibit E – Community Information Display Board

Task 4 – Watershed Hydrology

The College Street Drainage Alternatives Study is for a sub-basin within the larger Town Branch Watershed which at its confluence with Crab Creek is 1,284 acres. Crab Creek then generally drains northwest, where it empties into the North Fork of the New River. Exhibit F – Hydrologic Sub-Basin Map shown below is referenced from the prior Christiansburg Downtown Watershed Study to provide context of how the 22% upper-basin College Street study area fits into the larger watershed for Town Branch draining into Crab Creek. Sub-Basins 5 and 6 in Exhibit E represent approximately 22% of the larger downtown watershed study area from this prior study of drainage issues in the downtown area.

Land uses within the College Street upper watershed area (Sub-Basin 5 and 6) are mostly residential neighborhoods with some commercial and institutional parcels that are more predominant in the lower portion of the watershed. There is an existing storm drain system along the north side of College Street, roughly between Buffalo Drive and Depot Street, largely conveying overland flow from the north and west in roadside ditches and pipes. Runoff from south of West Main Street is largely collected via two storm drainage pipes located between Auburn Drive and Hickory Drive which discharge into backyard swales for College Street residences, then drain east in a rear yard ditch towards Depot Street, paralleling the College Street roadside drainage system. Remaining watershed runoff is from upland areas west of Moose Drive.

Exhibit F – Sub-Basin Map from Downtown Watershed Study

Sub-Basin descriptions summarized below are referenced directly from the new watershed hydrology model that was developed in PC-SWMM for this study, generally matching the previously studied downtown watershed for Basin 5 and 6 shown in Exhibit F. The new watershed size of 277-acres compares favorably to the previously studied 282-acres.

Table 1 – Sub-Basin Data

Sub-Basin	Area (acres)	% Impervious
0	23.12	18
1	13.89	7
2	4.40	34
3	4.84	66
4	9.12	11
5	1.09	25
6	1.33	18
7	5.01	23
8	5.52	23
9	11.89	19
10	1.11	33
11	9.55	36
12	64.94	26
13	4.08	52
14	0.73	25
15	5.33	15
16	4.88	11
17	11.71	16
18	9.60	50
19	27.12	26
20	7.65	12
21	2.99	45
22	18.39	43
23	9.78	77
24	1.89	74
25	8.91	36
26	1.98	85
27	2.30	55
28	4.49	15
29	1.61	91
SUM =	**277**	**35.6%**

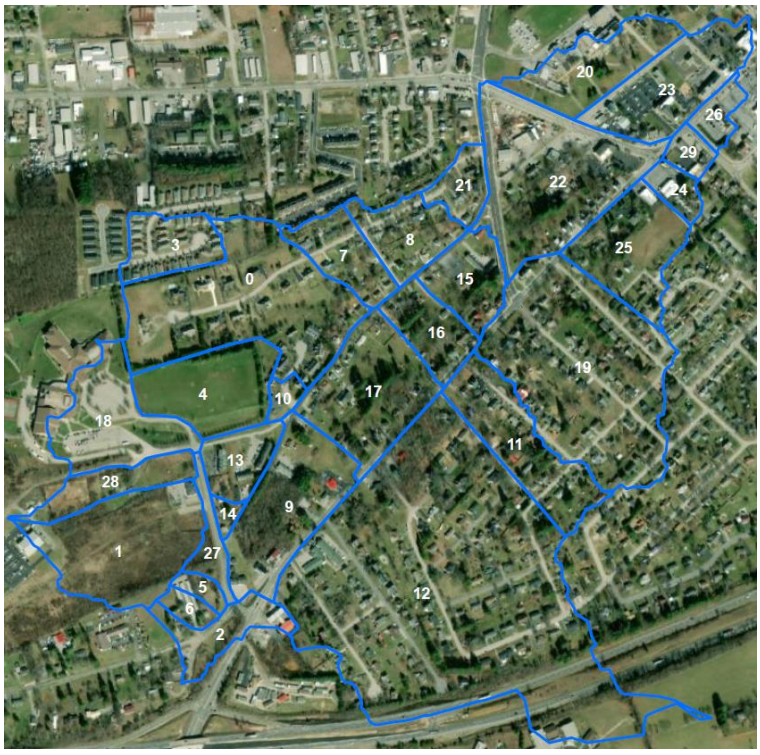


Exhibit G – Sub-Basin Map from College Street Study

For hydrology methods, PC-SWMM uses a percent impervious ratio as shown in Table 1, instead of the more traditional curve number method of runoff estimation - which requires the definition of hydrologic soil group (HSG) within each sub-basin. For this, the percent imperviousness used in the hydrology model was developed using VITA land cover tiles in GIS to estimate the impervious percentage by land use types in each sub-basin, and to predict estimated runoff for the required range of storm events. The resulting percentage imperviousness ranges from 7% to 91% in this watershed, with an average percent imperviousness of 35.6% for the watershed. The twenty-nine (29) sub-basins in the PC-SWMM model average approximately 15.4-acres in size, for a total of 277.1 total acres.

Summary of Peak Discharges

The PC-SWMM model evaluated peak discharges for numerous design storm events including 29 sub-basins and 8 existing stormwater management basins (BMP's). The (10-year, 24-hour) and (25-year, 24-hour) events were determined to be comparable to the recent storm events that caused impactful flooding in the watershed as compared to the (2-year, 24-hour), (25-year, 1-hour) and (100-year, 24-hour) check storm events that were also analyzed. By comparison to the 2020 flooding, the (25-year, 24-hour) storm most closely resembled the recent high-water marks and was selected as the design storm event for recommended drainage improvements.

A summary of the peak discharges at four study points in the PC-SWMM model for existing conditions is summarized below in Table 2.

Table 2 – PC-SWMM Peak Discharges (Existing Conditions)

Study Point Location	Q2 (cfs)	Q10 (cfs)	Q25 (cfs)	Q100 (cfs)
1 – First Inflow from West Main Street	9.25	20.43	43.29	52.69
2 – Second Inflow from West Main Street	12.43	22.47	48.38	74.89
3 – Rear Yard Ditch at Masonic Lodge	15.56	30.41	58.41	95.23
4 – Downstream Study Limits at Hickok Street	65.33	146.61	236.76	451.11

Based on these results, the (25-year, 24-hour) rainfall was then evaluated for sizing drainage improvement alternatives. As a result, the (25-year, 24-hour) flood inundation limits are also depicted on the Existing Conditions Plan (Sheet C1-1) in the report appendices. This provides a good comparison between recent flooded areas and the PC-SWMM model results for the design storm event (25-year, 24-hour).

Task 5 – Drainage System Analysis

Existing storm drain systems were modeled in PC-SWMM based on a combination of Town GIS data for the existing stormwater infrastructure, available record drawings for existing BMP's and drainage systems, supplemental survey of missing or incomplete GIS data, field verification of existing drainage systems, and design analysis to approximate the capacity required to convey a desired range of storm events including the design storm event.

Proposed drainage system improvements were then analyzed using PC-SWMM alternatives analysis to determine the required stormwater management basin retrofits, possible locations for new stormwater management basins, and the most feasible pipe culvert and ditch enlargements, to convey the (25-year, 24-hour) design storm event. Reduced flood stages were considered as benefits in the model results, as well as reduced peak discharges.

The recommended improvements (proposed conditions) are shown by comparison to existing conditions in a series of summary tables and graphical displays of hydraulic grade lines in the report appendices with additional PC-SWMM modeling and results available for the range of options considered in this drainage alternatives study.

This profile of the existing drainage system starts at West Main Street and Mudpike Drive and ends at Hickock Street in the downstream location. The red dots indicate a flooded structure causing water to overtop the existing storm drain system. The area of concern is for extensive flooding in the rear yard ditches running parallel to College Street.

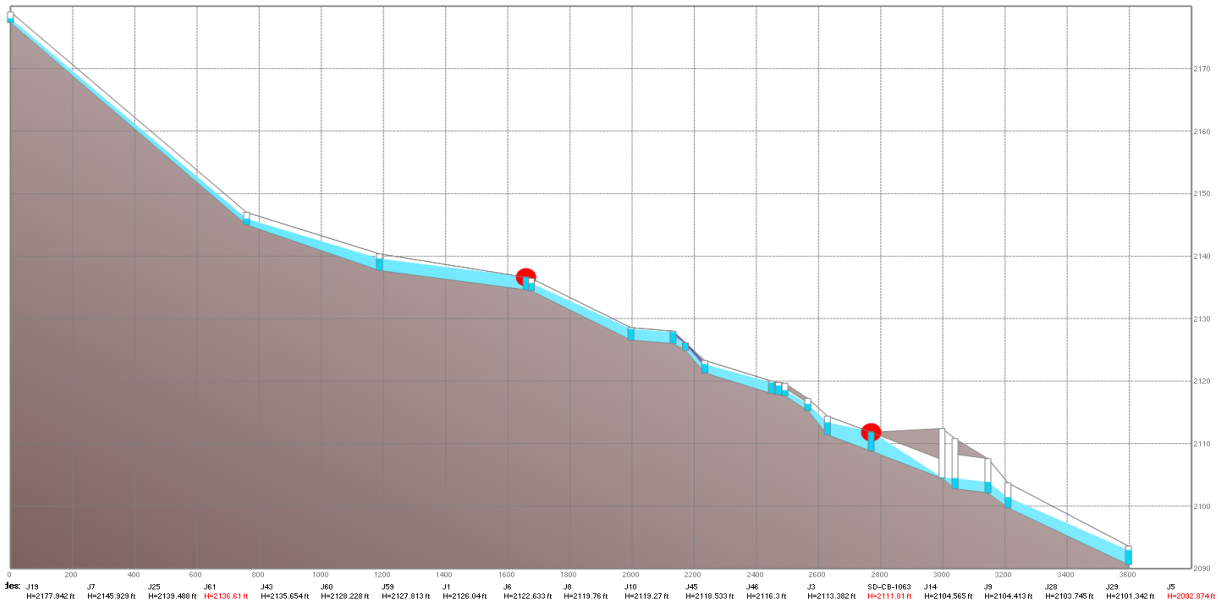


Exhibit H – PC-SWMM Existing Conditions Profile #1 (25-Year, 24-Hour)

This profile of the existing drainage system starts at the Christiansburg Middle School and ends at the 66-inch culvert crossing under Depot Street, following College Street. You can see that there is no overtopping of the existing roadside drainage system at full functionality, so the focus along College Street is on spot drainage improvements to enclose an open ditch section with elliptical pipes under a roadside swale.

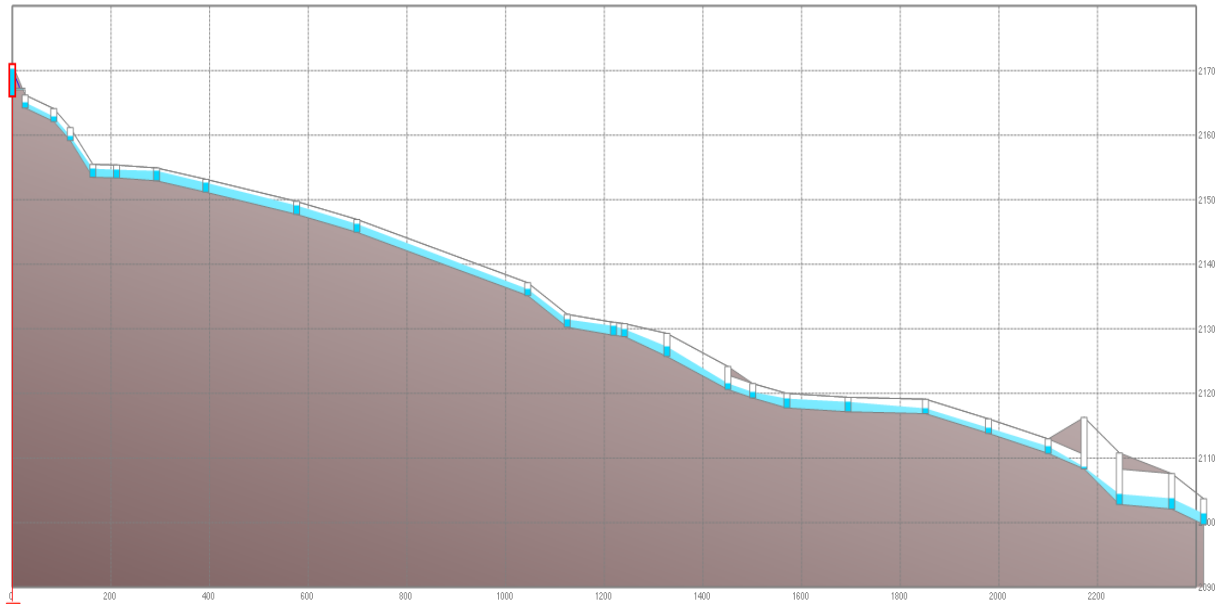


Exhibit I – PC-SWMM Existing Conditions Profile #2 (25-Year, 24-Hour)

This drone image capture below is taken from several videos following the drainage thalwegs along College Street and the rear yard ditches in the upstream and downstream direction to help document current conditions in the watershed. It shows how water collects on private property generally running parallel to College Street in rear yard ditches. It also shows the stormwater detention basin location at 1010 College Street in the rear yards of several properties as also shown in Phase 2, Alternative A for the conceptual drainage improvement plans.

Exhibit J – Possible BMP Site at 1010 College Street

Task 6 – Conceptual Drainage Improvement Plans

The report appendix E includes conceptual drainage improvement plans developed using GIS and AutoCAD software, that show existing conditions (C1-1) and four conceptual drainage improvement alternatives (C1-2 – C1-5) for the study area. All maps depict some measure of proposed drainage improvement alternatives including the existing conditions map which denotes retrofits to several existing upland stormwater management basins (or BMP's).

An opinion of probable cost was developed for each conceptual drainage improvement alternative. In each case, soft costs and a 30% contingency factor are included in the estimates as a conservative approach to capital project budgeting for these planned improvements. Details for each estimate are found in the report appendices, and a brief narrative description for each drainage improvement is provided below.

Table 3 – Summary of Drainage Improvement Alternatives

Alternative (ID)	Budget	Description
1	$640k	Alternate #1 proposes various BMP upgrades in an effort to reduce peak discharges and provide detention to offset other peak discharges throughout the watershed. This alternative also includes spot drainage improvements along Hillcrest Drive in an area of ponding, as well as cleaning and repairing the existing storm system along College Street, and replacing the open ditch portion of the roadside drainage system on College Street with a closed pipe system. Some of this work may be possible by Town Maintenance Staff, thereby reducing the overall construction cost.
2A	$1.61 Million	Alternate #2A proposes a new dry detention basin or shallow marsh BMP (depending on groundwater levels) in the backyards at 990 College Street (Exhibit J), including a storm drain system to convey runoff from West Main Street to the new BMP, and a maintenance access easement from West Main Street or College Street to the new BMP forebay via commercial businesses on either side. In order to convey longer duration, reduced peak rates of discharge from this new BMP, Alternate #2A also includes a 24" & 30" HDPE pipe culvert system with swales to replace the rear yard ditches. The system is sized to remove all surface runoff for the (25-year, 24-hour) storm event from the rear yards in this area, and would tie directly into the existing 36" corrugated metal pipe under the Masonic Lodge parking lot.
2B	$1.47 Million	Alternate #2B proposes a 36" HDPE pipe culvert system to remove all surface runoff for the (25-year, 24-hour) storm event from the rear yards along College Street by underground piping, and would be installed instead of a new detention basin (Alternate #2A) to capture and convey runoff to the Masonic Lodge, where the proposed pipe would tie into proposed dual 30" HDPE pipes. Some 48" HDPE culverts are also required downstream, to improve channel capacity and prevent erosion concerns as noted in Alternative #3.
3	$900k	Alternative #3 proposes to replace open ditch sections with 48" pipes to improve conveyance from Depot Street to Hickock Street. This would address eroding open channels and undersized pipes within that lower section of the study area, where the (25-Year, 24-Hour) storm event shows the likelihood of localized flooding issues. This would generally replace the need for the College Street (Phase 2) project that was previously programmed in the Downtown Watershed Study, removing a majority of those $2.75M costs from future project needs. A further evaluation of the runoff potential to College Street east of Depot Street and the overall walkable watershed concept for this corridor is subject for further evaluation and planning based on the alternatives selected from this study.

Task 7 – Project Prioritization and Ranking

To compare, rank and prioritize the four alternatives in this study, we utilized a similar approach to the downtown watershed study to establish scoring criteria, including a cost effectiveness ranking based on dollars invested per watershed acre. Detailed calculations for the rankings are provided in the report appendices, and the results are summarized in Table 4 below.

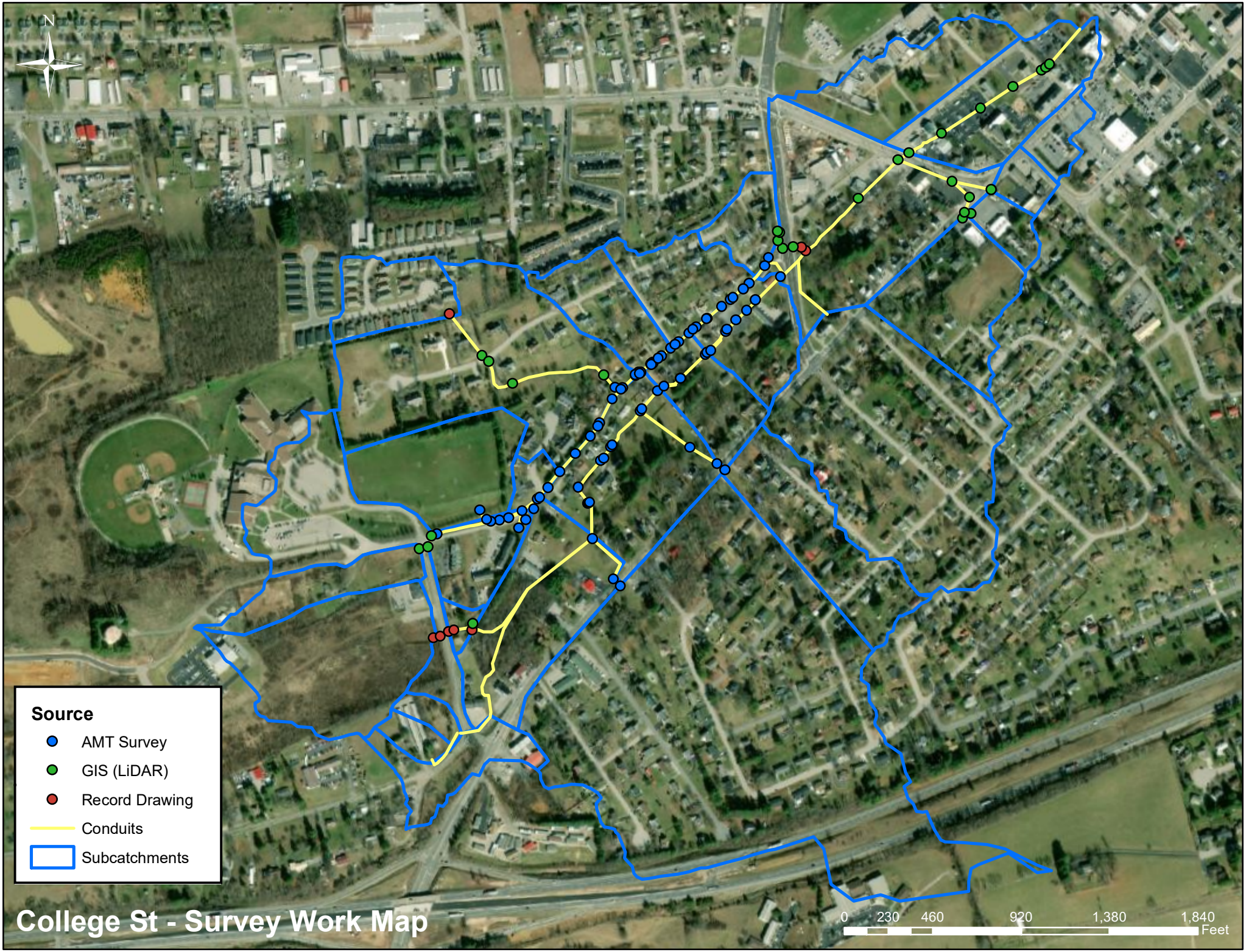
Table 4 – Prioritization of Drainage Improvements by Rank

Rank	ID	Description	Score
1	2A	Alternative #2A – The Town should seek to secure permanent easements for the construction of a rear yard stormwater management basin and the associated 24" HDPE pipes as the top ranked solution to alleviate flooding. The budgeted $1.67 million would likely be too expensive for a SLAF project funding alternative due to the high cost per pound of phosphorus removal, however this depends on whether the Town and affected residents are able to implement a shallow marsh BMP instead of a dry pond. Also, the project could be eligible for FEMA Building Resiliency in Communities (BRIC) funding through the Virginia Department of Emergency Management (VDEM). We would suggest the Town open a grant application in the VDEM portal and setup a kickoff meeting with VDEM representatives to discuss project goals and eligibility, while also securing property rights to study groundwater and soil conditions to then determine if a wet or dry detention basin would work best.	77
2	2B	Alternative #2B – This project would be slightly less expensive than Alternative #2A but is lower ranked and could lead to increased peak discharge rates and flood risks, downstream. We would not recommend this solution unless the Town was unable to secure property rights to build a new stormwater management basin as presented in Alternative #2A.	69
3	3	Alternative #3 – These spot drainage improvements to the east of Depot Street in the lower watershed would help address localized erosion and flooding concerns but will do nothing to address the issues along College Street upstream. We would recommend these improvements to be compared to the prior College Street (ID2) improvements in the downtown watershed study at $2.75M, and then re-establish priorities and rankings for the multi-phase improvements on College Street, considering the Walkable Watershed Concept and possible SLAF, FEMA, or VDOT funding for a College Street "Green Street" solution Some elements of Alternative #1 might also move into Alternative #3 as details for implementation are decided upon.	53
4	1	Alternative #1 – The Town should seek to modify three (3) BMP outlet structures by coordination with affected property owners to optimize BMP performance in the locations recommended for a reduction in peak discharges at a low cost. The Town should then seek to modify the two (2) BMP's requiring a larger detention storage volume, and to install the recommended spot drainage improvements on College Street and Hillcrest Drive for drainage concerns in those locations. If these projects can be built by Town maintenance staff, the cost would be greatly reduced.	46

The total project budget for Alternatives #1, #2A and #3 to be implemented for the College Street Sub-Basin is estimated at $3.15 Million, with up to 75% funding support from a combination of VDOT Revenue Sharing, FEMA BRIC, and the DEQ SLAF funded portions of the project. This does not include property acquisition costs for the required easements and does not include inspecting and repairing significant portions of the existing drainage systems which appear to be adequately sized. The $3.15 Million would be offset against the prior recommendation for drainage improvements along College Street, Phase 2 which is part of the 2018 Downtown Watershed Study ($2.75 Million) and could be further reduced due to grant funding opportunities as the Town moves the project forward towards implementation where are clearer picture of the required phasing and funding can be developed along with preliminary engineering designs for the next steps.

APPENDIX A

Survey Work Maps


N
Source
AMT Survey
GIS (LiDAR)
Record Drawing
Conduits
Subcatchments
College St - Survey Work Map
0 230 460 920 1,380 1,840
Feet

FID	Shape *	Layer	Rim_Elev	Invert	Source
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FID	Shape *	Layer	Rim_Elev	Invert	Source
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1	346.215	0.027	CIRCULAR	2	0	0	1	0.02832
2	288.889	0.011	TRAPEZOIDAL	2	2.5	2	1	0.03654
3	33.336	0.03	IRREGULAR	0	0	0	1	0.08884
4	108.857	0.03	TRIANGULAR	0.5	1.2	0	1	0.05797
5	29.49	0.013	CIRCULAR	1	0	0	1	0.12647
6	122.129	0.027	CIRCULAR	2	0	0	1	0.02277
7	45.761	0.027	CIRCULAR	1.5	0	0	1	0.00437
8	60.646	0.027	CIRCULAR	1.5	0	0	1	0.01154
9	33.349	0.013	CIRCULAR	1.25	0	0	1	0.024
10	88.231	0.013	CIRCULAR	1.5	0	0	1	0.01269
11	100.074	0.027	CIRCULAR	2	0	0	1	0.01759
12	80.887	0.027	CIRCULAR	2	0	0	1	0.00556
13	105.934	0.027	CIRCULAR	5.5	0	0	2	0.00661
14	56.057	0.013	CIRCULAR	1.25	0	0	1	0.05359
15	36.672	0.013	CIRCULAR	1.5	0	0	1	0.13763
16	41.814	0.013	HORIZ_ELLIPSE	1.5	2.5	0	1	0.06471
17	80.11	0.027	CIRCULAR	2	0	0	1	0.06128
18	51.629	0.013	CIRCULAR	1.25	0	0	1	0.00581
19	72.759	0.013	RECT_CLOSED	2.25	3.58	0	1	0.03314
20	121.018	0.013	RECT_CLOSED	2.25	3.58	0	1	0.02571
21	127.802	0.013	RECT_CLOSED	2.25	3.58	0	1	0.02379
22	156.941	0.013	RECT_CLOSED	2.25	3.58	0	1	0.00191
23	124.081	0.013	RECT_CLOSED	2.25	3.58	0	1	0.00476
24	69.133	0.013	RECT_CLOSED	2.25	3.58	0	1	0.02228
25	123.83	0.027	RECT_CLOSED	3.58	2.25	0	1	0.0413
26	50.284	0.013	RECT_CLOSED	2.25	3.58	0	1	0.02606
27	45.791	0.027	CIRCULAR	2	0	0	1	0.12501
28	48.26	0.027	CIRCULAR	2	0	0	1	0.00207
29	28.104	0.027	CIRCULAR	1.5	0	0	1	0.00356
30	197.446	0.03	VERT_ELLIPSE	2.67	2	0	1	0.03954
31	46.751	0.013	CIRCULAR	1.25	0	0	1	0.03424
32	91.473	0.011	CIRCULAR	1.25	0	0	1	0.02548
33	184.014	0.027	CIRCULAR	2	0	0	1	0.01864
34	10.164	0.013	CIRCULAR	1	0	0	1	0.01378
35	86.797	0.013	CIRCULAR	1	0	0	1	0.01567
36	135.552	0.03	IRREGULAR	0	0	0	1	0.00406
37	39.695	0.013	CIRCULAR	1.25	0	0	1	0.02797
38	62.477	0.013	CIRCULAR	1	0	0	1	0.0574
39	214.671	0.03	IRREGULAR	0	0	0	1	0.01542
40	227.783	0.045	CIRCULAR	3	0	0	1	0.01923
41	50.114	0.013	VERT_ELLIPSE	2.67	2	0	1	0.15674
42	86.609	0.013	VERT_ELLIPSE	2.67	2	0	1	0.0283
43	165.103	0.013	CIRCULAR	1.25	0	0	1	0.00406
44	322.302	0.03	IRREGULAR	0	0	0	1	0.01393
45	164.426	0.013	RECT_OPEN	1	2	0	1	0.01521
46	20.092	0.013	CIRCULAR	3	0	0	1	0.08492
47	162.754	0.013	CIRCULAR	3	0	0	1	0.02089
48	41.992	0.01	RECT_OPEN	8	15	0	1	0.03885
49	64.727	0.03	IRREGULAR	0	0	0	1	0.0371
50	387.47	0.03	IRREGULAR	0	0	0	1	0.02349
51	68.119	0.013	CIRCULAR	4	0	0	1	0.01321
52	205.526	0.03	IRREGULAR	0	0	0	1	0.01168
53	243.277	0.013	CIRCULAR	4	0	0	1	0.0074
54	201.321	0.013	CIRCULAR	4	0	0	1	0.01043
55	170.555	0.013	CIRCULAR	4	0	0	1	0.0041
56	25.489	0.013	CIRCULAR	4	0	0	1	0.10254
57	28.047	0.03	IRREGULAR	0	0	0	1	0.02497
58	32.2	0.013	CIRCULAR	1.5	0	0	1	0.02174
59	33.079	0.013	CIRCULAR	1.5	0	0	1	0.02419
60	82.134	0.013	CIRCULAR	1.5	0	0	1	0.01827
61	124.041	0.013	CIRCULAR	1.5	0	0	1	0.00967
62	208.113	0.013	CIRCULAR	1.5	0	0	1	0.01297
63	302.263	0.013	CIRCULAR	2	0	0	1	0.00132
64	13.147	0.013	CIRCULAR	1.25	0	0	1	0.04569
65	44.073	0.013	CIRCULAR	1.25	0	0	1	0.02724
66	71.597	0.013	RECT_OPEN	8	15	0	1	0.07705
67	22.031	0.027	CIRCULAR	2	0	0	2	0.00862
68	22.594	0.013	CIRCULAR	1.25	0	0	1	0.00885
69	140.988	0.045	CIRCULAR	3	0	0	1	0.01844
70	46.612	0.013	CIRCULAR	1.5	0	0	1	0.0322

FID	LENGTH	ROUGHNESS	XSECTION	GEOM1	GEOM2	GEOM3	BARRELS	SLOPE
71	226.815	0.033	TRAPEZOIDAL	0.6	1.7	2	1	0.01014
72	49.219	0.013	CIRCULAR	1.5	0	0	1	0.0529
73	287.47	0.013	CIRCULAR	3	0	0	1	0.01357
74	239.196	0.013	CIRCULAR	4	0	0	1	0.01882
75	363.646	0.03	IRREGULAR	0	0	0	1	0.06033
76	759.695	0.03	IRREGULAR	0	0	0	1	0.04266
77	29.595	0.013	CIRCULAR	4	0	0	1	0.03689
78	57.951	0.013	CIRCULAR	2	0	0	1	0.03626
79	275.731	0.013	CIRCULAR	1.5	0	0	1	0.01131
80	33.537	0.013	CIRCULAR	1	0	0	1	0.0376
81	37.371	0.013	CIRCULAR	1.25	0	0	1	0.02505
82	28.885	0.013	CIRCULAR	1.25	0	0	1	0.01752
83	16.6	0.027	CIRCULAR	1.5	0	0	2	0.00964
84	320.758	0.01	IRREGULAR	0	0	0	1	0.02461
85	20.734	0.01	IRREGULAR	0	0	0	1	0.00772
86	73.506	0.011	CIRCULAR	1.25	0	0	1	0.03267
87	62.888	0.01	IRREGULAR	0	0	0	1	0.06118
88	85.238	0.01	CIRCULAR	1.25	0	0	2	0.02406
89	504.811	0.03	IRREGULAR	0	0	0	1	0.01763
90	94.011	0.01	IRREGULAR	0	0	0	1	0.0133
91	86.028	0.01	IRREGULAR	0	0	0	1	0.03606
92	427.237	0.01	IRREGULAR	0	0	0	1	0.01709
93	471.887	0.01	IRREGULAR	0	0	0	1	0.00655
94	73.506	0.01	IRREGULAR	0	0	0	1	0.03267
95	22.594	0.01	IRREGULAR	0	0	0	1	0.00885
96	39.695	0.01	IRREGULAR	0	0	0	1	0.02797
97	62.477	0.01	IRREGULAR	0	0	0	1	0.0574
98	80.887	0.01	IRREGULAR	0	0	0	1	0.00556
99	48.26	0.01	IRREGULAR	0	0	0	1	0.00207
100	45.791	0.01	IRREGULAR	0	0	0	1	0.12501

FID	NAME	AREA	IMPERV	LENGTH	TOTALINFIL	PEAKRUNOFF
0	S13	23.1182	18	1370.107	6.76	11.95
1	S17	13.8923	7	857.151	7.67	6.63
2	S21	4.4045	34	383.72	5.44	3.54
3	S24	4.8415	66	602.559	2.8	4.46
4	S1	9.1239	11	712.253	7.34	4.84
5	S18_1	1.088094	25	94.795	6.19	1.27
6	S18_2	1.326506	18	115.565	6.76	1.31
7	S28_1	5.010729	23	436.535	6.35	3.49
8	S28_2	5.516371	23	480.586	6.35	3.75
9	S26_1	11.8618	19	1033.4	6.68	6.53
10	S27_2	1.11056	33	219.891	5.53	1.04
11	S20_1	9.5502	36	342.674	5.61	5.46
12	S20_2	64.9449	26	1517.704	6.35	30.83
13	S25_1	4.0833	52	355.737	3.96	3.85
14	S25_2	0.7252	25	63.179	6.19	0.97
15	S26_3	5.3339	15	356.357	7.01	3.56
16	S26_2	4.8751	11	325.705	7.34	3.13
17	S26_5	11.7139	16	782.604	6.93	6.55
18	S23	9.6049	50	1000.932	4.12	7.22
19	S6	27.1213	25	1342.504	6.19	15.33
20	S18	7.6539	12	1667.019	7.26	3.52
21	S20	2.9902	45	260.506	4.54	2.93
22	S22	18.3857	28	808.971	5.94	11.74
23	S27	9.7783	77	1290.736	1.9	8.59
24	S25_3	1.8881	25	685.38	6.19	1.21
25	S25_4	8.9128	25	588.245	6.19	5.9
26	S26_4	1.988	85	360.822	1.24	2.27
27	S8_1	2.3016	15	286.451	7.01	1.63
28	S8_2	4.4932	15	559.211	7.01	2.67

APPENDIX B

Community Informational Display

COLLEGE STREET

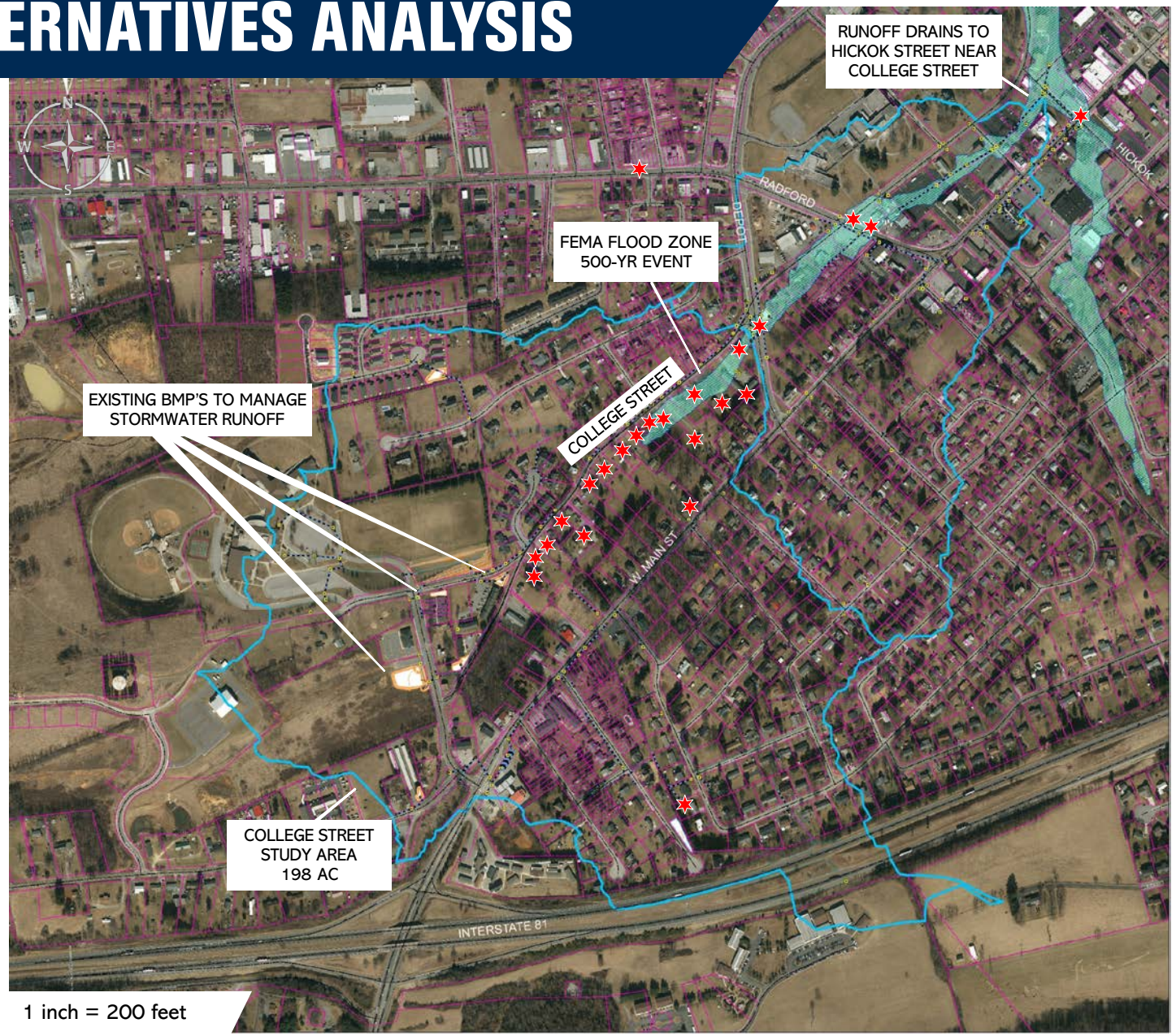
DRAINAGE ALTERNATIVES ANALYSIS

What is it?

The Town recently experienced flooding in the residential neighborhood along College Street. The goal of this drainage alternatives study is to evaluate those recent drainage and flooding problems, and then to develop recommendations for stormwater projects to reduce future flood risks.

Watershed Area =

278 acres



1 inch = 200 feet

What is Stormwater?

Stormwater is the runoff resulting from a rain event. Problems with stormwater occur when a large amount of rainfall happens in a short period of time. The ground becomes saturated and cannot absorb the water, so it becomes runoff. Impervious surfaces such as concrete and asphalt prevent the ground from absorbing rainfall increasing the amount of runoff.

For this study, runoff from College Street drains through existing pipes and ditches where it ultimately ends up in a large diameter pipe near the intersection of Hickok Street and College Street. This pipe then drains through the downtown area, discharging to Towne Branch and then Crab Creek.

What can we do about Stormwater issues?

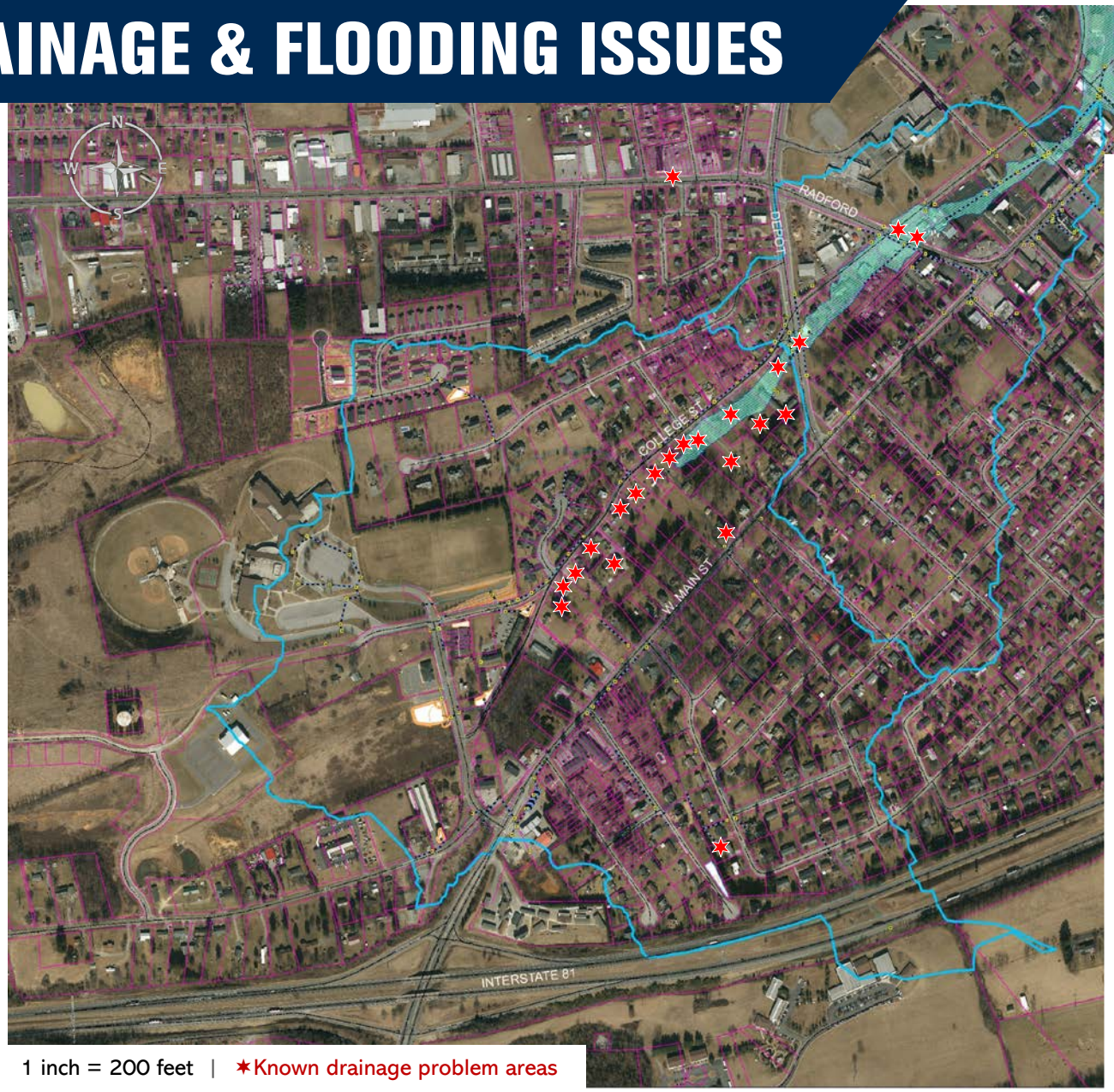
You have already taken the first step – by reviewing this project information. The next step is to provide your comments on the drainage, erosion and flooding problems in the study area to our team. We will evaluate your concerns and then develop a list of stormwater improvement recommendations to reduce or eliminate flooding for a future presentation of the study results.

COLLEGE STREET

KNOWN DRAINAGE & FLOODING ISSUES

Identifying, evaluating and reducing drainage, erosion, and flooding concerns is the #1 Goal of the College Street Drainage Alternatives Analysis. Any information you can provide will help us identify the biggest concerns in your neighborhood.

Within the study area are Eighteen (18) known drainage issues at this time. Your help is needed to make sure all known issues are accounted for within the study area.



1 inch = 200 feet | ✶Known drainage problem areas

Please note any additional drainage or flooding concerns on the map


PIPE OVERFLOW


DRIVEWAY FLOODING


FRONT OR REAR YARD FLOODING

College Street Drainage Alternatives Analysis

Town of Christiansburg, VA | Town Council Chambers

To submit additional information, please email stormwater@christiansburg.org.

To submit photos, email stormwater@christiansburg.org requesting a link to upload the images.

DECEMBER 7, 2020
6PM – 8PM

College Street Drainage Alternatives Analysis

Town of Christiansburg, VA

FLOOD PHOTOS

780 College Street

800 College Street

800 College Street

800 College Street

810 College Street

800 College Street

830 College Street

830 College Street

865 W. Main Street – Drainage Inlet

865 W. Main Street – Pipe Outfall

890 College Street

THANK YOU

for participating!

College Street Drainage
Alternatives Analysis
Community Outreach

APPENDIX C
Hydrology Results

NOAA Atlas 14, Volume 2, Version 3
Location name: Christiansburg, Virginia, USA*
Latitude: 37.1259°, Longitude: -80.4169°
Elevation: 2146.41 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.299 (0.271-0.331)	0.356 (0.323-0.395)	0.429 (0.388-0.474)	0.481 (0.433-0.531)	0.546 (0.488-0.603)	0.591 (0.525-0.655)	0.637 (0.561-0.708)	0.679 (0.592-0.758)	0.731 (0.627-0.823)	0.770 (0.651-0.874)
10-min	0.477 (0.432-0.528)	0.570 (0.516-0.631)	0.687 (0.621-0.760)	0.769 (0.693-0.850)	0.870 (0.778-0.961)	0.942 (0.836-1.04)	1.01 (0.891-1.12)	1.08 (0.938-1.20)	1.16 (0.992-1.30)	1.21 (1.03-1.38)
15-min	0.597 (0.541-0.660)	0.717 (0.649-0.793)	0.869 (0.785-0.961)	0.973 (0.877-1.08)	1.10 (0.986-1.22)	1.19 (1.06-1.32)	1.28 (1.13-1.42)	1.36 (1.18-1.52)	1.46 (1.25-1.64)	1.52 (1.29-1.73)
30-min	0.818 (0.741-0.905)	0.990 (0.897-1.10)	1.23 (1.12-1.37)	1.41 (1.27-1.56)	1.63 (1.46-1.80)	1.80 (1.60-1.99)	1.96 (1.72-2.18)	2.11 (1.84-2.36)	2.32 (1.99-2.61)	2.47 (2.09-2.80)
60-min	1.02 (0.924-1.13)	1.24 (1.13-1.38)	1.58 (1.43-1.75)	1.84 (1.65-2.03)	2.17 (1.94-2.40)	2.43 (2.16-2.70)	2.70 (2.38-3.00)	2.97 (2.58-3.31)	3.32 (2.85-3.74)	3.60 (3.04-4.08)
2-hr	1.18 (1.08-1.31)	1.44 (1.31-1.59)	1.85 (1.67-2.04)	2.15 (1.94-2.38)	2.57 (2.31-2.84)	2.90 (2.58-3.22)	3.24 (2.85-3.60)	3.59 (3.12-4.01)	4.05 (3.46-4.57)	4.41 (3.71-5.02)
3-hr	1.27 (1.15-1.40)	1.54 (1.40-1.70)	1.95 (1.78-2.15)	2.28 (2.07-2.51)	2.73 (2.45-3.00)	3.08 (2.75-3.40)	3.44 (3.04-3.82)	3.82 (3.33-4.25)	4.32 (3.69-4.87)	4.71 (3.97-5.36)
6-hr	1.53 (1.41-1.68)	1.85 (1.70-2.03)	2.33 (2.14-2.55)	2.72 (2.49-2.97)	3.26 (2.96-3.57)	3.70 (3.33-4.06)	4.17 (3.70-4.59)	4.66 (4.07-5.15)	5.34 (4.56-5.96)	5.88 (4.93-6.63)
12-hr	1.85 (1.71-2.03)	2.23 (2.05-2.44)	2.80 (2.57-3.05)	3.27 (2.99-3.56)	3.95 (3.58-4.30)	4.51 (4.04-4.92)	5.12 (4.53-5.61)	5.78 (5.02-6.37)	6.73 (5.70-7.50)	7.52 (6.23-8.46)
24-hr	2.26 (2.09-2.47)	2.74 (2.53-2.98)	3.48 (3.21-3.78)	4.09 (3.76-4.44)	4.97 (4.55-5.39)	5.72 (5.19-6.18)	6.51 (5.88-7.03)	7.37 (6.60-7.96)	8.61 (7.61-9.32)	9.64 (8.44-10.5)
2-day	2.69 (2.48-2.92)	3.26 (3.00-3.54)	4.11 (3.79-4.47)	4.81 (4.41-5.22)	5.80 (5.30-6.28)	6.62 (6.02-7.17)	7.49 (6.77-8.11)	8.42 (7.56-9.12)	9.74 (8.65-10.6)	10.8 (9.52-11.8)
3-day	2.86 (2.65-3.10)	3.46 (3.20-3.75)	4.36 (4.03-4.73)	5.09 (4.69-5.51)	6.13 (5.61-6.62)	6.98 (6.36-7.54)	7.88 (7.15-8.52)	8.83 (7.96-9.56)	10.2 (9.08-11.1)	11.3 (9.96-12.3)
4-day	3.03 (2.81-3.28)	3.66 (3.40-3.97)	4.61 (4.27-4.99)	5.37 (4.96-5.81)	6.45 (5.93-6.96)	7.33 (6.71-7.91)	8.27 (7.52-8.93)	9.25 (8.35-10.00)	10.7 (9.50-11.5)	11.8 (10.4-12.8)
7-day	3.53 (3.27-3.82)	4.25 (3.94-4.60)	5.29 (4.90-5.71)	6.11 (5.64-6.59)	7.25 (6.67-7.82)	8.17 (7.49-8.80)	9.13 (8.32-9.84)	10.1 (9.17-10.9)	11.5 (10.3-12.4)	12.6 (11.2-13.7)
10-day	4.07 (3.80-4.37)	4.88 (4.55-5.24)	5.98 (5.57-6.41)	6.82 (6.35-7.31)	7.97 (7.38-8.53)	8.86 (8.18-9.48)	9.76 (8.98-10.5)	10.7 (9.77-11.5)	11.9 (10.8-12.8)	12.9 (11.6-13.9)
20-day	5.53 (5.19-5.89)	6.58 (6.17-7.01)	7.89 (7.40-8.40)	8.91 (8.35-9.49)	10.3 (9.61-10.9)	11.4 (10.6-12.1)	12.4 (11.5-13.2)	13.5 (12.5-14.4)	14.9 (13.7-16.0)	16.0 (14.6-17.2)
30-day	6.87 (6.48-7.29)	8.13 (7.66-8.62)	9.56 (9.00-10.1)	10.6 (10.0-11.3)	12.1 (11.3-12.8)	13.1 (12.3-13.9)	14.2 (13.2-15.0)	15.2 (14.1-16.1)	16.5 (15.2-17.5)	17.4 (16.0-18.6)
45-day	8.71 (8.24-9.21)	10.3 (9.70-10.8)	11.9 (11.2-12.5)	13.1 (12.4-13.8)	14.6 (13.8-15.4)	15.8 (14.8-16.6)	16.8 (15.8-17.7)	17.8 (16.7-18.8)	19.1 (17.8-20.2)	20.0 (18.6-21.2)
60-day	10.5 (9.96-11.0)	12.3 (11.7-12.9)	14.0 (13.3-14.7)	15.3 (14.5-16.1)	16.9 (16.0-17.8)	18.0 (17.1-19.0)	19.1 (18.0-20.1)	20.1 (18.9-21.2)	21.3 (20.0-22.5)	22.1 (20.7-23.4)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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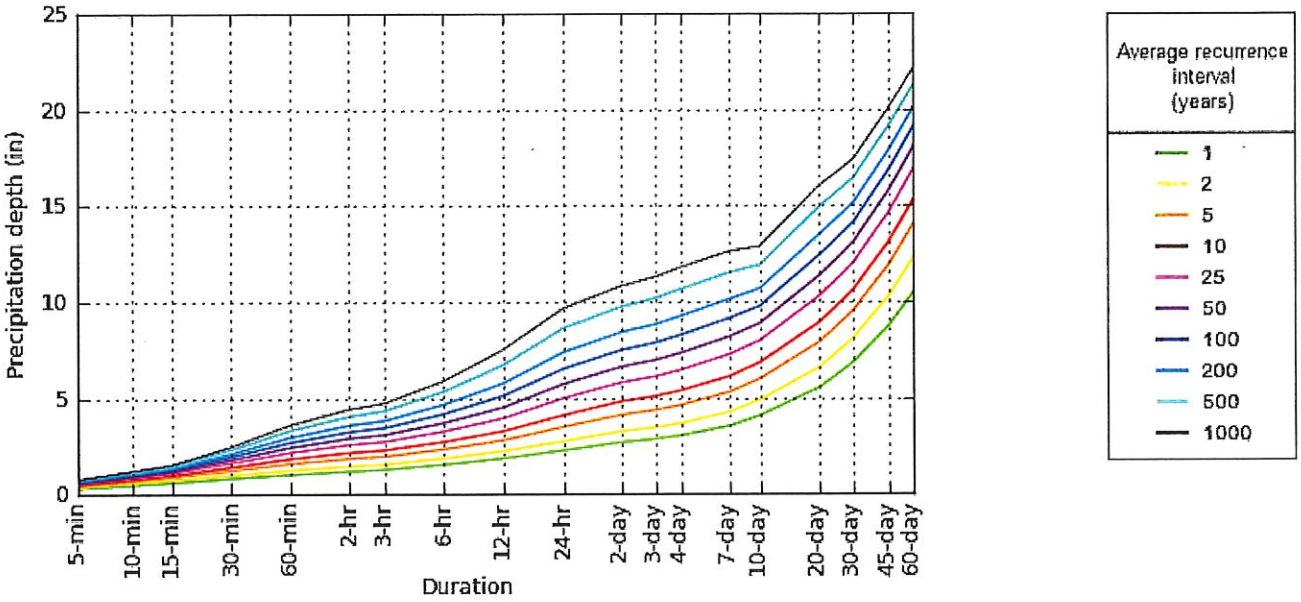
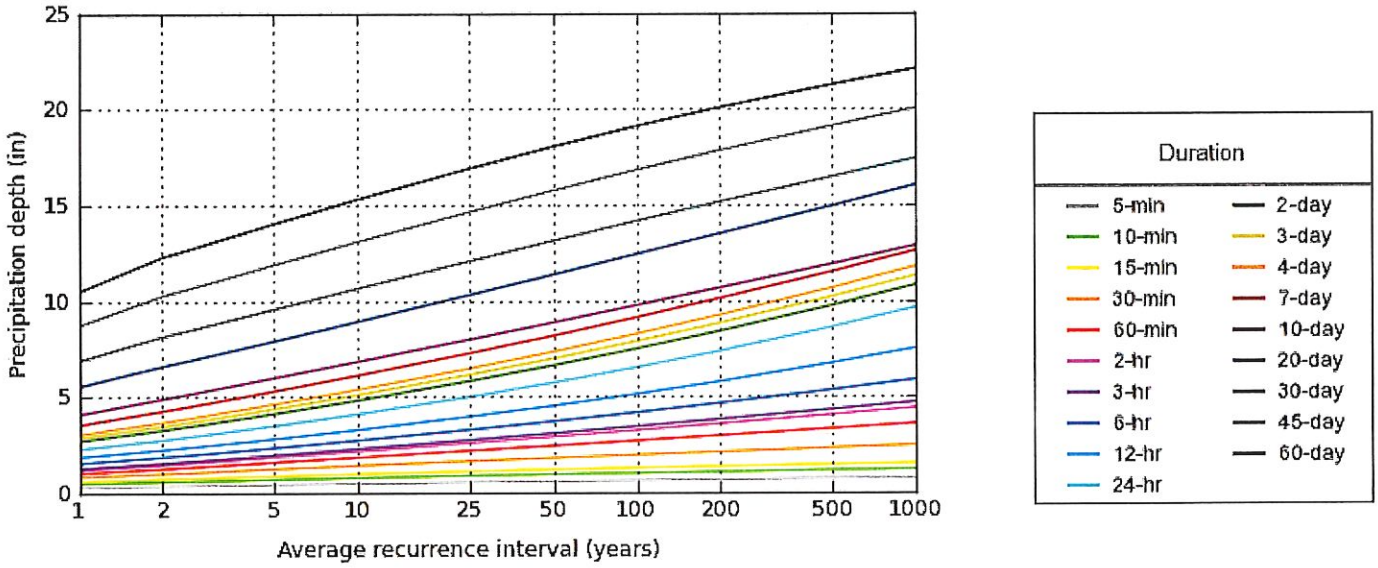
PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 37.1259°, Longitude: -80.4169°





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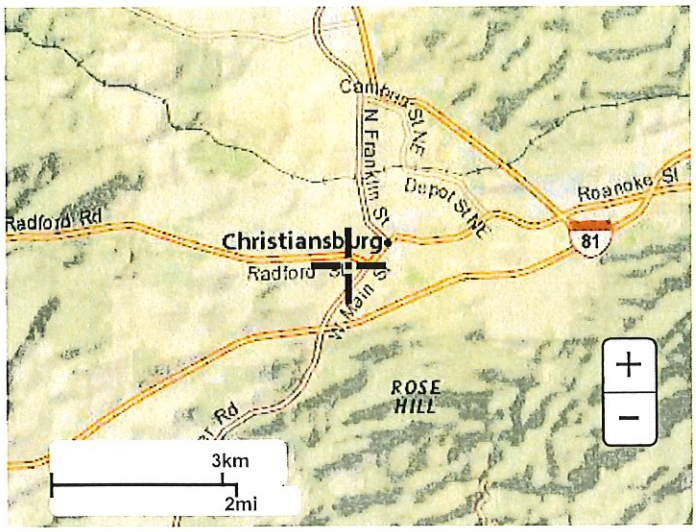
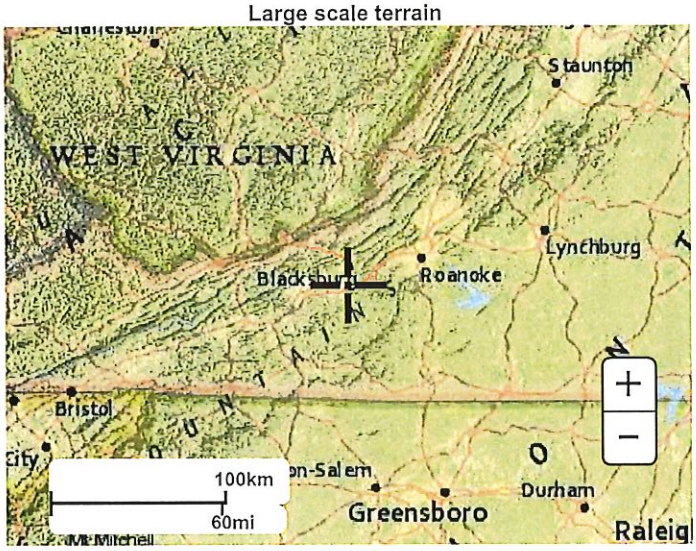
Maps & aerials

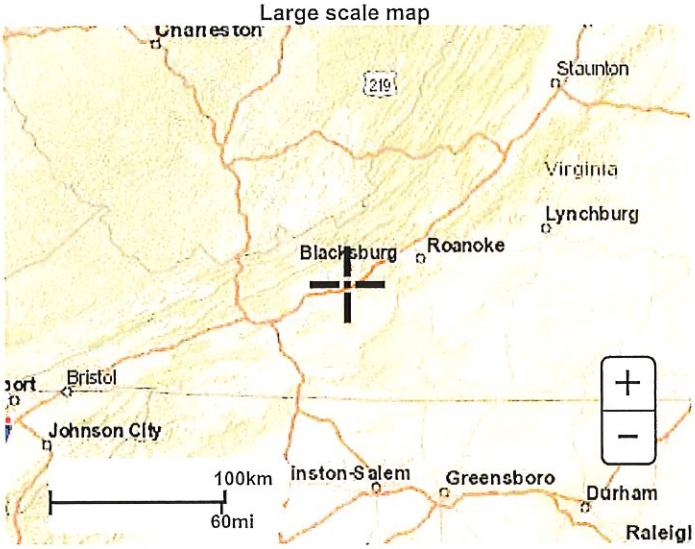
Small scale terrain



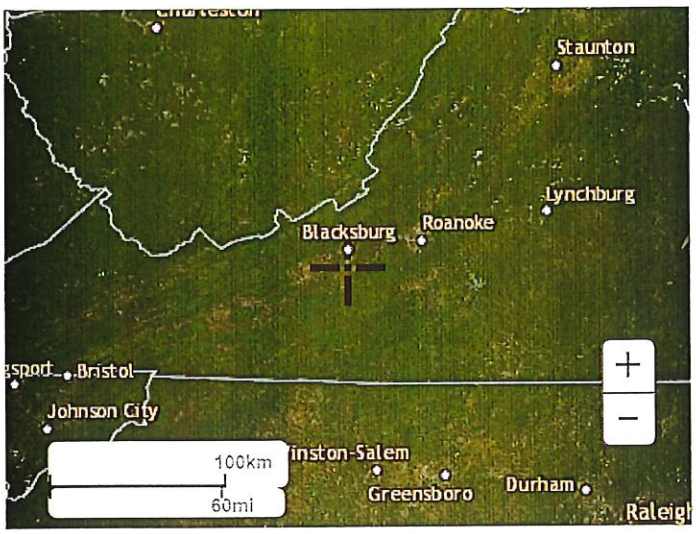
Large scale terrain



Large scale map



Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data, and Information Service

Current Location: Elev: 2100 ft. Lat: 37.1278° N Lon: -80.4033° W
Station: **CHRISTIANSBURG, VA US USC00441692**

Record of Climatological Observations

These data are quality controlled and may not be identical to the original observations.

Generated on 11/10/2020

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Observation Time Temperature: 0700 Observation Time Precipitation: 0700

Year	Month	Day	Temperature (F)			Precipitation					Evaporation		Soil Temperature (F)					
			24 Hrs. Ending at Observation Time		At Obs.	24 Hour Amounts Ending at Observation Time				At Obs. Time	24 Hour Wind Movement (mi)	Amount of Evap. (in)	4 in. Depth			8 in. Depth		
			Max.	Min.		Rain, Melted Snow, Etc. (in)	Flag	Snow, Ice Pellets, Hail (in)	Flag	Snow, Ice Pellets, Hail, Ice on Ground (in)			Ground Cover (see *)	Max.	Min.	Ground Cover (see *)	Max.	Min.
2020	05	01																
2020	05	02	53	42	43	0.00		0.0		0.0								
2020	05	03	73	43	63	0.00		0.0		0.0								
2020	05	04	79	55	56	0.03		0.0		0.0								
2020	05	05	70	49	49	T		0.0		0.0								
2020	05	06	52	45	48	0.21		0.0		0.0								
2020	05	07	52	36	38	0.00		0.0		0.0								
2020	05	08	60	38	47	0.00		0.0		0.0								
2020	05	09	56	29	32	0.13		0.0		0.0								
2020	05	10	49	30	32	0.00		0.0		0.0								
2020	05	11	61	32	41	0.00		0.0		0.0								
2020	05	12	49	36	37	0.00		0.0		0.0								
2020	05	13	57	37	42	0.00		0.0		0.0								
2020	05	14	57	42	52	T		0.0		0.0								
2020	05	15	76	52	55	0.00		0.0		0.0								
2020	05	16	77	54	57	0.00		0.0		0.0								
2020	05	17	82	57	59	0.00		0.0		0.0								
2020	05	18	76	57	58	0.00		0.0		0.0								
2020	05	19	72	49	49	0.75		0.0		0.0								
2020	05	20	50	39	39	1.53		0.0		0.0								
2020	05	21	47	39	47	2.50		0.0		0.0								
2020	05	22	53	46	52			0.0		0.0								
2020	05	23	72	52	56			0.0		0.0								
2020	05	24	74	56	56	*		0.0		0.0								
2020	05	25	81	56	59	1.75		0.0		0.0								
2020	05	26	70	59	62	0.00		0.0		0.0								
2020	05	27	71	61	61	T		0.0		0.0								
2020	05	28	71	61	61	1.33		0.0		0.0								
2020	05	29	78	61	68	0.00		0.0		0.0								
2020	05	30	78	59	59	T		0.0		0.0								
2020	05	31	75	53	55	0.00		0.0		0.0								
Summary			66	48		8.23		0.0										

Empty, or blank, cells indicate that a data observation was not reported.

*Ground Cover: 1=Grass; 2=Fallow; 3=Bare Ground; 4=Brome grass; 5=Sod; 6=Straw mulch; 7=Grass muck; 8=Bare muck; 0=Unknown

"s" This data value failed one of NCDC's quality control tests. "At Obs." = Temperature at time of observation

"T" values in the Precipitation or Snow category above indicate a "trace" value was recorded.

"A" values in the Precipitation Flag or the Snow Flag column indicate a multiday total, accumulated since last measurement, is being used.

Data value inconsistency may be present due to rounding calculations during the conversion process from SI metric units to standard imperial units.

* MIKE KELLY SAYS THIS OCCURRED IN 90-MINUTES

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data, and Information Service

Current Location: Elev: 2018 ft. Lat: 37.1682° N Lon: -80.4443° W
Station: **CHRISTIANSBURG 2.9 NW, VA US US1VAMN0010**

Record of Climatological Observations

These data are quality controlled and may not be identical to the original observations.

Generated on 11/12/2020

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Observation Time Temperature: Unknown Observation Time Precipitation: Unknown

Year	Month	Day	Temperature (F)			Precipitation					Evaporation		Soil Temperature (F)					
			24 Hrs. Ending at Observation Time		At Obs.	24 Hour Amounts Ending at Observation Time				At Obs. Time			4 in. Depth			8 in. Depth		
			Max.	Min.		Rain, Melted Snow, Etc. (in)	Flag	Snow, Ice Pellets, Hail (in)	Flag	Snow, Ice Pellets, Hail, Ice on Ground (in)	24 Hour Wind Movement (mi)	Amount of Evap. (in)	Ground Cover (see *)	Max.	Min.	Ground Cover (see *)	Max.	Min.
2015	09	01				0.00		0.0										
2015	09	02				0.00		0.0										
2015	09	03				0.00		0.0										
2015	09	04				0.03												
2015	09	05				0.09												
2015	09	06				0.00		0.0										
2015	09	07				0.00		0.0										
2015	09	08				0.00		0.0										
2015	09	09				0.00		0.0										
2015	09	10				0.04												
2015	09	11				0.55												
2015	09	12				0.03												
2015	09	13				0.03		0.0										
2015	09	14				0.00		0.0										
2015	09	15				0.00		0.0										
2015	09	16				0.00		0.0										
2015	09	17				0.00		0.0										
2015	09	18				0.00		0.0										
2015	09	19				0.00		0.0										
2015	09	20				0.00		0.0										
2015	09	21				0.85												
2015	09	22				0.03												
2015	09	23				0.00		0.0										
2015	09	24				0.00		0.0										
2015	09	25				0.04												
2015	09	26				0.00		0.0										
2015	09	27				0.75												
2015	09	28		64"		0.85												
2015	09	29				1.50												
2015	09	30				3.30												
		Summary				8.09		0.0										

Empty, or blank, cells indicate that a data observation was not reported.

*Ground Cover: 1=Grass; 2=Fallow; 3=Bare Ground; 4=Brome grass; 5=Sod; 6=Straw mulch; 7=Grass muck; 8=Bare muck; 0=Unknown

"s" This data value failed one of NCDC's quality control tests. "At Obs." = Temperature at time of observation

"T" values in the Precipitation or Snow category above indicate a "trace" value was recorded.

"A" values in the Precipitation Flag or the Snow Flag column indicate a multiday total, accumulated since last measurement, is being used.

Data value inconsistency may be present due to rounding calculations during the conversion process from SI metric units to standard imperial units.

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data, and Information Service

Current Location: Elev: 2175 ft. Lat: 37.1192° N Lon: -80.4193° W
Station: **CHRISTIANSBURG 1.8 SSW, VA US US1VAMN0001**

Record of Climatological Observations

These data are quality controlled and may not be identical to the original observations.

Generated on 11/12/2020

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Observation Time Temperature: Unknown Observation Time Precipitation: Unknown

Year	Month	Day	Temperature (F)			Precipitation					Evaporation		Soil Temperature (F)					
			24 Hrs. Ending at Observation Time		At Obs.	24 Hour Amounts Ending at Observation Time				At Obs. Time	24 Hour Wind Movement (mi)	Amount of Evap. (in)	4 in. Depth			8 in. Depth		
			Max.	Min.		Rain, Melted Snow, Etc. (in)	Flag	Snow, Ice Pellets, Hail (in)	Flag	Snow, Ice Pellets, Hail, Ice on Ground (in)			Ground Cover (see *)	Max.	Min.	Ground Cover (see *)	Max.	Min.
2015	09	01				0.00		0.0										
2015	09	02				0.00		0.0										
2015	09	03				0.00		0.0										
2015	09	04				0.05		0.0										
2015	09	05				0.13		0.0										
2015	09	06				0.00		0.0										
2015	09	07				0.00		0.0										
2015	09	08				0.00		0.0										
2015	09	09				0.00		0.0										
2015	09	10				0.04		0.0										
2015	09	11				0.15		0.0										
2015	09	12				0.01		0.0										
2015	09	13				0.03		0.0										
2015	09	14				0.00		0.0										
2015	09	15				0.00		0.0										
2015	09	16				0.00		0.0										
2015	09	17				0.00		0.0										
2015	09	18				0.00		0.0										
2015	09	19				0.00		0.0										
2015	09	20				0.00		0.0										
2015	09	21				1.40		0.0										
2015	09	22				0.16		0.0										
2015	09	23				0.03		0.0										
2015	09	24				0.00		0.0										
2015	09	25				0.04		0.0										
2015	09	26																
2015	09	27		8.66"		1.61				0.0								
2015	09	28				1.81		0.0										
2015	09	29				1.29		0.0										
2015	09	30				3.95		0.0										
		Summary				10.70		0.0										

Empty, or blank, cells indicate that a data observation was not reported.

*Ground Cover: 1=Grass; 2=Fallow; 3=Bare Ground; 4=Brome grass; 5=Sod; 6=Straw mulch; 7=Grass muck; 8=Bare muck; 0=Unknown

"s" This data value failed one of NCDC's quality control tests. "At Obs." = Temperature at time of observation

"T" values in the Precipitation or Snow category above indicate a "trace" value was recorded.

"A" values in the Precipitation Flag or the Snow Flag column indicate a multiday total, accumulated since last measurement, is being used.

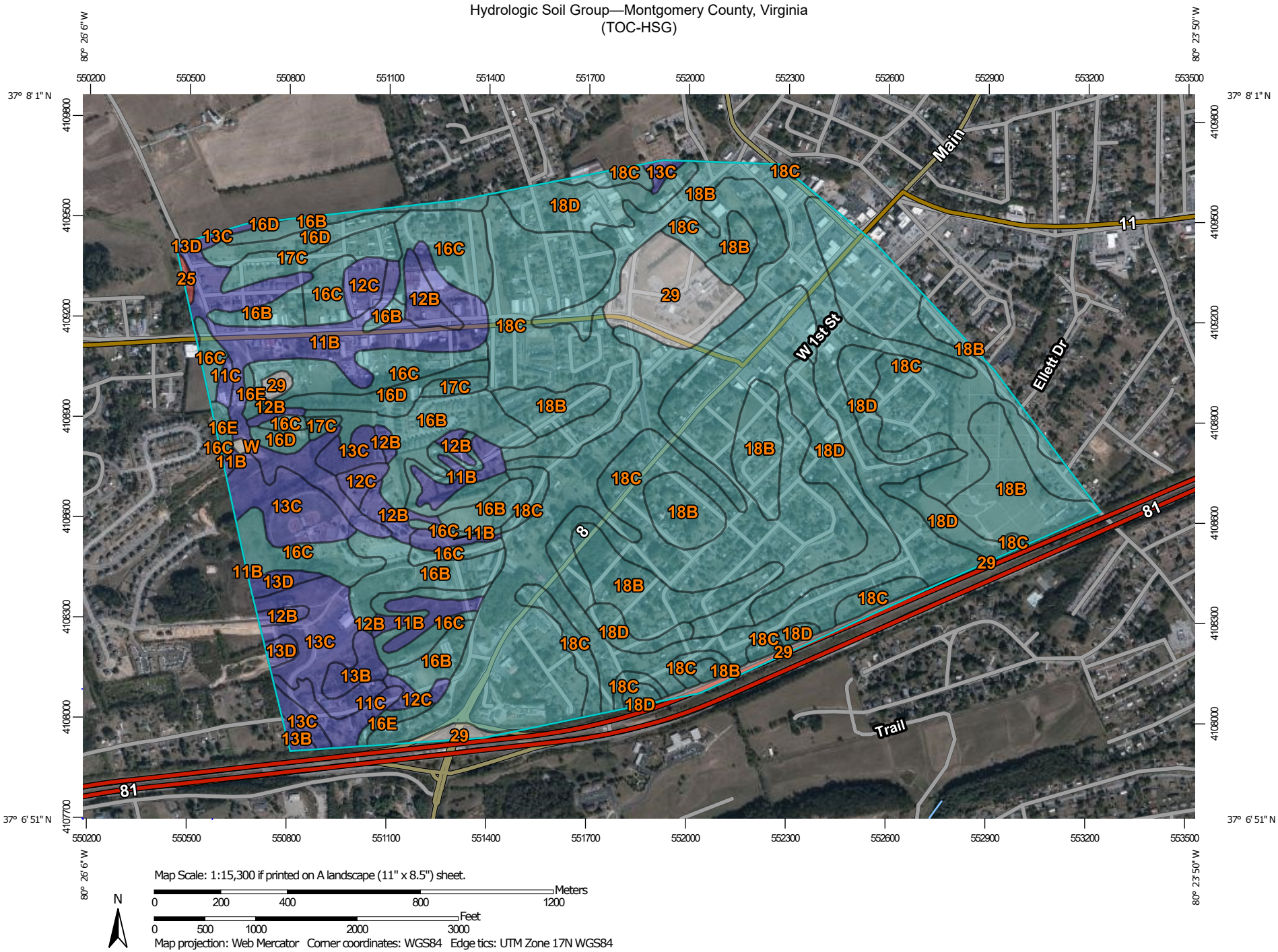
Data value inconsistency may be present due to rounding calculations during the conversion process from SI metric units to standard imperial units.

To: Roanoke.upd@deq.virginia.gov
Cc: Randy Wingfield, James Lancianese, Don Cole, Wayne Nelson, Justin St. Clair, Justin Shepherd, Lawrence Hoffman, Dayton Poff, Zach Trout, Jacquie Peyton, Helen Pack,JW Bishop, H Dodd
In accordance with Part II. G, H,and I of our VPDES permit, the Town of Christiansburg WWTF is providing the following 24 hour notification and 5 Day Letter:
The table below summarizes the event and includes information concerning the location, nature, cause, start and stop time, discharge volume, and any adverse effects of the discharge.

VPDES Number:	**VA0061751**	**Facility:**	**Town of Christiansburg WWTF**
Type and nature of discharge:	**Untreated domestic wastewater & rainfall**	**Estimate Volume in gallons:**	**1,054,020**
Location:	**75 Mill Lane Manhole # TP-1007**		
Start Date:	**5/20/2020**	**Start Time:**	**6:20 AM**
End Date:	**5/27/2020**	**End Time:**	**2:00 PM**
Cause of Discharge:	**High flows produced by heavy rains**		
Rainfall received @ WWTF:	**4.8 " in 72 hours- 5/20-22/2020 and 2" in 45 minutes- 5/24/2020 (in Town only)**		**Inches**
Adverse effects:	**None noted**		
Did discharge reach state waters?	**Yes, Town Branch**		
Contact name and title:	**Helen Pack, Laboratory Supervisor**		
Contact phone number:	**(540) 382-8221**		
Comments:	**2020-CS-16**		

Please feel free to contact the WWTF if you need additional information.

Hydrologic Soil Group—Montgomery County, Virginia
(TOC-HSG)



MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Soil Rating Lines

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Soil Rating Points

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Water Features

Streams and Canals

Transportation

Rails
Interstate Highways
US Routes
Major Roads
Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Montgomery County, Virginia
Survey Area Data: Version 13, Jun 5, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 29, 2019—Oct 4, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
11B	Duffield-Ernest complex, 2 to 7 percent slopes	B	57.4	6.8%
11C	Duffield-Ernest complex, 7 to 15 percent slopes	B	7.7	0.9%
12B	Frederick and Vertrees silt loams, 2 to 7 percent slopes	B	15.3	1.8%
12C	Frederick and Vertrees silt loams, 7 to 15 percent slopes	B	9.6	1.1%
13B	Frederick and Vertrees gravelly silt loams, 2 to 7 percent slopes	B	5.9	0.7%
13C	Frederick and Vertrees gravelly silt loams, 7 to 15 percent slopes	B	43.0	5.1%
13D	Frederick and Vertrees gravelly silt loams, 15 to 25 percent slopes	B	4.8	0.6%
16B	Groseclose and Poplimento soils, 2 to 7 percent slopes	C	55.8	6.6%
16C	Groseclose and Poplimento soils, 7 to 15 percent slopes	C	66.3	7.9%
16D	Groseclose and Poplimento soils, 15 to 25 percent slopes	C	18.1	2.1%
16E	Groseclose and Poplimento soils, 25 to 60 percent slopes	C	5.0	0.6%
17C	Groseclose and Poplimento gravelly soils, 7 to 15 percent slopes	C	13.2	1.6%
18B	Groseclose-Urban land complex, 2 to 7 percent slopes	C	227.0	27.0%
18C	Groseclose-Urban land complex, 7 to 15 percent slopes	C	223.3	26.5%
18D	Groseclose-Urban land complex, 15 to 25 percent slopes	C	59.4	7.0%
25	McGary and Purdy soils	D	0.8	0.1%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
29	Udorthents and Urban land		29.1	3.5%
W	Water		0.4	0.1%
Totals for Area of Interest			**842.2**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "Dominant Condition" first groups like attribute values for the components in a map unit. For each group, percent composition is set to the sum of the percent composition of all components participating in that group. These groups now represent "conditions" rather than components. The attribute value associated with the group with the highest cumulative percent composition is returned. If more than one group shares the highest cumulative percent composition, the corresponding "tie-break" rule determines which value should be returned. The "tie-break" rule indicates whether the lower or higher group value should be returned in the case of a percent composition tie. The result returned by this aggregation method represents the dominant condition throughout the map unit only when no tie has occurred.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

APPENDIX D

Drainage System Analysis

(Hydraulic Results)

Summary 1: Options

Name	Existing	Alternative 1	Alternative 2A	Alternative 2B
Flow Units	CFS	CFS	CFS	CFS
Infiltration method	Horton	Horton	Horton	Horton
Flow routing method	Dynamic Wave	Dynamic Wave	Dynamic Wave	Dynamic Wave
Link offsets defined by	Depth	Depth	Depth	Depth
Allow ponding	No	No	No	No
Skip steady flow periods	No	No	No	No
Inertial dampening	Partial	Partial	Partial	Partial
Define supercritical flow by	Both	Both	Both	Both
Force Main Equation	H-W	H-W	H-W	H-W
Variable time step	On	On	On	On
Adjustment factor (%)	75	75	75	75
Conduit lengthening (s)	0	0	0	0
Minimum surface area (ft²)	0	0	0	0
Starting date	Nov-24-2020 12:00:00 AM	Nov-24-2020 12:00:00 AM	Nov-24-2020 12:00:00 AM	Nov-24-2020 12:00:00 AM
Ending date	Nov-25-2020 12:00:00 AM	Nov-25-2020 12:00:00 AM	Nov-25-2020 12:00:00 AM	Nov-25-2020 12:00:00 AM
Duration of simulation (hours)	24	24	24	24
Antecedent dry days (days)	0	0	0	0
Rain interval (h:mm)	0:01	0:01	0:01	0:01
Report time step (h:mm:ss)	00:01:00	00:01:00	00:01:00	00:01:00
Wet time step (h:mm:ss)	00:05:00	00:05:00	00:05:00	00:05:00
Dry time step (h:mm:ss)	00:05:00	00:05:00	00:05:00	00:05:00
Routing time step (s)	5	5	5	5
Minimum time step used (s)	0.3	0.42	0.39	0.16
Average time step used (s)	1.17	1.27	1.19	1.22
Minimum conduit slope	0	0	0	0
Ignore rainfall/runoff	No	No	No	No
Ignore snow melt	No	No	No	No
Ignore groundwater	No	No	No	No

Summary 1: Options (continued...)

Name	Existing	Alternative 1	Alternative 2A	Alternative 2B
Ignore flow routing	No	No	No	No
Ignore water quality	No	No	No	No
Report average results	No	No	No	No

Summary 2: Model inventory

Name	Existing	Alternative 1	Alternative 2A	Alternative 2B
Raingages	6	6	6	6
Subcatchments	30	30	30	30
Aquifers	0	0	0	0
Snowpacks	0	0	0	0
RDII hydrographs	0	0	0	0
Junction nodes	122	122	116	113
Outfall nodes	1	1	1	1
Flow divider nodes	0	0	0	0
Storage unit nodes	8	8	9	8
Conduit links	101	101	98	96
Pump links	0	0	0	0
Orifice links	8	8	10	8
Weir links	8	8	9	8
Outlet links	12	12	7	4
Treatment units	0	0	0	0
Transects	3	3	3	3
Control rules	0	0	0	0
Pollutants	0	0	0	0
Land Uses	0	0	0	0
Control Curves	0	0	0	0
Diversion Curves	0	0	0	0
Pump Curves	0	0	0	0
Rating Curves	0	0	0	0
Shape Curves	0	0	0	0
Storage Curves	10	10	11	11
Tidal Curves	0	0	0	0
Weir Curves	0	0	0	0
Time Series	1	1	1	1
Time Patterns	0	0	0	0

Summary 3: Model complexity

Name	Existing	Alternative 1	Alternative 2A	Alternative 2B
Subcatchments	420	420	420	420
Groundwater	0	0	0	0
Aquifers	n/a	n/a	n/a	n/a
Snowpacks	n/a	n/a	n/a	n/a
RDII hydrographs	n/a	n/a	n/a	n/a
Junction nodes	151	116	136	130
Outfall nodes	1	1	1	1
Flow divider nodes	n/a	n/a	n/a	n/a
Storage unit nodes	23	23	27	24
Conduit links	552	537	566	563
Pump links	n/a	n/a	n/a	n/a
Orifice links	24	24	30	24
Weir links	32	32	36	32
Outlet links	24	n/a	14	8
Transect	9	9	9	9
Pollutants	n/a	n/a	n/a	n/a
Land Uses	n/a	n/a	n/a	n/a
Model complexity (total uncertain input parameters)	1236	1162	1239	1211

Summary 4: Inflows

Name	Existing	Alternative 1	Alternative 2A	Alternative 2B
Time series inflows	0	0	0	0
Dry weather	0	0	0	0
Groundwater	0	0	0	0
RDII inflows	0	0	0	0

Summary 5: Subcatchment statistics

Name	Existing	Alternative 1	Alternative 2A	Alternative 2B
Max. width (ft)	1864	1864	1864	1864
Min. width (ft)	120	120	120	120
Max. area (ac)	64.9449	64.9449	64.9449	64.9449
Min. area (ac)	0.7252	0.7252	0.7252	0.7252
Total area (ac)	279.2534	279.2534	279.2534	279.2534
Max. length of overland flow (ft)	1667.0194	1667.0194	1667.0194	1667.0194
Min. length of overland flow (ft)	63.1794	63.1794	63.1794	63.1794
Max. slope (%)	5	5	5	5

Summary 5: Subcatchment statistics (continued...)

Name	Existing	Alternative 1	Alternative 2A	Alternative 2B
Min. slope (%)	0.5	0.5	0.5	0.5
Max. imperviousness (%)	92	92	92	92
Min. imperviousness (%)	7	7	7	7
Max. imp. roughness	0.01	0.01	0.01	0.01
Min. imp. roughness	0.01	0.01	0.01	0.01
Max. perv. roughness	0.1	0.1	0.1	0.1
Min. perv. roughness	0.1	0.1	0.1	0.1
Max. imp. depression storage (in)	0.05	0.05	0.05	0.05
Min. imp. depression storage (in)	0.05	0.05	0.05	0.05
Max. perv. depression storage (in)	0.05	0.05	0.05	0.05
Min. perv. depression storage (in)	0.05	0.05	0.05	0.05

Summary 6: Node statistics

Name	Existing	Alternative 1	Alternative 2A	Alternative 2B
Max. ground elev. (ft)	2193	2193	2193	2193
Min. ground elev. (ft)	2075.5	2075.5	2075.5	2075.5
Max. invert elev. (ft)	2188	2188	2188	2188
Min. invert elev. (ft)	2071	2071	2071	2071
Max. depth (ft)	5	5	5	5
Min. depth (ft)	0	0	0	0

Summary 7: Conduit statistics

Name	Existing	Alternative 1	Alternative 2A	Alternative 2B
Max. roughness	0.045	0.035	0.033	0.033
Min. roughness	0.01	0.01	0.01	0.01
Max. entry loss coef.	0.3	0.3	0.3	0.3
Min. entry loss coef.	0	0	0	0
Max. exit loss coef.	0.5	0.5	0.5	0.5
Min. exit loss coef.	0	0	0	0
Max. avg. loss coef.	0	0	0	0
Min. avg. loss coef.	0	0	0	0
Max. length (ft)	759.695	759.695	759.695	759.695
Min. length (ft)	10.164	10.164	10.164	10.164
Total length (ft)	12549.204	12174.095	12712.752	12329.278
Max. slope (ft/ft)	0.1567	0.1567	0.1567	0.1567
Min. slope (ft/ft)	0.0013	0.0002	0.0013	0.0013

Summary 8: Conduit Inventory

Name	Existing	Alternative 1	Alternative 2A	Alternative 2B
Open Rectangular (ft)	375.499	436.882	408.835	408.835
Trapezoidal (ft)	515.704	515.704	515.704	515.704
Triangular (ft)	108.857	108.857	108.857	108.857
Irregular (ft)	4876.536	4440.044	3066.606	2440.642
Circular (ft)	5450.777	5450.777	7328.304	7559.651
Closed Rectangular (ft)	845.848	845.848	845.848	845.848
Horizontal Elliptical (ft)	41.814	41.814	41.814	41.814
Vertical Elliptical (ft)	334.169	334.169	396.784	407.927

Summary 9: Pipe inventory

Name	Existing	Alternative 1	Alternative 2A	Alternative 2B
Max. pipe diameter (ft)	5.5	5.5	5.5	5.5
Min. pipe diameter (ft)	0.66	0.66	0.66	0.66
Total 12” pipe length (ft)	222.465	222.465	159.988	159.988
Total 15” pipe length (ft)	697.398	697.398	344.871	344.871
Total 18” pipe length (ft)	1127.143	1127.143	1110.543	1649.577
Total 24” pipe length (ft)	1389.725	1389.725	2843.052	1569.764
Total 30” pipe length (ft)	0	0	622.231	231.347
Total 36” pipe length (ft)	839.087	839.087	551.617	1908.102
Total 48” pipe length (ft)	977.552	977.552	1498.595	1498.595
Total 66” pipe length (ft)	105.934	105.934	105.934	105.934
Total other pipe length (ft)	91.473	91.473	91.473	91.473
Total pipe length (ft)	5450.777	5450.777	7328.304	7559.651

Summary 10: Unused objects

Name	Existing	Alternative 1	Alternative 2A	Alternative 2B
Rain Gages	0	0	0	0
Aquifers	n/a	n/a	n/a	n/a
Snow Packs	n/a	n/a	n/a	n/a
Unit Hydrographs	n/a	n/a	n/a	n/a
Transects	0	0	1	1
Control Curves	n/a	n/a	n/a	n/a
Diversion Curves	n/a	n/a	n/a	n/a
Pump Curves	n/a	n/a	n/a	n/a
Rating Curves	n/a	n/a	n/a	n/a
Shape Curves	n/a	n/a	n/a	n/a

Summary 10: Unused objects (continued...)

Name	Existing	Alternative 1	Alternative 2A	Alternative 2B
Storage Curves	2	2	2	3
Tidal Curves	n/a	n/a	n/a	n/a
Weir Curves	n/a	n/a	n/a	n/a
Time Series	0	0	0	0
Time Patterns	n/a	n/a	n/a	n/a

Summary 11: Runoff quantity continuity

Name	Existing	Alternative 1	Alternative 2A	Alternative 2B
Initial LID storage (in)	n/a	n/a	n/a	n/a
Initial snow cover (in)	n/a	n/a	n/a	n/a
Total precipitation (in)	14.502	11.026	11.026	11.026
Outfall runon (in)	n/a	n/a	n/a	n/a
Evaporation loss (in)	0.000	0.000	0.000	0.000
Infiltration loss (in)	6.284	6.085	6.085	6.085
Surface runoff (in)	7.616	4.484	4.484	4.484
LID drainage (in)	n/a	n/a	n/a	n/a
Snow removed (in)	n/a	n/a	n/a	n/a
Final snow cover (in)	n/a	n/a	n/a	n/a
Final storage (in)	0.642	0.481	0.481	0.481
Continuity error (%)	-0.269	-0.221	-0.221	-0.221

Summary 12: Flow routing continuity

Name	Existing	Alternative 1	Alternative 2A	Alternative 2B
Dry weather inflow (MG)	0.000	0.000	0.000	0.000
Wet weather inflow (MG)	57.715	33.982	33.982	33.982
Groundwater inflow (MG)	0.000	0.000	0.000	0.000
RDII inflow (MG)	0.000	0.000	0.000	0.000
External inflow (MG)	0.000	0.000	0.000	0.000
External outflow (MG)	30.530	21.040	24.882	29.235
Flooding loss (MG)	25.591	10.905	6.667	3.120
Evaporation loss (MG)	0.000	0.000	0.000	0.000
Exfiltration loss (MG)	0.000	0.000	0.000	0.000
Initial stored volume (MG)	0.000	0.000	0.000	0.000
Final stored volume (MG)	2.169	2.014	2.480	1.615
Continuity error (%)	-0.995	0.069	-0.135	0.034

Summary 13: Results statistics

Name	Existing	Alternative 1	Alternative 2A	Alternative 2B
Max. subcatchment total runoff (MG)	12.21	6.91	6.91	6.91
Max. subcatchment peak runoff (cfs)	48.87	30.83	30.83	30.83
Max. subcatchment runoff coefficient	0.942	0.912	0.912	0.912
Max. subcatchment total precip (in)	14.5	11.03	11.03	11.03
Min. subcatchment total precip (in)	14.5	11.03	11.03	11.03
Max. node depth (ft)	5	5	4.69	4.24
Num. nodes surcharged	29	27	22	19
Max. node surcharge duration (hours)	24	24	24	24
Max. node height above crown (ft)	2	0	0.005	0
Min. node depth below rim (ft)	-2.25	0	-2153.08	-2153.08
Num. nodes flooded	16	13	6	4
Max. node flooding duration (hours)	14.13	13.39	9.96	9.16
Max. node flood volume (MG)	8.631	4.532	3.698	3.024
Max. node ponded volume or depth (acre-in/1000 ft^3/ft)	2	0	0	0
Max. storage volume (1000 ft^3)	154.579	144.95	126.897	126.896
Max. storage percent full (%)	100	100	91	82
Max. outfall flow frequency (%)	99.21	99.38	99.49	99.49
Max. outfall peak flow (cfs)	90.71	69.62	87.04	108.91
Max. outfall total volume (MG)	30.527	21.038	24.88	29.233
Total outfall volume (MG)	30.527	21.038	24.880	29.233
Max. link peak flow (cfs)	91.16	62.22	84.04	167.93
Max. link peak velocity (ft/s)	50	13.67	50	50
Min. link peak velocity (ft/s)	0	0	0.72	0.72
Num. conduits surcharged	34	28	21	17
Max. conduit surcharge duration (hours)	18.22	17.49	17.49	17.49
Max. conduit capacity limited duration (hours)	13.51	12.68	0.01	1.1

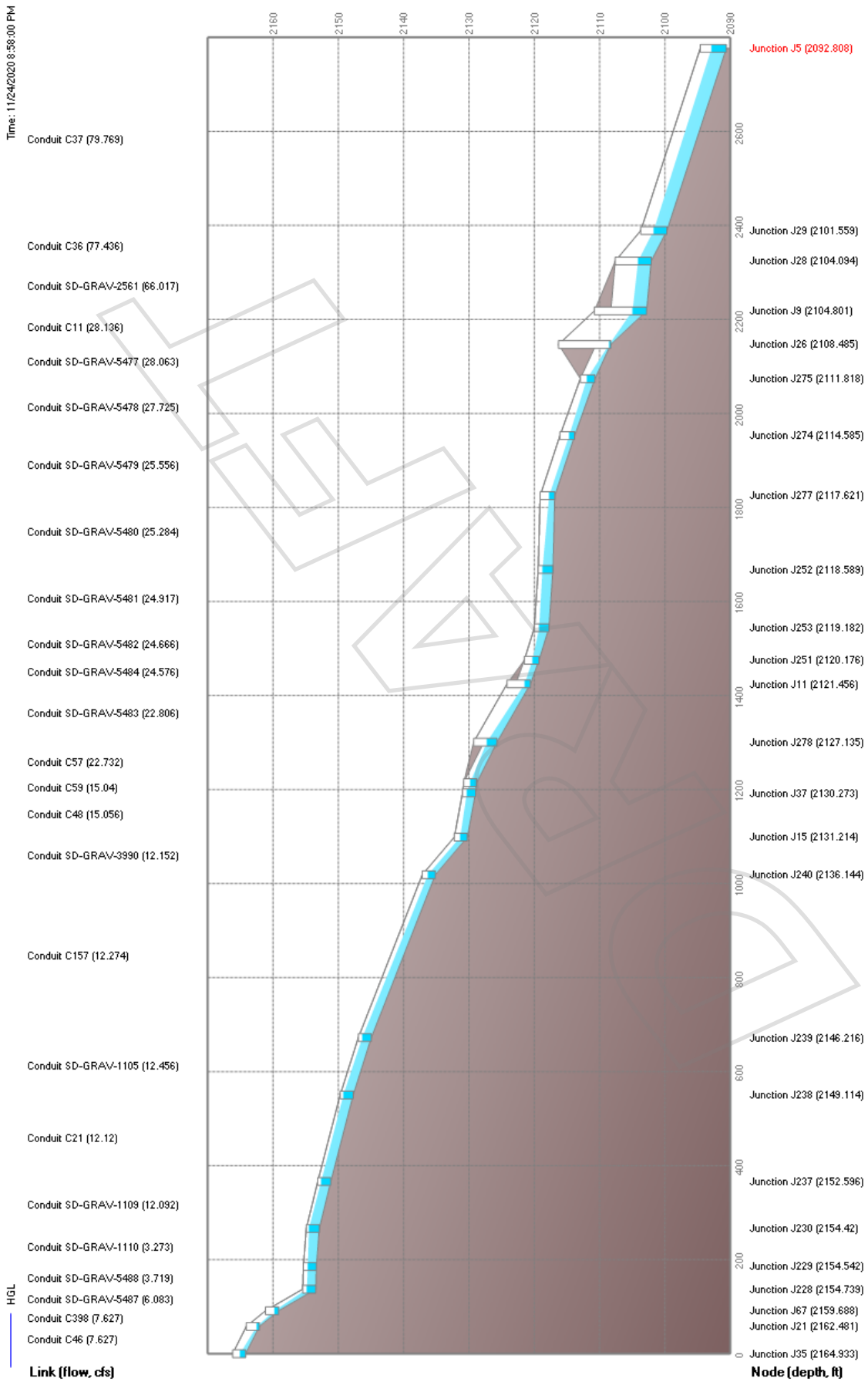


Figure 2: CollegeSt

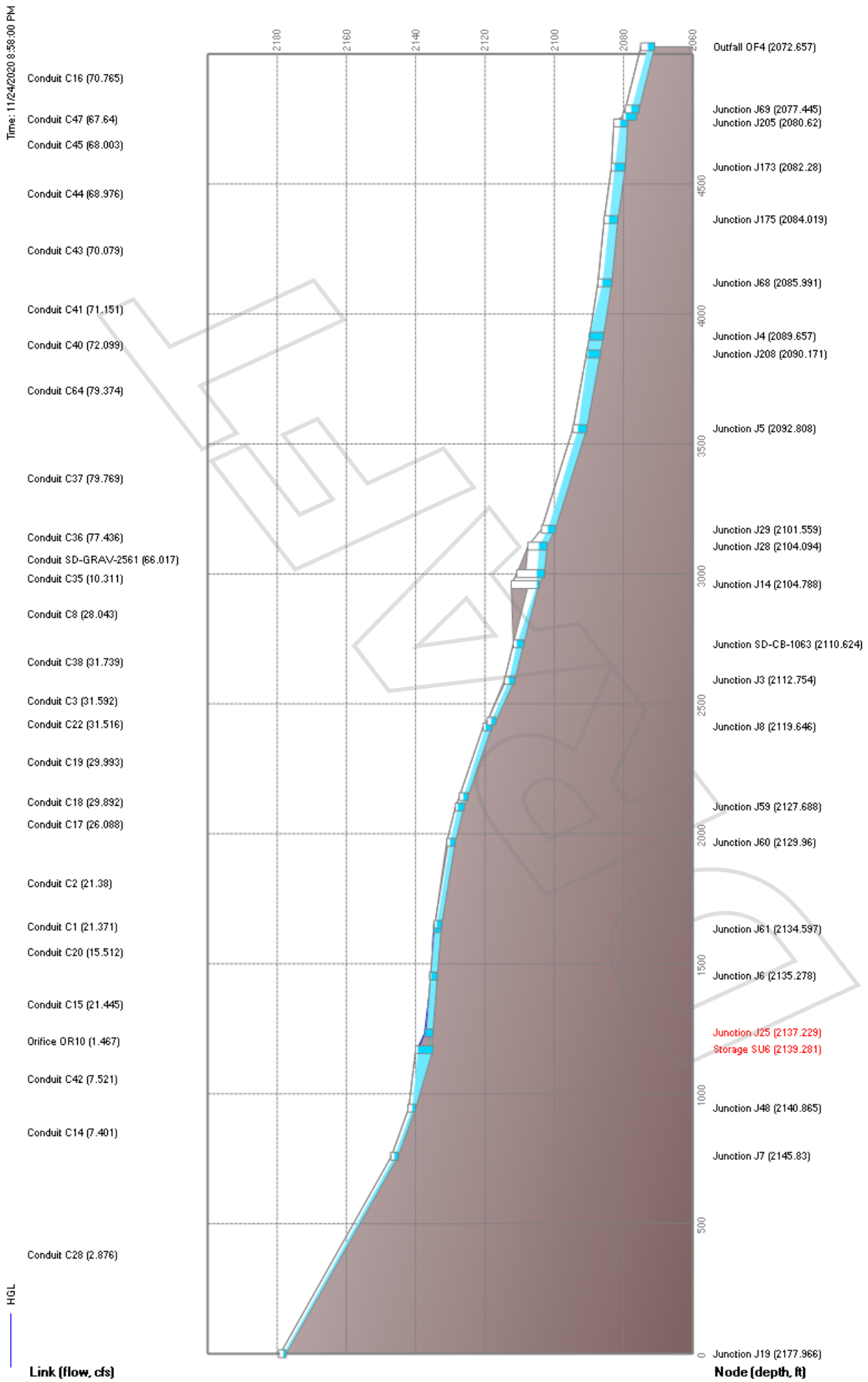


Figure 3: FloodReach


N
12
8
7
11
6
10
9
5
3
4
2
1
Existing BMP
Conduits
Subcatchments
PC-SWMM Model Results Index Map
0 230 460 920 1,380 1,840
Feet

ID: 1
BMP: More Western BMP along Mudpike Drive
Description: Localized BMP capturing runoff from a Self-Storage Unit Facility
Planned Upgrade: Install Low Flow Orifice
Drainage Area = 1.33ac
Basin Invert = 2188.0'

Design Storm	Existing Flow	Proposed Flow
2yr-24hr	1.99	1.25
10yr-1hr	2.06	1.31
10yr-24hr	4.49	1.63
25yr-1hr	3.10	1.56
25yr-24hr	5.84	1.84
100yr-24hr	7.86	4.53

Design Storm	Existing Peak	Proposed Peak
2yr-24hr	2,191.2	2,189.7
10yr-1hr	2,191.3	2,190.2
10yr-24hr	2,191.6	2,191.1
25yr-1hr	2,191.5	2,190.9
25yr-24hr	2,191.8	2,191.8
100yr-24hr	2,191.4	2,192.6

ID: 2
BMP: More Eastern BMP along Mudpike Drive
Description: Localized BMP capturing runoff before it travels under College Street
Planned Upgrade: Install Steel Plate with Low Flow Orifice
Drainage Area = 2.42ac
Basin Invert = 2180.0'

Design Storm	Existing Flow	Proposed Flow
2yr-24hr	2.39	0.54
10yr-1hr	2.67	0.58
10yr-24hr	4.38	1.46
25yr-1hr	3.51	1.21
25yr-24hr	5.44	2.32
100yr-24hr	7.02	5.08

Design Storm	Existing Peak	Proposed Peak
2yr-24hr	2,181.9	2,181.8
10yr-1hr	2,182.0	2,181.8
10yr-24hr	2,182.2	2,182.1
25yr-1hr	2,182.1	2,181.9
25yr-24hr	2,182.3	2,182.5
100yr-24hr	2,182.6	2,182.8

ID: 3
BMP: Hospice BMP
Description: Localized BMP capturing runoff from a planned future use site
Planned Upgrade: No Upgrades Planned - sized for future development
Drainage Area = 13.89ac
Basin Invert = 2175.7'

Design Storm	Existing Flow	Proposed Flow
2yr-24hr	0.52	N/A
10yr-1hr	0.54	N/A
10yr-24hr	0.81	N/A
25yr-1hr	0.67	N/A
25yr-24hr	3.27	N/A
100yr-24hr	12.57	N/A

Design Storm	Existing Peak	Proposed Peak
2yr-24hr	2,178.2	N/A
10yr-1hr	2,178.4	N/A
10yr-24hr	2,180.1	N/A
25yr-1hr	2,179.1	N/A
25yr-24hr	2,180.3	N/A
100yr-24hr	2,180.9	N/A

ID: 4
BMP: Townhome BMP Along Buffalo Dr
Description: Localized BMP capturing runoff from the surrounding townhomes
Planned Upgrade: No Planned Upgrade
Drainage Area = 0.73ac
Basin Invert = 2169.7

Design Storm	Existing Flow	Proposed Flow
2yr-24hr	0.50	N/A
10yr-1hr	0.54	N/A
10yr-24hr	0.66	N/A
25yr-1hr	0.57	N/A
25yr-24hr	1.24	N/A
100yr-24hr	3.50	N/A

Design Storm	Existing Peak	Proposed Peak
2yr-24hr	2,171.7	N/A
10yr-1hr	2,171.9	N/A
10yr-24hr	2,172.1	N/A
25yr-1hr	2,172.0	N/A
25yr-24hr	2,172.2	N/A
100yr-24hr	2,172.4	N/A

ID: 5
BMP: Townhome BMP Along College St and Buffalo Dr
Description: Localized BMP capturing runoff from the surrounding townhomes
Planned Upgrade: Add a berm for inc. storage and install a raised lowflow orifice
Drainage Area = 4.08ac
Basin Invert = 2156.3'

Design Storm	Existing Flow	Proposed Flow
2yr-24hr	5.45	1.92
10yr-1hr	7.34	2.04
10yr-24hr	9.12	2.83
25yr-1hr	8.95	2.52
25yr-24hr	9.23	3.64
100yr-24hr	9.27	5.77

Design Storm	Existing Peak	Proposed Peak
2yr-24hr	2,158.1	2,159.9
10yr-1hr	2,158.7	2,160.2
10yr-24hr	2,159.1	2,160.8
25yr-1hr	2,158.9	2,160.4
25yr-24hr	2,159.3*	2,161.0
100yr-24hr	2,159.3*	2,161.1

*** Denotes Basin Rim Elevation**

ID: 6
BMP: Christiansburg Middle School
Description: Large roadside BMP handling runoff from the Middle School
Planned Upgrade: C-Shaped Lowflow Weir/Orifice Structure to Reduce Peak Flows
Drainage Area = 18.73ac
Basin Invert = 2164.2'

Design Storm	Existing Flow	Proposed Flow
2yr-24hr	0.26	0.24
10yr-1hr	0.29	0.28
10yr-24hr	3.13	3.06
25yr-1hr	2.81	2.61
25yr-24hr	6.64	6.43
100yr-24hr	12.79	12.79

Design Storm	Existing Peak	Proposed Peak
2yr-24hr	2,165.7	2,165.8
10yr-1hr	2,166.1	2,166.1
10yr-24hr	2,166.5	2,166.7
25yr-1hr	2,166.3	2,166.4
25yr-24hr	2,169.0	2,169.1
100yr-24hr	2,169.2*	2,169.2*

*** Denotes Basin Rim Elevation**

ID: 7
BMP: Hilcrest Dr Backyard BMP
Description: Localized BMP capturing runoff from the surrounding buildings
Planned Upgrade: Resizing Orifice to create more Detention and Expanding Basin
Drainage Area = 4.84ac
Basin Invert = 2150.8'

Design Storm	Existing Flow	Proposed Flow
2yr-24hr	8.04	3.10
10yr-1hr	8.13	3.14
10yr-24hr	11.03	4.67
25yr-1hr	10.92	3.33
25yr-24hr	11.48	6.04
100yr-24hr	11.80	7.06

Design Storm	Existing Peak	Proposed Peak
2yr-24hr	2,154.6	2,154.5
10yr-1hr	2,154.9	2,154.7
10yr-24hr	2,155.4	2,155.2
25yr-1hr	2,155.1	2,154.9
25yr-24hr	2,155.7	2,155.3
100yr-24hr	2,155.8*	2,155.6

*** Denotes Basin Rim Elevation**

ID: 8
BMP: BMP Along Depot St Draining into Creek
Description: Localized BMP capturing stormwater runoff along Depot St
Planned Upgrade: Clean Blockage at Lowflow - high sediment accumulation in basin
Drainage Area = 2.99ac
Basin Invert = 2100.8

Design Storm	Existing Flow	Proposed Flow
2yr-24hr	6.52	N/A
10yr-1hr	6.88	N/A
10yr-24hr	7.95	N/A
25yr-1hr	7.69	N/A
25yr-24hr	8.98	N/A
100yr-24hr	13.22	N/A

Design Storm	Existing Peak	Proposed Peak
2yr-24hr	2,101.7	N/A
10yr-1hr	2,101.9	N/A
10yr-24hr	2,102.5	N/A
25yr-1hr	2,102.4	N/A
25yr-24hr	2,102.6	N/A
100yr-24hr	2,102.8	N/A

ID: 9
Flow Monitor Location 1 / Proposed BMP
Description: Upstream West Main Street flow joining the flood prone area
Planned Upgrade: Detention Basin to Offset Peaks
Drainage Area = 98.24ac
Ground Elevation = 2140.0'

Design Storm	Existing Flow	Alternative 2A	Alternative 2B
2yr-24hr	9.25	7.10	10.56
10yr-1hr	14.23	12.39	16.44
10yr-24hr	20.43	18.02	24.87
25yr-1hr	18.17	16.30	20.08
25yr-24hr	43.29	26.17	46.78
100yr-24hr	52.69	49.88	62.24

Design Storm	Existing Peak	Alternative 2A	Alternative 2B
2yr-24hr	2,137.8	2,138.1	2,137.4
10yr-1hr	2,138.2	2,138.4	2,137.4
10yr-24hr	2,138.6	2,139.0	2,137.6
25yr-1hr	2,138.5	2,138.7	2,137.5
25yr-24hr	2,139.2	2,139.6	2,137.8
100yr-24hr	2,140.0	2,140.0	2,138.0

ID: 10
Flow Monitor Location 2
Description: Downstream West Main Street flow joining the flood prone area
Planned Upgrade: Pipe Installations
Drainage Area = 107.79ac
Ground Elevation = 2131.1'

Design Storm	Existing Flow	Alternative 2A	Alternative 2B
2yr-24hr	12.43	9.89	15.80
10yr-1hr	16.78	13.22	18.47
10yr-24hr	22.47	20.33	25.48
25yr-1hr	21.87	18.06	24.91
25yr-24hr	48.38	31.42	53.22
100yr-24hr	74.89	54.54	80.79

Design Storm	Existing Peak	Alternative 2A	Alternative 2B
2yr-24hr	2,128.9	2,192.2	2,129.1
10yr-1hr	2,129.3	2,129.4	2,129.3
10yr-24hr	2,130.3	2,129.8	2,130.3
25yr-1hr	2,129.5	2,129.7	2,129.5
25yr-24hr	2,130.2	2,130.3	2,130.8
100yr-24hr	2,131.1	2,130.6	2,131.1

ID: 11
Flow Monitor Location 3
Description: Start of 36" Pipe under the Moose Lodge
Planned Upgrade: Pipe Installations
Drainage Area = 124.38ac
Ground Eleavtion = 2113.0'

Design Storm	Existing Flow	Alternative 2A	Alternative 2B
2yr-24hr	15.56	11.89	19.13
10yr-1hr	20.32	17.76	23.32
10yr-24hr	30.41	26.09	31.98
25yr-1hr	28.82	22.94	30.46
25yr-24hr	58.41	41.73	64.64
100yr-24hr	95.23	68.98	106.08

Design Storm	Existing Peak	Alternative 2A	Alternative 2B
2yr-24hr	2,111.9	2,111.4	2,111.9
10yr-1hr	2,111.9	2,111.4	2,111.9
10yr-24hr	2,112.1	2,111.9	2,112.4
25yr-1hr	2,112.4	2,111.6	2,112.1
25yr-24hr	2,112.7	2,112.2	2,112.7
100yr-24hr	2,113.0	2,112.5	2,113.0

ID: 12
Flow Monitor Location 4
Description: Drainage Area Outfall onto Hickock Street
Planned Upgrade: Pipe Installations Instead of Open Ditches from Depot to Hickock
Drainage Area = 277.1
Ground Elevation = 2075.0'

Design Storm	Existing Flow	Alternative 2A	Alternative 2B	Non-Attenuated Flow
2yr-24hr	65.33	54.21	71.18	78.65
10yr-1hr	116.02	98.51	124.05	139.79
10yr-24hr	146.61	120.23	165.50	186.32
25yr-1hr	121.83	105.32	138.78	158.96
25yr-24hr	236.76	155.63	211.59	290.88
100yr-24hr	451.11	387.49	426.28	482.23

Design Storm	Existing Peak	Alternative 2A	Alternative 2B	Non-Attenuated Peak
2yr-24hr	2,072.2	2,072.1	2,072.2	2073.3
10yr-1hr	2,072.8	2,072.7	2,072.8	2073.0
10yr-24hr	2,073.4	2,073.4	2,073.3	2073.6
25yr-1hr	2,073.1	2,073.0	2,072.9	2073.3
25yr-24hr	2,074.1	2,074.5	2,073.8	2074.8
100yr-24hr	2,075.0*	2,075.0*	2,075.0*	2,075.0*

*** Denotes Structure Rim**

APPENDIX E

Conceptual Improvement Plans

Christiansburg Middle School
Melody Dr
Wingsong Ln
Underwood St
Queensberry St
Power St
Clearview Dr
James St
Brackens St
Sullivan St
New St
Depot St. NW
EX. BMP WINDSONG HEIGHTS
Hillcrest Dr
Lee Hwy Ct
Radford St
Taylor St
Shelman St
EX. BMP MIDDLE COURT TOWNHOMES
EX. BMP CHRISTIANSBURG MIDDLE SCHOOL
EX. BMP KYLE MANOR
NEW BMP FOR FUTURE DEVELOPMENT
Buffalo Dr
Morning Mist Dr
Center St
FLOW MONITOR LOCATION 4
FLOW MONITOR LOCATION 3
EX. BMP DEPOT STREET
College St
Eans Cir
Dunkley St
Hickok St
EX. BMP GOOD SAMARITAN HOSPICE
Moose Dr
FLOW MONITOR LOCATION 2
FLOW MONITOR LOCATION 1
EX. BMP MUD PIKE STORAGE
EX. BMP COLLEGE STREET APARTMENTS
Mud Pike
W Main St
EX. BMP MUD PIKE AT MOOSE DR
FUTURE DEVELOPMENT PROJECT
South Hill Dr
Auburn Dr
Robin Rd
Hickory Dr
Grove Ln
Cherry Ln
Highview St
Oak Dr
1st ST SW
Angle Dr
Longview Dr
Chrisman St
Phlegar St
1st St
Floyd St
Hummingbird Dr
2nd St
LOWER WATERSHED (80± ACRES)
Mitchell St
Cooper Ln
3rd St
Cardinal Dr
EX. BMP SOUTH HILL PARK
Mountainway Dr
UPPER WATERSHED (198± ACRES)
Roseland Dr
Carson Dr
4th St
Roundhill Dr
I-81
Atkinson Rd

LEGEND

- PROPERTY LINE
- EXISTING EDGE OF PAVEMENT
- EXISTING SANITARY SEWER
- EXISTING WATER LINE
- EXISTING STORM SEWER
- EXISTING CREEK LINE
- EXISTING CATCH BASIN
- EXISTING FIRE HYDRANT
- EXISTING WATER VALVE
- EXISTING SANITARY MANHOLE
- EXISTING BMP
- DRAINAGE AREA BOUNDARY
- 25 YEAR FLOODPLAIN BOUNDARY
- 25 YEAR FLOOD LIMITS (ESTIMATED)

0 200' 400'
SCALE: 1"=200'

Date	D. PAPA	L. LANGLOIS	D. RISSMEYER	–
	05/21	05/21	05/21	
	Designed	Drawn	Checked	Approved

COMMONWEALTH OF VIRGINIA
DONALD J. RISSMEYER
No. 26104
PROFESSIONAL ENGINEER

Town of Christiansburg – College Street
Existing Conditions
Conceptual Design Plans
Town of Christiansburg, VA

A. MORTON THOMAS AND ASSOCIATES, INC.
CONSULTING ENGINEERS

AMT Project No.
20-0609.001

Drawing Name
C1-1

Sheet 1 of 5

X:\RICHMOND\20-0609.001 - TOWN OF CHRISTIANSBURG COLLEGE STREET\05-CAD\20609.001-EXIST.DWG, 4/22/2021 10:05 AM, DPAPA

Date		
Designed	D. PAPA	05/21
Drawn	L. LANGLOIS	05/21
Checked	D. RISSMEYER	05/21
Approved	–	

COMMONWEALTH OF VIRGINIA
DONALD J. RISSMEYER
No. 26104
PROFESSIONAL ENGINEER

Town of Christiansburg – College Street
Alternative 1
Conceptual Design Plans
Town of Christiansburg, VA

A. MORTON THOMAS AND ASSOCIATES, INC.
CONSULTING ENGINEERS

AMT Project No.
20-0609.001

Drawing Name
C1-2

Sheet 2 of 5

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LEGEND

— · —	PROPERTY LINE
— —	EXISTING EDGE OF PAVEMENT
—SS—	EXISTING SANITARY SEWER
—W—	EXISTING WATER LINE
— —	EXISTING STORM SEWER
— · · —	EXISTING CREEK LINE
□	EXISTING CATCH BASIN
⌖	EXISTING FIRE HYDRANT
◑	EXISTING WATER VALVE
◎	EXISTING SANITARY MANHOLE
🟥	EXISTING BMP
— —	PROPOSED STORM SEWER
▪	PROPOSED DI–7
═	PROPOSED STORM SEWER ALIGNMENT

Designed	D. PAPA	05/21
Drawn	L. LANGLOIS	05/21
Checked	D. RISSMEYER	05/21
Approved	–	

COMMONWEALTH OF VIRGINIA
DONALD J. RISSMEYER
Lic. No. 26104
PROFESSIONAL ENGINEER
NOT FOR CONSTRUCTION

Town of Christiansburg – College Street

Alternative 2A

Conceptual Design Plans

Town of Christiansburg, VA

AMT
A. MORTON THOMAS AND ASSOCIATES, INC.
CONSULTING ENGINEERS

AMT Project No.
20–0609.001

Drawing Name
C1–3

Sheet 3 of 5

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Christiansburg Middle School

Melody Dr

Wingsong Ln

Underwood St

Quesenberry St

Clearview Dr

Radford St

Hillcrest Dr

Lee Hwy Ct

Buffalo Dr

Morning Mist Dr

Center St

Moose Dr

College St

Depot St NW

W Main St

Mud Pike Dr

South Hill Dr

Auburn Dr

Robin Rd

Hickory Dr

Grove Ln

Cherry Ln

Oak Dr

DI-1

DI-2

DI-3

DI-4

DI-7

654 L.F. 36" HDPE

267 L.F. 36" RCP

308 L.F. 36" HDPE

172 L.F. 36" HDPE

358 L.F. DUAL 30" HDPE

339 L.F. 24" HDPE

RELOCATE SHED

THACKER ROBERT W
THACKER SUE G
1230 COLLEGE ST.

THACKER ROBERT W
THACKER SUE G
MOOSE RD.

THACKER ROBERT W
THACKER SUE G
COLLEGE ST.

SHAH DEVELOPMENT LLC
1145 W MAIN ST.

THACKER ROBERT W
THACKER SUE G
1245 MOOSE RD.

LEGEND

- PROPERTY LINE
- EXISTING EDGE OF PAVEMENT
- EXISTING SANITARY SEWER
- EXISTING WATER LINE
- EXISTING STORM SEWER
- EXISTING CREEK LINE
- EXISTING CATCH BASIN
- EXISTING FIRE HYDRANT
- EXISTING WATER VALVE
- EXISTING SANITARY MANHOLE
- EXISTING BMP
- PROPOSED STORM SEWER
- PROPOSED DI-7
- PROPOSED STORM SEWER ALIGNMENT

0 62.5' 125'
SCALE: 1"=125'

Date	Designed	Drawn	Checked	Approved
05/21	D. PAPA	L. LANGLOIS	D. RISSMEYER	–

COMMONWEALTH OF VIRGINIA
DONALD J. RISSMEYER
No. 26104
PROFESSIONAL ENGINEER
NOT FOR CONSTRUCTION

Town of Christiansburg – College Street

Alternative 2B

Conceptual Design Plans

Town of Christiansburg, VA

A. Morton Thomas and Associates, Inc.
Consulting Engineers

AMT Project No.
20-0609.001

Drawing Name
C1-4

X:\RICHMOND\20-0609.001 - TOWN OF CHRISTIANSBURG COLLEGE STREET\05-CAD\20609.001-ALT-3NEW.DWG, 4/22/2021 2:05 PM, DPAPA

EXPAND EXISTING BMP TO PROVIDE MORE DETENTION

RAIN GARDEN TO ELIMINATE PONDING

ADD 2' BERM TO PROVIDE MORE DETENTION AND PROTECT COLLEGE ST

192 L.F. 27"x43" ELIP

277 L.F. 48" HDPE

187 L.F. 48" HDPE

383 L.F. 48" HDPE

Christiansburg Middle School

LEGEND

- PROPERTY LINE
- EXISTING EDGE OF PAVEMENT
- EXISTING SANITARY SEWER
- EXISTING WATER LINE
- EXISTING STORM SEWER
- EXISTING CREEK LINE
- EXISTING CATCH BASIN
- EXISTING FIRE HYDRANT
- EXISTING WATER VALVE
- EXISTING SANITARY MANHOLE
- EXISTING BMP
- PROPOSED STORM SEWER

0 200 400
SCALE: 1"=200'

Date		
Designed	D. PAPA	05/21
Drawn	L. LANGLOIS	05/21
Checked	D. RISSMEYER	05/21
Approved	–	

COMMONWEALTH OF VIRGINIA
DONALD J. RISSMEYER
REGISTRATION No. 26104
PROFESSIONAL ENGINEER

Town of Christiansburg – College Street

Alternative 3

Conceptual Design Plans

Town of Christiansburg, VA

A. MORTON THOMAS AND ASSOCIATES, INC.
CONSULTING ENGINEERS

AMT Project No.
20-0609.001

Drawing Name
C1-5

Sheet 5 of 5

X:\RICHMOND\20-0609.001 - TOWN OF CHRISTIANSBURG COLLEGE STREET\05-CAD\200609.001-ALT-4.DWG, 4/22/2021 11:00 AM, DPAPA

APPENDIX F

Cost Estimates / Ranking Criteria

COLLEGE STREET DRAINAGE IMPROVEMENTS

ALTERNATIVE 1 - CONCEPTUAL COST ESTIMATE

ITEM NO.	DESCRIPTION	UNIT PRICE	QUANTITY	UNIT	COST
	ENGINEERING COSTS				
1	Surveying	$5,490.20	1	LS	$5,490.20
2	Engineering Design	$27,451.00	1	LS	$27,451.00
3	Construction Engineering and Inspection	$33,832.80	1	LS	$33,832.80
	SUBTOTAL				**$66,774.00**
	GENERAL CONDITIONS				
4	Mobilization and Temporary Facilities	$30,000.00	1	LS	$30,000.00
5	Bonds, Taxes, Permits, and Insurance	$30,000.00	1	LS	$30,000.00
6	As-Builts/Survey Stakeout	$10,000.00	1	LS	$10,000.00
7	Traffic Control	$50,000.00	1	LS	$50,000.00
	SUBTOTAL				**$120,000.00**
	SITE PREPARATION & EROSION AND SEDIMENT CONTROL				
8	Erosion and Sediment Control	$39,510.00	1	LS	$39,510.00
9	Excavation and Grading	$75,000.00	1	LS	$75,000.00
	SUBTOTAL				**$114,510.00**
	DRAINAGE IMPROVEMENTS & BMP RETROFITS				
10	Optimize Ex. BMP - Christiansburg M.S.	$10,000.00	1	LS	$10,000.00
11	Optimize Ex. BMP's - Moose Drive (2)	$20,000.00	2	LS	$40,000.00
12	Optimize and Enlarge Ex. BMP - Townhomes	$40,000.00	1	LS	$40,000.00
13	Optimize and Enlarge Ex. BMP - Melody Dr.	$20,000.00	1	LS	$20,000.00
14	Rain Garden - Hillcrest Drive	$25,000.00	1	LS	$25,000.00
15	Elliptical Pipe Extentsion - College St	$200.00	192	LF	$38,400.00
	SUBTOTAL				**$173,400.00**
	SITE IMPROVEMENTS				
16	Existing Structures Relocation/Removal	$15,000.00	1	LS	$15,000.00
	SUBTOTAL				**$15,000.00**
	SUBTOTAL CONSTRUCTION COST				**$489,684.00**
	CONTINGENCY	**30%**			**$146,906.00**
	CONSTRUCTION COST				**$640,000.00**

COLLEGE STREET DRAINAGE IMPROVEMENTS

ALTERNATIVE 2A - CONCEPTUAL COST ESTIMATE

ITEM NO.	DESCRIPTION	UNIT PRICE	QUANTITY	UNIT	COST
	ENGINEERING COSTS				
1	Surveying	$20,632.34	1	LS	$20,632.34
2	Engineering Design	$103,161.70	1	LS	$103,161.70
3	Construction Engineering and Inspection	$82,529.36	1	LS	$82,529.36
	ENGINEERING COSTS SUBTOTAL				**$206,323.40**
	GENERAL CONDITIONS				
4	Mobilization and Temporary Facilities	$50,000.00	1	LS	$50,000.00
5	Bonds, Taxes, Permits, and Insurance	$50,000.00	1	LS	$50,000.00
6	As-Builts/Survey Stakeout	$15,000.00	1	LS	$15,000.00
7	Traffic Control	$50,000.00	1	LS	$50,000.00
	GENERAL CONDITIONS SUBTOTAL				**$165,000.00**
	SITE PREPARATION & EROSION AND SEDIMENT CONTROL				
8	Erosion and Sediment Control	$113,037.00	1	LS	$113,037.00
9	Excavation and Grading	$175,000.00	1	LS	$175,000.00
	SITE PREPARATION & EROSION AND SEDIMENT CONTROL SUBTOTAL				**$288,037.00**
	STORMWATER MANAGEMENT				
10	New BMP Inlet and Outlet Structures	$100,000.00	1	LS	$100,000.00
13	Clean & Repair Ex. SD System (~1090 LF)	$30,000.00	1	LS	$30,000.00
14	Clean & Grade Backyard Ditch (~152 LF)	$12,500.00	1	LS	$12,500.00
15	24" Diameter - HDPE	$180.00	1211	LF	$217,980.00
16	30" Diameter - HDPE	$220.00	480	LF	$105,600.00
	STORMWATER MANAGEMENT SUBTOTAL				**$466,080.00**
	SITE IMPROVEMENTS				
19	Asphalt Pavement Replacement	$150.00	250	SY	$37,500.00
20	Sanitary Sewer Relocation	$40,000.00	1	LS	$40,000.00
21	Existing Structures Relocation/Removal	$15,000.00	1	LS	$15,000.00
22	Dry Utilities Relocation	$5,000.00	1	LS	$5,000.00
23	Topsoil and Permanent Seeding	$15,000.00	1	LS	$15,000.00
	SITE IMPROVEMENTS SUBTOTAL				**$112,500.00**
	SUBTOTAL CONSTRUCTION COST				**$1,237,940.40**
	CONTINGENCY	**30%**			**$371,383.00**
	CONSTRUCTION COST				**$1,610,000.00**

COLLEGE STREET DRAINAGE IMPROVEMENTS

ALTERNATIVE 2B - CONCEPTUAL COST ESTIMATE

ITEM NO.	DESCRIPTION	UNIT PRICE	QUANTITY	UNIT	COST
	ENGINEERING COSTS				
1	Surveying	$18,783.14	1	LS	$18,783.14
2	Engineering Design	$93,915.70	1	LS	$93,915.70
3	Construction Engineering and Inspection	$75,132.56	1	LS	$75,132.56
	ENGINEERING COSTS SUBTOTAL				**$187,831.40**
	GENERAL CONDITIONS				
4	Mobilization and Temporary Facilities	$50,000.00	1	LS	$50,000.00
5	Bonds, Taxes, Permits, and Insurance	$50,000.00	1	LS	$50,000.00
6	As-Builts/Survey Stakeout	$15,000.00	1	LS	$15,000.00
7	Traffic Control	$50,000.00	1	LS	$50,000.00
	GENERAL CONDITIONS SUBTOTAL				**$165,000.00**
	SITE PREPARATION & EROSION AND SEDIMENT CONTROL				
8	Erosion and Sediment Control	$100,977.00	1	LS	$100,977.00
9	Excavation and Grading	$75,000.00	1	LS	$75,000.00
	SITE PREPARATION & EROSION AND SEDIMENT CONTROL SUBTOTAL				**$175,977.00**
	STORMWATER MANAGEMENT				
11	24" Diameter - HDPE	$180.00	339	LF	$61,020.00
12	36" Diameter - HDPE	$260.00	1401	LF	$364,260.00
13	Dual 30" Diameter - HDPE	$300.00	358	LF	$107,400.00
	STORMWATER MANAGEMENT SUBTOTAL				**$532,680.00**
	SITE IMPROVEMENTS				
14	Asphalt Pavement Replacement	$150.00	250	SY	$37,500.00
15	Existing Structures Relocation/Removal	$15,000.00	1	LS	$15,000.00
16	Dry Utilities Relocation	$5,000.00	1	LS	$5,000.00
17	Topsoil and Permanent Seeding	$8,000.00	1	LS	$8,000.00
	SITE IMPROVEMENTS SUBTOTAL				**$65,500.00**
	SUBTOTAL CONSTRUCTION COST				**$1,126,988.40**
	CONTINGENCY	**30%**			**$338,097.00**
	CONSTRUCTION COST				**$1,470,000.00**

COLLEGE STREET DRAINAGE IMPROVEMENTS

ALTERNATIVE 3 - CONCEPTUAL COST ESTIMATE

ITEM NO.	DESCRIPTION	UNIT PRICE	QUANTITY	UNIT	COST
	ENGINEERING COSTS				
1	Surveying	$11,451.42	1	LS	$11,451.42
2	Engineering Design	$57,257.10	1	LS	$57,257.10
3	Construction Engineering and Inspection	$45,805.68	1	LS	$45,805.68
	ENGINEERING COSTS SUBTOTAL				**$114,514.20**
	GENERAL CONDITIONS				
4	Mobilization and Temporary Facilities	$30,000.00	1	LS	$30,000.00
5	Bonds, Taxes, Permits, and Insurance	$30,000.00	1	LS	$30,000.00
6	As-Builts/Survey Stakeout	$10,000.00	1	LS	$10,000.00
7	Traffic Control	$50,000.00	1	LS	$50,000.00
	GENERAL CONDITIONS SUBTOTAL				**$120,000.00**
	SITE PREPARATION & EROSION AND SEDIMENT CONTROL				
8	Erosion and Sediment Control	$59,031.00	1	LS	$59,031.00
9	Excavation and Grading	$60,000.00	1	LS	$60,000.00
	SITE PREPARATION & EROSION AND SEDIMENT CONTROL SUBTOTAL				**$119,031.00**
	STORMWATER MANAGEMENT				
12	48" Diameter - HDPE	$320.00	847	LF	$271,040.00
	STORMWATER MANAGEMENT SUBTOTAL				**$271,040.00**
	SITE IMPROVEMENTS				
13	Asphalt Pavement Replacement	$150.00	150	SY	$22,500.00
14	Sanitary Sewer Relocation	$20,000.00	1	LS	$20,000.00
15	Existing Structures Relocation/Removal	$15,000.00	1	LS	$15,000.00
16	Dry Utilities Relocation	$5,000.00	1	LS	$5,000.00
	SITE IMPROVEMENTS SUBTOTAL				**$62,500.00**
	SUBTOTAL CONSTRUCTION COST				**$687,085.20**
	CONTINGENCY	**30%**			**$206,126.00**
	CONSTRUCTION COST				**$900,000.00**

Town of Christiansburg - College Street Drainage Study
Summary of CIP Rankings

Description of Study Results	Weighed Value	ALTERNATIVE ID				
		1	2	3	4	
		Alternative #1	Alternative #2A	Alternative #2B	Alternative #3	
Safety & Property Damage (Max. 30 Points)						
Potential for Loss of Life / Injuries	**30**	0	0	0	0	
Structure Flooding / Potential Damage	**24**	0	24	24	0	
Roadway Overtopping - Commercial Area	**18**	0	0	0	0	
Roadway Overtopping - Residential Area	**12**	12	0	0	12	
Excessive Gutter Spread / Hydroplaning Risk	**6**	0	0	0	0	
No Safety Concerns	**0**	0	0	0	0	
Number of Properties Directly Affected (Max. 20 Points)						
Greater than 25	**20**	0	0	0	20	
10 to 25	**15**	0	15	15	0	
5 to 10	**10**	10	0	0	0	
2 to 5	**8**	0	0	0	0	
One property	**4**	0	0	0	0	
Ease of Implementation (Max. 15 Points)						
Within R/W, Simple Design and No Neighborhood Opposition	**15**	0	0	0	0	
Very Feasible (3 out of 4 factors)	**10**	10	0	0	0	
Somewhat Feasible (2 out of 4 factors)	**5**	0	5	5	5	
Possibly Feasible (1 out of 4 factors)	**0**	0	0	0	0	
Environmental Factors (Max. 10 Points)						
Potential Water Quality Benefits	**10**	0	10	0	0	
Minimal Environmental Benefits	**5**	5	0	0	0	
Environmental Impacts or No Benefits	**0**	0	0	0	0	
Cost Effectiveness (Max. 25 Points)						
Based on the ratio of $ per watershed acre	**25**	9	23	25	16	---
Project Score (100 Max.) =		46	77	69	53	0

Project Ranking =		4	1	2	3	---

Town of Christiansburg - College Street Drainage Study
Cost Effectiveness Factor for Ranking Criteria

Project Cost Effectiveness				
Alternative ID	Project Cost	Project Watershed	Proj. Cost / Proj. Watershed	Weighed Value
1	$640,000	30	$21,333	9
2A	$1,610,000	198	$8,131	23
2B	$1,470,000	198	$7,424	25
3	$900,000	79	$11,392	16
SUM =	$4,620,000	198	$7,424	25.0

DEQ Virginia Runoff Reduction Method New Development Compliance Spreadsheet - Version 3.0

BMP Design Specifications List: **2013 Draft Stds & Specs**

Site Summary

Project Title: College Street Drainage Improvments

Date: 44320

Total Rainfall = 43 inches

Site Land Cover Summary

	A soils	B Soils	C Soils	D Soils	Totals	% of Total
Forest/Open (acres)	0.00	0.00	36.27	0.00	36.27	37
Managed Turf (acres)	0.00	0.00	39.67	0.00	39.67	40
Impervious Cover (acres)	0.00	0.00	22.30	0.00	22.30	23
					98.24	100

Site Tv and Land Cover Nutrient Loads

Site Rv	0.32
Treatment Volume (ft^3)	113,848
TP Load (lb/yr)	71.53
TN Load (lb/yr)	511.72

Total TP Load Reduction Required (lb/yr)	31.25

Site Compliance Summary

Total Runoff Volume Reduction (ft^3)	16,287
Total TP Load Reduction Achieved (lb/yr)	19.57
Total TN Load Reduction Achieved (lb/yr)	117.92
Remaining Post Development TP Load (lb/yr)	51.96
Remaining TP Load Reduction (lb/yr) Required	11.68

Drainage Area Summary

	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	Total
Forest/Open (acres)	11.84	0.89	23.54	0.00	0.00	36.27
Managed Turf (acres)	1.26	0.65	37.76	0.00	0.00	39.67
Impervious Cover (acres)	1.52	0.87	19.91	0.00	0.00	22.30
Total Area (acres)	**14.62**	**2.41**	**81.21**	**0.00**	**0.00**	**98.24**

Drainage Area Compliance Summary

	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	Total
TP Load Reduced (lb/yr)	1.51	0.85	17.21	0.00	0.00	19.57

TN Load Reduced (lb/yr)	8.74	4.92	104.26	0.00	0.00	117.92

Drainage Area A Summary

Land Cover Summary

	A Soils	B Soils	C Soils	D Soils	Total	% of Total
Forest/Open (acres)	0.00	0.00	11.84	0.00	11.84	81
Managed Turf (acres)	0.00	0.00	1.26	0.00	1.26	9
Impervious Cover (acres)	0.00	0.00	1.52	0.00	1.52	10
					14.62	

BMP Selections

Practice	Managed Turf Credit Area (acres)	Impervious Cover Credit Area (acres)	BMP Treatment Volume (ft^3)	TP Load from Upstream Practices (lbs)	Untreated TP Load to Practice (lbs)	TP Removed (lb/yr)	TP Remaining (lb/yr)	Downstream Treatment to be Employed

Total Impervious Cover Treated (acres)	1.52
Total Turf Area Treated (acres)	1.26
Total TP Load Reduction Achieved in D.A. (lb/yr)	1.51
Total TN Load Reduction Achieved in D.A. (lb/yr)	8.74

Drainage Area B Summary

Land Cover Summary

	A Soils	B Soils	C Soils	D Soils	Total	% of Total
Forest/Open (acres)	0.00	0.00	0.89	0.00	0.89	37
Managed Turf (acres)	0.00	0.00	0.65	0.00	0.65	27
Impervious Cover (acres)	0.00	0.00	0.87	0.00	0.87	36
					2.41	

BMP Selections

Practice	Managed Turf Credit Area (acres)	Impervious Cover Credit Area (acres)	BMP Treatment Volume (ft^3)	TP Load from Upstream Practices (lbs)	Untreated TP Load to Practice (lbs)	TP Removed (lb/yr)	TP Remaining (lb/yr)	Downstream Treatment to be Employed

Total Impervious Cover Treated (acres)	0.87
Total Turf Area Treated (acres)	0.65
Total TP Load Reduction Achieved in D.A. (lb/yr)	0.85
Total TN Load Reduction Achieved in D.A. (lb/yr)	4.92

Drainage Area C Summary

Land Cover Summary

	A Soils	B Soils	C Soils	D Soils	Total	% of Total
Forest/Open (acres)	0.00	0.00	23.54	0.00	23.54	29
Managed Turf (acres)	0.00	0.00	37.76	0.00	37.76	46
Impervious Cover (acres)	0.00	0.00	19.91	0.00	19.91	25
					81.21	

BMP Selections

Practice	Managed Turf Credit Area (acres)	Impervious Cover Credit Area (acres)	BMP Treatment Volume (ft^3)	TP Load from Upstream Practices (lbs)	Untreated TP Load to Practice (lbs)	TP Removed (lb/yr)	TP Remaining (lb/yr)	Downstream Treatment to be Employed

Total Impervious Cover Treated (acres)	19.91
Total Turf Area Treated (acres)	37.76
Total TP Load Reduction Achieved in D.A. (lb/yr)	17.21
Total TN Load Reduction Achieved in D.A. (lb/yr)	104.26

Drainage Area D Summary

Land Cover Summary

	A Soils	B Soils	C Soils	D Soils	Total	% of Total
Forest/Open (acres)	0.00	0.00	0.00	0.00	0.00	0
Managed Turf (acres)	0.00	0.00	0.00	0.00	0.00	0
Impervious Cover (acres)	0.00	0.00	0.00	0.00	0.00	0
					0.00	

BMP Selections

Practice	Managed Turf Credit Area (acres)	Impervious Cover Credit Area (acres)	BMP Treatment Volume (ft^3)	TP Load from Upstream Practices (lbs)	Untreated TP Load to Practice (lbs)	TP Removed (lb/yr)	TP Remaining (lb/yr)	Downstream Treatment to be Employed

Total Impervious Cover Treated (acres)	0.00
Total Turf Area Treated (acres)	0.00
Total TP Load Reduction Achieved in D.A. (lb/yr)	0.00
Total TN Load Reduction Achieved in D.A. (lb/yr)	0.00

Drainage Area E Summary

Land Cover Summary

	A Soils	B Soils	C Soils	D Soils	Total	% of Total
Forest/Open (acres)	0.00	0.00	0.00	0.00	0.00	0
Managed Turf (acres)	0.00	0.00	0.00	0.00	0.00	0
Impervious Cover (acres)	0.00	0.00	0.00	0.00	0.00	0
					0.00	

BMP Selections

Practice	Managed Turf Credit Area (acres)	Impervious Cover Credit Area (acres)	BMP Treatment Volume (ft^3)	TP Load from Upstream Practices (lbs)	Untreated TP Load to Practice (lbs)	TP Removed (lb/yr)	TP Remaining (lb/yr)	Downstream Treatment to be Employed

Total Impervious Cover Treated (acres)	0.00
Total Turf Area Treated (acres)	0.00
Total TP Load Reduction Achieved in D.A. (lb/yr)	0.00
Total TN Load Reduction Achieved in D.A. (lb/yr)	0.00

Runoff Volume and CN Calculations

	1-year storm	2-year storm	10-year storm
Target Rainfall Event (in)	0.00	0.00	0.00

Drainage Areas	RV & CN	Drainage Area A	Drainage Area B	Drainage Area C	Drainage Area D	Drainage Area E
CN		73	81	79	0	0
RR (ft^3)		937	528	14,822	0	0
1-year return period	RV wo RR (ws-in)	0.00	0.00	0.00	0.00	0.00
	RV w RR (ws-in)	0.00	0.00	0.00	0.00	0.00
	CN adjusted	100	100	100	0	0
2-year return period	RV wo RR (ws-in)	0.00	0.00	0.00	0.00	0.00
	RV w RR (ws-in)	0.00	0.00	0.00	0.00	0.00
	CN adjusted	100	100	100	0	0
10-year return period	RV wo RR (ws-in)	0.00	0.00	0.00	0.00	0.00
	RV w RR (ws-in)	0.00	0.00	0.00	0.00	0.00
	CN adjusted	100	100	100	0	0

APPENDIX G

Homeowner Flood Documentation

Date	8/6/20 10:00
Name of Interviewer	W. Nelson
Other Staff on Site	R. Wingfield

Address	960 College St.
Name(s)	Danielle Sempervivo
Phone	641-4176
Email	~~dburcham~~ dnburcham@gmail.com
Rent/Own	Own
Owner Contact	
Other	

Questions:

1. Do you have ponding after rain events anywhere on your property?
Yes, trash misquitos who own property at fence ditch ~~etc~~ also flooding on street side

2. Does your home have either a basement or a crawl space?
3. If so, have you ever experienced flooding in that area?

2. Basement

3. Yes, has tried to install "drainage rock"

4. Do you have downspouts, and where are the discharge points?

Yes @ channel

also has multiple sewer connections, co.

5. Do you currently have flood insurance for your home?
6. Are you willing to consider the purchase of flood insurance?

5. No, contacted ins. but told not in flood zone

6. yes but ins. said not elegible

7. Are you willing to remove all or a portion of your fence or make modifications to your fence to allow for the free flow of water?
8. Are you willing to remove or relocate other structures located in the drainage way?

7. Woven wire fence, not necessarily necessary. Does catch trash currently

9. Are you willing to donate an easement to the Town for potential future drainage improvements?

Yes even pay for pipe

Date_____ Address _____

Name of Observer _____

Observations

Supported by Pictures

Storage Shed	
Play Equipment	
Fence	
Pool	
Lower level door entry	Yes, 2 doors
Raised planter bed	
Significant landscaping	
Detached garage	
Driveway culvert, size	
Foundation wall type	
Other	

Date	8/7/2020
Name of Interviewer	W. Nelson
Other Staff on Site	M. Kelley

Address	890 College Street
Name(s)	Henry Nixon / Doris
Phone	(540) 382-4750
Email	
Rent/Own	Own
Owner Contact	
Other	"Greatful Town is taking an interest"

Questions:

1. Do you have ponding after rain events anywhere on your property?
No, dug ditch and installed 30" lower culvert.

2. Does your home have either a basement or a crawl space?
3. If so, have you ever experienced flooding in that area?

2. Basement, 17" higher than culvert invert.
3. Occassionally 3rd foundation seepage. 2 sump pumps and drains to culvert area.

4. Do you have downspouts, and where are the discharge points?

Yes, discharge on grade at foundation.

5. Do you currently have flood insurance for your home?
6. Are you willing to consider the purchase of flood insurance?

5. No
6. Checked w/ ins. company. Not available

7. Are you willing to remove all or a portion of your fence or make modifications to your fence to allow for the free flow of water?
8. Are you willing to remove or relocate other structures located in the drainage way?

7. N/A
8. Permits for outbuildings.

9. Are you willing to donate an easement to the Town for potential future drainage improvements?

yes

Date_____ Address _____
Name of Observer _____

Observations

Supported by Pictures

Storage Shed	
Play Equipment	
Fence	
Pool	
Lower level door entry	
Raised planter bed	
Significant landscaping	
Detached garage	
Driveway culvert, size	
Foundation wall type	
Other	

Date	8/7/20
Name of Interviewer	~~MICHAEL KELLEY~~ WAYNE NELSON
Other Staff on Site	~~WAYNE NELSON~~ MICHAEL KELLEY

Address	890 COLLEGE STREET
Name(s)	HENRY NIXON
Phone	540-382-4750
Email	
Rent/Own	OWN
Owner Contact	
Other	

Questions:

1. Do you have ponding after rain events anywhere on your property?
NO, Dug all this by hand.. INSTALLED CULVERT

2. Does your home have either a basement or a crawl space? YES
3. If so, have you ever experienced flooding in that area? SEEPS IN SOMETIMES

Black Corrugated pipe discharging at Fence
2 sump pumps IN Basement. 17" higher than pipe.

4. Do you have downspouts, and where are the discharge points?

Downspouts visible. Discharge at the house. AT GRADE
No leaders away from structure.

5. Do you currently have flood insurance for your home? NO
6. Are you willing to consider the purchase of flood insurance?

Was told that you COULD NOT get insurance
UNLESS WATER CAME INTO THE HOUSE.

7. Are you willing to remove all or a portion of your fence or make modifications to your fence to allow for the free flow of water? N/A
8. Are you willing to remove or relocate other structures located in the drainage way? N/A

NO FENCE
SHED IS OUT OF FLOW PATH. RECEIVED PERMIT
FROM TOWN FOR SHED.

9. Are you willing to donate an easement to the Town for potential future drainage improvements? OH YEAH. YES

Date 8/7/20 Address 890 COLLEGE ST.
Name of Observer MICHAEL KELLEY

Observations

Supported by Pictures

Storage Shed	YES. OUT OF FLOW PATH
Play Equipment	N/A
Fence	N/A
Pool	N/A
Lower level door entry	N/A
Raised planter bed	N/A
Significant landscaping	N/A
Detached garage	N/A
Driveway culvert, size	YES 30" CMP (MEASURED)
Foundation wall type	CMU BLOCK.
Other	Thankful for the Town looking at situation.

Date	8/10/2020 2:00
Name of Interviewer	W. Nelson
Other Staff on Site	M. Kelley

Address	1000 College St.
Name(s)	Louise Saul
Phone	(540) 449-7522
Email	nanaof256@gmail.com
Rent/Own	Own
Owner Contact	
Other	

Questions:

1. Do you have ponding after rain events anywhere on your property?
Backyard is a lake/river. Has had swing set ruined. Drive washes (gravel) after Middle School was built. (SW Basin)

Sewer overflows are an issue as is trash from W. Main Street.

Mother of Amanda Reid.

Gabe Martin, son of owner, lives next door.

2. Does your home have either a basement or a crawl space?
3. If so, have you ever experienced flooding in that area?

2. Basement

3. No, but now concerned w/ street drainage coming down driveway.

4. Do you have downspouts, and where are the discharge points?

Downspouts, yes.

5. Do you currently have flood insurance for your home?
6. Are you willing to consider the purchase of flood insurance?

5. No.

6. No.

7. Are you willing to remove all or a portion of your fence or make modifications to your fence to allow for the free flow of water?
8. Are you willing to remove or relocate other structures located in the drainage way?

7. No Fence

8. No ancillary other than carport

9. Are you willing to donate an easement to the Town for potential future drainage improvements?

Yes. Willing to do anything that may help this situation.

Date_____ Address _____
Name of Observer _____

Observations

Supported by Pictures

Storage Shed	
Play Equipment	
Fence	
Pool	
Lower level door entry	
Raised planter bed	
Significant landscaping	
Detached garage	
Driveway culvert, size	
Foundation wall type	
Other	

Date	8/10/20
Name of Interviewer	WAYNE NELSON
Other Staff on Site	MIKE KELLEY

Address	1000 COLLEGE STREET
Name(s)	LOUISE SAUL
Phone	540-449-7522
Email	nanaof256@gmail.com
Rent/Own	OWN
Owner Contact	
Other	GRATEFUL FOR TEAM. WILLING TO DO WHATEVER I HAVE TO DO.

Questions:

1. Do you have ponding after rain events anywhere on your property?

~~[illegible]~~

~~[illegible]~~

DRIVEWAY WASHING OUT. HAVE TO PICK UP TRASH THAT WASHES IN WITH RAINS. HAD SEWER OVERFLOW IN PAST.

2. Does your home have either a basement or a crawl space? BASEMENT
3. If so, have you ever experienced flooding in that area? NO I HAVE NOT.

PRIMARY CONCERN IS STREET DRAINAGE COMING DOWN THE DRIVEWAY.

4. Do you have downspouts, and where are the discharge points?

YES.

5. Do you currently have flood insurance for your home? NO.
6. Are you willing to consider the purchase of flood insurance? NO

7. Are you willing to remove all or a portion of your fence or make modifications to your fence to allow for the free flow of water? NO FENCE ON PROPERTY
8. Are you willing to remove or relocate other structures located in the drainage way?

8. SURE, BUT I DONT HAVE ANY SHEDS.

9. Are you willing to donate an easement to the Town for potential future drainage improvements? ABSOLUTELY, NOT A PROBLEM.

RIVER IN BACK YARD WHEN RAINS
DRIVEWAY WASH OUT STARTED ± 4 TO 5 YEARS AGO
WATER KEEPS GETTING WORSE. MY DRIVEWAY IS THE WORST PART.
I GET LOTS OF TRASH THAT I PICK UP.

Date 8/10/20 Address 1000 COLLEGE STREET

Name of Observer MIKE KELLEY

Observations

Supported by Pictures

Storage Shed	N/A
Play Equipment	N/A
Fence	N/A
Pool	N/A
Lower level door entry	YES
Raised planter bed	N/A
Significant landscaping	N/A
Detached garage	N/A
Driveway culvert, size	N/A
Foundation wall type	CMU
Other	

Date	8/11/2020 1:00
Name of Interviewer	W. Nelson
Other Staff on Site	M. Kelley

Address	740 College St.
Name(s)	Steve Purcell
Phone	(804) 517-5755
Email	Purcell137@gmail.com
Rent/Own	Rent
Owner Contact	Cary Hopper
Other	

Questions:

1. Do you have ponding after rain events anywhere on your property?
yes - 2 feet deep in garage & 2 feet below FFE

2. Does your home have either a basement or a crawl space?
3. If so, have you ever experienced flooding in that area?

2. Crawl Space

3. yes!

4. Do you have downspouts, and where are the discharge points?

yes, discharges to channel

5. Do you currently have flood insurance for your home?
6. Are you willing to consider the purchase of flood insurance?

5. Renters Ins. which did cover the flooding. Owner did install flapper on SS lateral.

6. N/A

7. Are you willing to remove all or a portion of your fence or make modifications to your fence to allow for the free flow of water?
8. Are you willing to remove or relocate other structures located in the drainage way?

7. Check w/ owner but did install new fence

8.

9. Are you willing to donate an easement to the Town for potential future drainage improvements?

9. Discuss w/ owner

Date_____ Address _____
Name of Observer _____

Observations

Supported by Pictures

Storage Shed	
Play Equipment	
Fence	
Pool	
Lower level door entry	
Raised planter bed	
Significant landscaping	
Detached garage	
Driveway culvert, size	
Foundation wall type	
Other	

Date	8/11/20
Name of Interviewer	WAYNE NELSON
Other Staff on Site	MICHAEL KELLEY

Address	740 COLLEGE STREET
Name(s)	STEVE PURCELL
Phone	804 517 5755
Email	purcell1371@gmail.com
Rent/Own	RENT
Owner Contact	CARY HOPPER
Other	

Questions:

1. Do you have ponding after rain events anywhere on your property?
YES, WATER CAME UP TO THE TOP OF THE DECK. HAVE HAD SEWER BACK UPS

2. Does your home have either a basement or a crawl space?
3. If so, have you ever experienced flooding in that area?

2. CRAWL SPACE
3. YES.

4. Do you have downspouts, and where are the discharge points?

YES, PIPED TO CHANNEL.

5. Do you currently have flood insurance for your home? NO
6. Are you willing to consider the purchase of flood insurance?

HAVE RENTERS INSURANCE. THIS COVERED OUR DAMAGES.

7. Are you willing to remove all or a portion of your fence or make modifications to your fence to allow for the free flow of water?
8. Are you willing to remove or relocate other structures located in the drainage way?

CHAIN LINK FENCE NOT SURE IF FENCE BELONGS TO THE PROPERTY.

WILL DIRECT QUESTION TO OWNER

9. Are you willing to donate an easement to the Town for potential future drainage improvements?

DIRECT TO OWNER

Date_____ Address _____

Name of Observer _____

Observations

Supported by Pictures

Storage Shed	YES
Play Equipment	N/A
Fence	YES NOT SURE IF BELONGS TO PROPERTY.
Pool	N/A
Lower level door entry	N/A
Raised planter bed	N/A
Significant landscaping	N/A
Detached garage	N/A
Driveway culvert, size	N/A
Foundation wall type	CMU
Other	36" CMP 15" PVC PIPE - SUMP PUMP

Date	8/13/2020
Name of Interviewer	W. Nelson
Other Staff on Site	M. Kelley

Address	640 + 642
Name(s)	Jerry Sheppard / Scott Alan (Son-in-law)
Phone	(540) 353-1532 (540) 357-1532
Email	N/A
Rent/Own	Own
Owner Contact	
Other	

Questions:

1. Do you have ponding after rain events anywhere on your property?
In rear after a heavy rain; damp + soggy.

2. Does your home have either a basement or a crawl space?
3. If so, have you ever experienced flooding in that area?

2. Crawl space

3. Yes, to his knowledge the Memorial Day event has been the only time.

4. Do you have downspouts, and where are the discharge points?

Yes, ~~at grade~~ piped to ditch

5. Do you currently have flood insurance for your home?
6. Are you willing to consider the purchase of flood insurance?

5. No NO only Re: Fire

6. Not sure

7. Are you willing to remove all or a portion of your fence or make modifications to your fence to allow for the free flow of water?
8. Are you willing to remove or relocate other structures located in the drainage way?

7. No fences

8. Yes, Trampoline of center can be moved.

9. Are you willing to donate an easement to the Town for potential future drainage improvements?

9. Yes, as long as property value is not negatively impacted. Interested in filling in drain @ Depot Street.

Date_____ Address _____

Name of Observer _____

Observations

Supported by Pictures

Storage Shed	
Play Equipment	
Fence	
Pool	
Lower level door entry	
Raised planter bed	
Significant landscaping	
Detached garage	
Driveway culvert, size	
Foundation wall type	
Other	

Date	8/13/20
Name of Interviewer	WAYNE NELSON
Other Staff on Site	MICHAEL KELLEY

Address	640/642 COLLEGE STREET
Name(s)	JERRY SHEPERD
Phone	540 357 1532
Email	NO EMAIL
Rent/Own	
Owner Contact	
Other	

Questions:

1. Do you have ponding after rain events anywhere on your property?
IN THE REAR SOME. AFTER HEAVY RAIN

2. Does your home have either a basement or a crawl space?
3. If so, have you ever experienced flooding in that area?

2) CRAWL SPACE
3) YES MEMORIAL DAY WEEKEND

4. Do you have downspouts, and where are the discharge points?

4) YES, PIPED TO DITCH.

5. Do you currently have flood insurance for your home?
6. Are you willing to consider the purchase of flood insurance?

5) NO, I HAVE HOMEOWNERS

6) NOT SURE

7. Are you willing to remove all or a portion of your fence or make modifications to your fence to allow for the free flow of water?
8. Are you willing to remove or relocate other structures located in the drainage way?

7) NO FENCE

8) NO STRUCTURES
YES TO THE TRAMPOLINE

9. Are you willing to donate an easement to the Town for potential future drainage improvements?

9) LET ME THINK ABOUT IT. DOES IT IMPACT MY PROPERTY VALUE? YES IF DOES NOT IMPACT PROPERTY VALUE.

Date_____ Address _____
Name of Observer _____

Observations

Supported by Pictures

Storage Shed	N/A
Play Equipment	TRAMPOLINE
Fence	N/A
Pool	N/A
Lower level door entry	N/A
Raised planter bed	N/A
Significant landscaping	N/A
Detached garage	N/A
Driveway culvert, size	N/A
Foundation wall type	N/A
Other	TRAMPOLINE

PROPERTY HAS DRAINAGE PIPE RUNNING ACROSS BACK YARD.

Date	8/21/2020
Name of Interviewer	W. Nelson
Other Staff on Site	M. Kelley

Address	660 College St.
Name(s)	(Son) Michael Mengsheng / Amy Wang
Phone	917-515-3073
Email	mecyang@gmail.com
Rent/Own	Own
Owner Contact	
Other	

Questions:

1. Do you have ponding after rain events anywhere on your property?
Pond in the back of building

2. Does your home have either a basement or a crawl space?
3. If so, have you ever experienced flooding in that area?

Slab on grade

4. Do you have downspouts, and where are the discharge points?

Piped and discharges underground but unsure of discharge point.

5. Do you currently have flood insurance for your home?
6. Are you willing to consider the purchase of flood insurance?

No sure

7. Are you willing to remove all or a portion of your fence or make modifications to your fence to allow for the free flow of water?
8. Are you willing to remove or relocate other structures located in the drainage way?

7. N/A

8. N/A

9. Are you willing to donate an easement to the Town for potential future drainage improvements?

Aside from concern over 13 water service lines and unsure where sanitary sewer is located.

Date_____ Address _____
Name of Observer _____

Observations

Supported by Pictures

Storage Shed	
Play Equipment	
Fence	
Pool	
Lower level door entry	
Raised planter bed	
Significant landscaping	
Detached garage	
Driveway culvert, size	
Foundation wall type	
Other	

Date	8/21/20
Name of Interviewer	WAYNE NELSON
Other Staff on Site	MICHAEL KELLEY

Address	660 COLLEGE STREET
Name(s)	MICHAEL MENGSHENG AMY YANG — OWNER
Phone	917-515-3073
Email	MECYANG@GMA.Y.COM.
Rent/Own	OWN
Owner Contact	
Other	

Questions:

1. Do you have ponding after rain events anywhere on your property?
NOT IN FRONT BUT YES IN THE BACK.

2. Does your home have either a basement or a crawl space?
3. If so, have you ever experienced flooding in that area?

2. NO BASEMENT. SLAB ON GRADE

4. Do you have downspouts, and where are the discharge points?

4. YES PIPED. NOT SURE WHERE THEY DISCHARGE.

5. Do you currently have flood insurance for your home?
6. Are you willing to consider the purchase of flood insurance?

5. NOT SURE. NEED TO ASK.

7. Are you willing to remove all or a portion of your fence or make modifications to your fence to allow for the free flow of water?
8. Are you willing to remove or relocate other structures located in the drainage way?

7. DO NOT OWN FENCE IN FLOW PATH.

9. Are you willing to donate an easement to the Town for potential future drainage improvements?

YES. AS LONG AS YOU ARE TAKING CARE OF EVERYTHING.

Date_____ Address _____
Name of Observer _____

Observations

Supported by Pictures

Storage Shed	
Play Equipment	
Fence	
Pool	
Lower level door entry	
Raised planter bed	
Significant landscaping	
Detached garage	
Driveway culvert, size	
Foundation wall type	
Other	

Date	8/22/2020
Name of Interviewer	WAYNE NELSON
Other Staff on Site	MICHAEL KELLEY

Address	860 COLLEGE STREET
Name(s)	ADAM STRASBAUGH
Phone	919 581 7705
Email	ABSTRAS1007@gmail.com
Rent/Own	OWN
Owner Contact	
Other	

Questions:

1. Do you have ponding after rain events anywhere on your property?
YES WE DO. WHEN WE MOVED IN HAD ABOUT 18" IN THE CRAWL SPACE. IT WENT AWAY QUICKLY.

2. Does your home have either a basement or a crawl space?
3. If so, have you ever experienced flooding in that area?

2. CRAWL SPACE

3. YES

4. Do you have downspouts, and where are the discharge points?

5. Do you currently have flood insurance for your home?
6. Are you willing to consider the purchase of flood insurance?

5. NO

6. WILLING TO CONSIDER

7. Are you willing to remove all or a portion of your fence or make modifications to your fence to allow for the free flow of water?
8. Are you willing to remove or relocate other structures located in the drainage way?

7. YES.

8. YES.

9. Are you willing to donate an easement to the Town for potential future drainage improvements?

9. POSSIBLY BUT WOULD NEED TO SEE THE EXACT PLAN FIRST.

Date 8/22/20 Address 860 COLLEGE ST.

Name of Observer M. KELLEY

Observations

Supported by Pictures

Storage Shed	YES
Play Equipment	YES
Fence	YES
Pool	NO
Lower level door entry	NO
Raised planter bed	NO
Significant landscaping	NO
Detached garage	YES
Driveway culvert, size	NO
Foundation wall type	CMU
Other	

Date	
Name of Interviewer	
Other Staff on Site	

Address	
Name(s)	Adam Strasbaugh
Phone	919-581-7705
Email	abstras1007@gmail.com
Rent/Own	Own
Owner Contact	
Other	

Questions:

1. Do you have ponding after rain events anywhere on your property?

2. Does your home have either a basement or a crawl space?
3. If so, have you ever experienced flooding in that area?

Crawl Space
Yes, but drained quickly

4. Do you have downspouts, and where are the discharge points?

Yes

5. Do you currently have flood insurance for your home?
6. Are you willing to consider the purchase of flood insurance?

5. No

6. Yes, if necessary

7. Are you willing to remove all or a portion of your fence or make modifications to your fence to allow for the free flow of water?
8. Are you willing to remove or relocate other structures located in the drainage way?

7. Yes
8. Yes!

9. Are you willing to donate an easement to the Town for potential future drainage improvements?

9. Yes, would consider but wants to see the plan.

Date_____ Address _____
Name of Observer _____

Observations

Supported by Pictures

Storage Shed	
Play Equipment	
Fence	
Pool	
Lower level door entry	
Raised planter bed	
Significant landscaping	
Detached garage	
Driveway culvert, size	
Foundation wall type	
Other	

Date	8/28/2020
Name of Interviewer	W. Nelson
Other Staff on Site	M. Kelley

Address	710 College
Name(s)	Billy Duncan, Masonic Lodge Rep.
Phone	230-4466
Email	
Rent/Own	Masonic Lodge Representative
Owner Contact	
Other	

Questions:

1. Do you have ponding after rain events anywhere on your property?
No, other than what is yet to come through the drain pipe.

2. Does your home have either a basement or a crawl space?
3. If so, have you ever experienced flooding in that area?

2. Slab

3. No, not since built in 1975

4. Do you have downspouts, and where are the discharge points?

Yes, discharge at grade.

5. Do you currently have flood insurance for your home?
6. Are you willing to consider the purchase of flood insurance?

5. No

6. No

7. Are you willing to remove all or a portion of your fence or make modifications to your fence to allow for the free flow of water?
8. Are you willing to remove or relocate other structures located in the drainage way?

7. No, needed to protect people from ditch

9. Are you willing to donate an easement to the Town for potential future drainage improvements?

9. Yes but would need to go before the Lodge. McDaniel Massonic Lodge.

Date_____ Address _____
Name of Observer _____

Observations

Supported by Pictures

Storage Shed	N/A
Play Equipment	N/A
Fence	C.L.F.
Pool	N/A
Lower level door entry	N/A
Raised planter bed	N/A
Significant landscaping	N/A
Detached garage	N/A
Driveway culvert, size	36" CMP
Foundation wall type	CMU/BRICK
Other	

Date	8/28/2020
Name of Interviewer	WAYNE NELSON
Other Staff on Site	MICHAEL KELLEY

Address	710 COLLEGE STREET
Name(s)	BILLY DUNCAN (MCDANIEL MASONIC LODGE)
Phone	230-4466
Email	
Rent/Own	
Owner Contact	
Other	

Questions:

1. Do you have ponding after rain events anywhere on your property?
NOT THAT WE KNOW OF. JUST WHAT DRAINS THROUGH THE PIPE.

2. Does your home have either a basement or a crawl space?
3. If so, have you ever experienced flooding in that area?

2) NO, SLAB ON GRADE,

4. Do you have downspouts, and where are the discharge points?

4) YES, DISCHARGE AT GRADE.

5. Do you currently have flood insurance for your home?
6. Are you willing to consider the purchase of flood insurance?

5) DON'T THINK SO.

6) CAN'T AFFORD IT.

7. Are you willing to remove all or a portion of your fence or make modifications to your fence to allow for the free flow of water?
8. Are you willing to remove or relocate other structures located in the drainage way?

7) IT IS THERE FOR SAFETY. NO.

8) N/A.

9. Are you willing to donate an easement to the Town for potential future drainage improvements?

9) THE REQUEST WOULD NEED TO GO BEFORE THE LODGE, BUT WOULD NEED TO KNOW EXACTLY WHAT YOU ARE PLANNING TO DO.

Date 8/28/20 Address 710 COLLEGE ST,
Name of Observer MICHAEL KELLEY

Observations

Supported by Pictures

Storage Shed	N/A
Play Equipment	N/A
Fence	C.L.F.
Pool	N/A
Lower level door entry	N/A
Raised planter bed	N/A
Significant landscaping	N/A
Detached garage	N/A
Driveway culvert, size	36" CMP ACROSS THE WIDTH OF THE PARKING LOT.
Foundation wall type	CMU/BRICK
Other	

Date	9/3/20
Name of Interviewer	W. Nelson
Other Staff on Site	M. Kelley

Address	1010 College St.
Name(s)	Brian Bishop / Shauna Hudson (Water Hall)
Phone	577-2014
Email	kbishop1942@gmail.com
Rent/Own	Own
Owner Contact	
Other	

Questions:

1. Do you have ponding after rain events anywhere on your property?
Not aware of any but ~~after~~ before TH developed, front versa lok retaining wall collapsed. Resident confirmed runoff from street still top front wall.

2. Does your home have either a basement or a crawl space?
3. If so, have you ever experienced flooding in that area?

2. Split foyer w/ finished lower level

3. Yes, several years ago, 2005 or 2006 there was flooding but sealed exterior.

4. Do you have downspouts, and where are the discharge points?

Yes, piped away

5. Do you currently have flood insurance for your home?
6. Are you willing to consider the purchase of flood insurance?

5. Unsure but possibly

6. No, not a present but no flooding.

7. Are you willing to remove all or a portion of your fence or make modifications to your fence to allow for the free flow of water?
8. Are you willing to remove or relocate other structures located in the drainage way?

7. N/A - No

8. Shed belongs to owner and will move. Trampoline and pool belong to renter.

9. Are you willing to donate an easement to the Town for potential future drainage improvements?

Yes

Date_____ Address _____

Name of Observer _____

Observations

Supported by Pictures

Storage Shed	
Play Equipment	
Fence	
Pool	
Lower level door entry	
Raised planter bed	
Significant landscaping	
Detached garage	
Driveway culvert, size	
Foundation wall type	
Other	

Date	9/3/2020
Name of Interviewer	WAYNE NELSON
Other Staff on Site	MICHAEL KELLEY

Address	1010 COLLEGE STREET
Name(s)	BRIAN BISHOP (KELLY)
Phone	540-577-2014
Email	KBishop1942@gmail.com.
Rent/Own	OWN
Owner Contact	
Other	RENTER NAME – WALTER HALL.

Questions:

1. Do you have ponding after rain events anywhere on your property?
WAS NOT AWARE THERE WAS A PROBLEM HERE ANYMORE. MY WALL WAS WASHED OUT. RUNS LIKE A WATER FALL OVER THE WALL LIVED HERE 1979-2004

2. Does your home have either a basement or a crawl space?
3. If so, have you ever experienced flooding in that area?

2) SPLIT LEVEL - BASEMENT.

3) A LONG TIME AGO. I DUG UP & SEALED THE BASEMENT WALLS.

4. Do you have downspouts, and where are the discharge points?

4) DOWNSPOUTS ARE PIPED.

5. Do you currently have flood insurance for your home?
6. Are you willing to consider the purchase of flood insurance?

5) NOT THAT I KNOW.

6) NOT AT THE PRESENT TIME.

7. Are you willing to remove all or a portion of your fence or make modifications to your fence to allow for the free flow of water?
8. Are you willing to remove or relocate other structures located in the drainage way?

7) YES FOR THE SITE.

8) POOL & TRAMPOLINE BELONG TO THE RENTER.

9. Are you willing to donate an easement to the Town for potential future drainage improvements?

9) SURE.

Date_____ Address _____

Name of Observer _____

Observations

Supported by Pictures

Storage Shed	YES
Play Equipment	YES — TRAMPOLINE
Fence	N/A
Pool	~~XXXX~~ YES
Lower level door entry	YES
Raised planter bed	YES — AGAINST HOUSE
Significant landscaping	YES WALL & LANDSCAPE IN FRONT YARD.
Detached garage	N/A
Driveway culvert, size	N/A
Foundation wall type	CMU
Other	

Date	8/10/2020 3:00
Name of Interviewer	W. Nelson
Other Staff on Site	M. Kelley

Address	800 College St.
Name(s)	Dale Gillespie
Phone	(540) 200-6727
Email	dgillespie@jetbroadband.com
Rent/Own	Own
Owner Contact	
Other	

Questions:

1. Do you have ponding after rain events anywhere on your property?
Built #1R riprap drainage channel. Handles small rain events not large.

2. Does your home have either a basement or a crawl space?
3. If so, have you ever experienced flooding in that area?

2. Crawl Space "Realtor was hesitant to disclose about flooding."

3. Memorial Day event caused minor intrusion only. Not

4. Do you have downspouts, and where are the discharge points?

Yes, onto splash blocks

5. Do you currently have flood insurance for your home?
6. Are you willing to consider the purchase of flood insurance?

5. No

6. No, not at this time.

7. Are you willing to remove all or a portion of your fence or make modifications to your fence to allow for the free flow of water?
8. Are you willing to remove or relocate other structures located in the drainage way?

7. Yes

8. Would consider relocating of shed but has concern over the cost

9. Are you willing to donate an easement to the Town for potential future drainage improvements?

Yes

Date_____ Address _____
Name of Observer _____

Observations

Supported by Pictures

Storage Shed	✓
Play Equipment	✓
Fence	✓
Pool	
Lower level door entry	N/A
Raised planter bed	
Significant landscaping	
Detached garage	
Driveway culvert, size	
Foundation wall type	
Other	

Date	8/10/20
Name of Interviewer	WAYNE NELSON
Other Staff on Site	MIKE KELLEY

Address	800 COLLEGE STREET
Name(s)	DALE GILLESPIE
Phone	540-200-7627
Email	Dgillespie@jetbroadband.com.
Rent/Own	OWN
Owner Contact	
Other	

Questions:

1. Do you have ponding after rain events anywhere on your property?
YES. SIR. SPENT $11,000 ON IMPROVEMENTS. (RIP RAP CHANNEL) CHANNEL CAN HANDLE SMALL RAINS.

2. Does your home have either a basement or a crawl space? CRAWL SPACE
3. If so, have you ever experienced flooding in that area?

LUCKILY, IT DID NOT GET UNDER THE HOUSE. SOME SEEPED THROUGH THE BLOCK. NOTHING DESTRUCTIVE.

4. Do you have downspouts, and where are the discharge points?

YES. DISCHARGE AT GRADE.

5. Do you currently have flood insurance for your home? NO
6. Are you willing to consider the purchase of flood insurance? NOT AT THIS TIME.

7. Are you willing to remove all or a portion of your fence or make modifications to your fence to allow for the free flow of water?
8. Are you willing to remove or relocate other structures located in the drainage way?

7. YES SIR. FENCE IS ABOVE THE FLOW NOW.

8. YES WILL CONSIDER BUT CONCERNED ABOUT THE EXPENSE TO RELOCATE.

9. Are you willing to donate an easement to the Town for potential future drainage improvements?

YES. SURE.

Date 8/10/20 Address 800 COLLEGE STREET

Name of Observer MIKE KELLEY

Observations

Supported by Pictures

Storage Shed	YES
Play Equipment	YES
Fence	YES CLF
Pool	NO
Lower level door entry	NO
Raised planter bed	NO
Significant landscaping	NO
Detached garage	NO
Driveway culvert, size	NO
Foundation wall type	CMU
Other	

APPENDIX H

Flood Photos

Photo 1 – Flow Relief Along Backyard Reach

Photo 2 – Western Most Lateral Flow from West Main

Photo 3 – Surface Flow in Backyard Reach

Photo 4 – More Surface Runoff

Photo 5 – Proposed BMP Location

Photo 6 – Ponding Near Proposed BMP Location

Photo 7 – More Ponding at Proposed BMP Location

Photo 8 – Mudpike Dr BMP Outlet Structure

Photo 9 – Hospice BMP Outlet Structure

Photo 10 – Christiansburg Middle School BMP

Photo 11 – Christiansburg Middle School BMP Outlet Structure

Photo 12 – Start of Drainage Along College St

Photo 13 – BMP at the Townhomes Along College St

Photo 14 – Buried CB Along College St

Photo 15 – Confluence of Two Upstream Reaches Before Crossing Depot St

Photo 16 – Depot BMP Outlet Structure

Photo 17 – Easternmost Lateral Flow from West Main

Photo 18 – Surface Outlet of Photo 17

Photo 19 – Hillcrest BMP Outlet Structure

APPENDIX I

Town Council Presentation

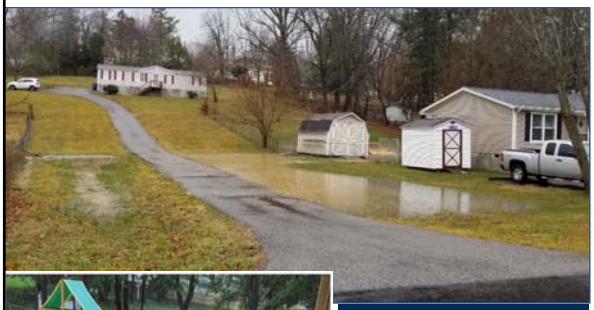
College Street Drainage Alternatives Analysis

Town of Christiansburg, Virginia

TOWN COUNCIL
April 27, 2021

1

2020 FLOODING PROBLEMS



800 College Street

February 6, 2020

780 College Street

May 24, 2020

2

FLOODING PROBLEMS

3

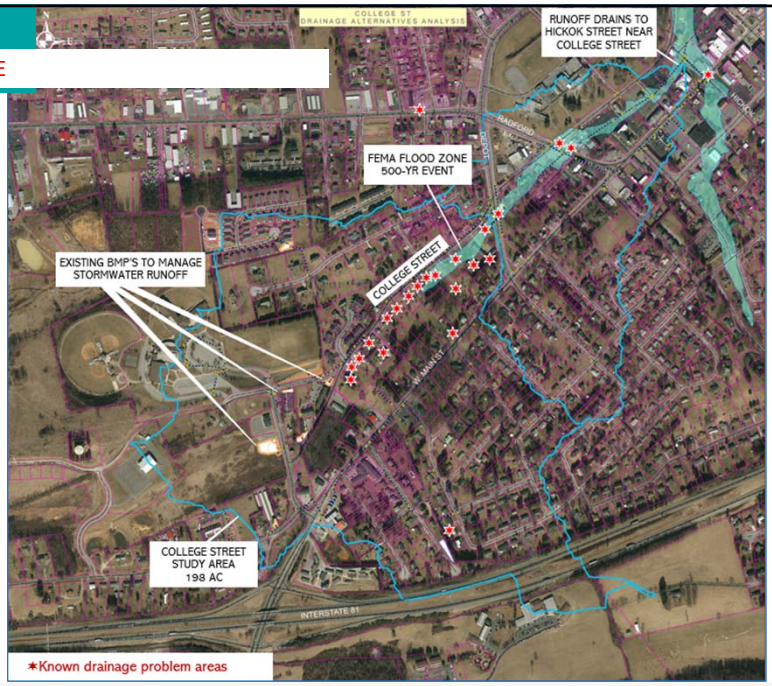
FLOODING PROBLEMS

4

STUDY AREA

OLD SLIDE

- Upper Watershed = 198-Acres
- Lower Watershed = 79-Acres
- Existing Stormwater Basins = 10 total
- Drainage Problem Areas
  - FEMA Zone X (500-Year Flood)
  - 18 Known Drainage Issues *



5

STUDY AREA

- Upper Watershed = 198-Acres
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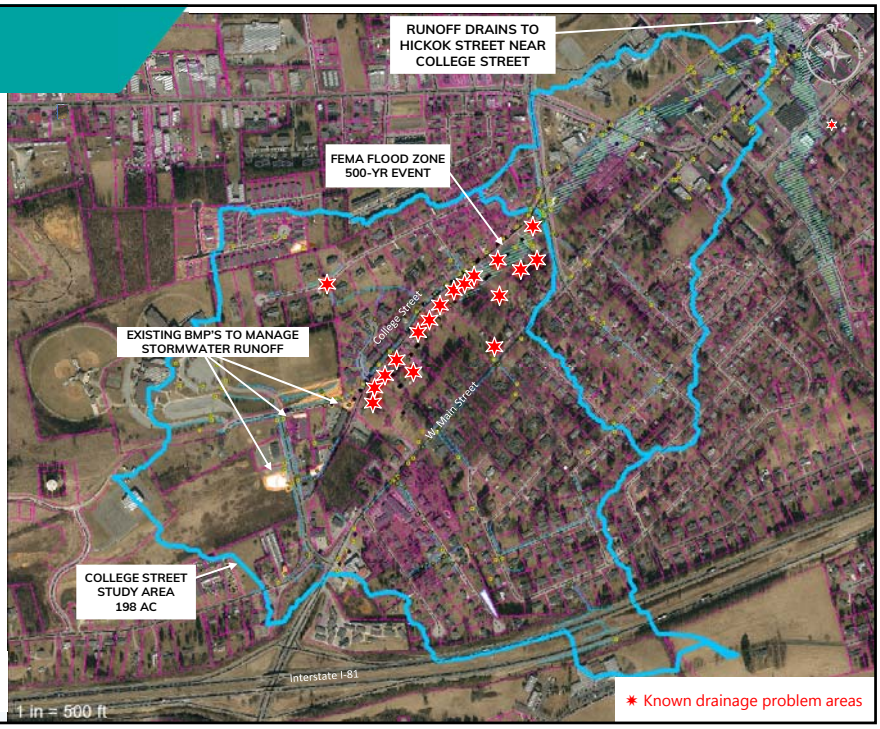


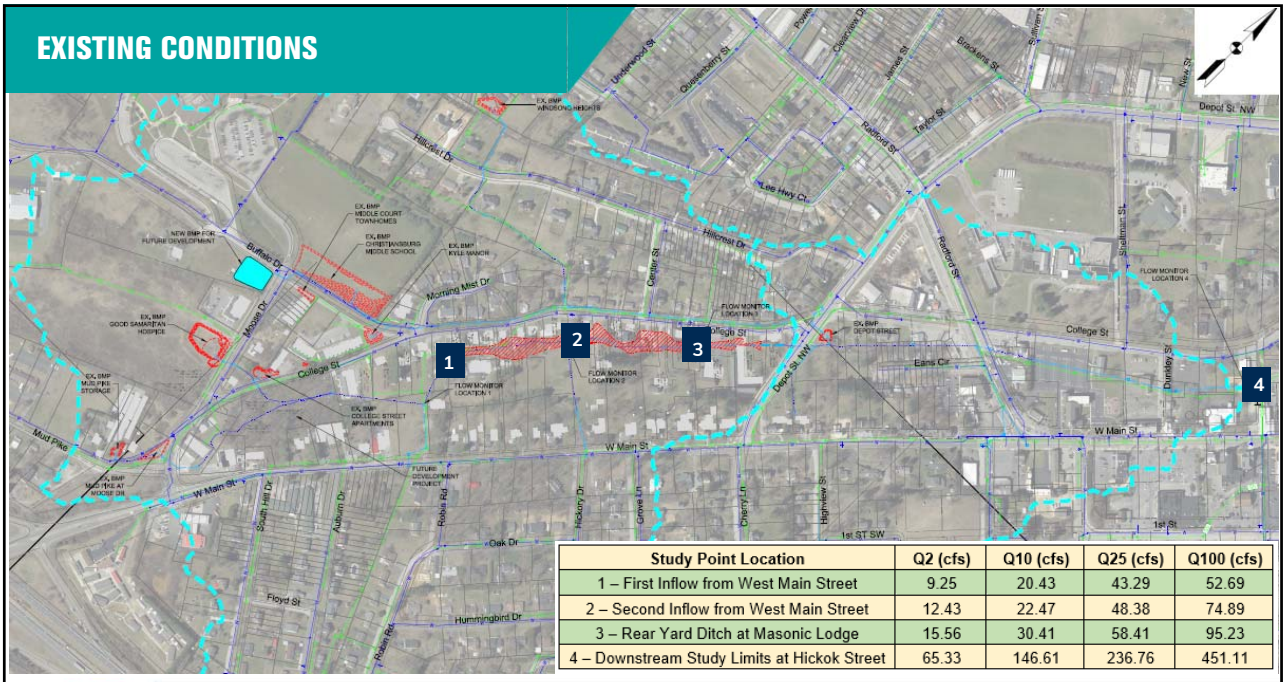
6

WATERSHED MODELING IN PC-SWMM

Sub-Basin	Area (acres)	% Impervious
0	23.12	18
1	13.89	7
2	4.40	34
3	4.84	66
4	9.12	11
5	1.09	25
6	1.33	18
7	5.01	23
8	5.52	23
9	11.89	19
10	1.11	33
11	9.55	36
12	64.94	26
13	4.08	52
14	0.73	25
15	5.33	15
16	4.88	11
17	11.71	16
18	9.60	50
19	27.12	26
20	7.65	12
21	2.99	45
22	18.39	43
23	9.78	77
24	1.89	74
25	8.91	36
26	1.98	85
27	2.30	55
28	4.49	15
29	1.61	91
SUM =	**277.1**	**35.6%**

7

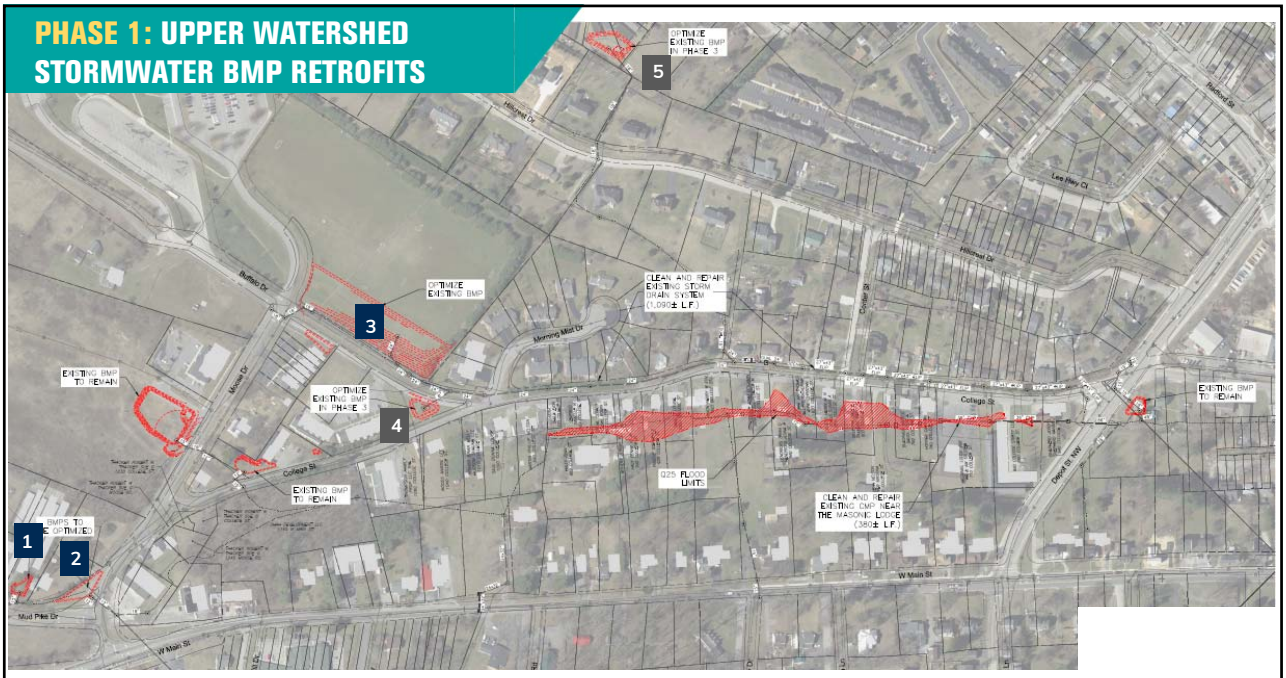
EXISTING CONDITIONS



Study Point Location	Q2 (cfs)	Q10 (cfs)	Q25 (cfs)	Q100 (cfs)
1 – First Inflow from West Main Street	9.25	20.43	43.29	52.69
2 – Second Inflow from West Main Street	12.43	22.47	48.38	74.89
3 – Rear Yard Ditch at Masonic Lodge	15.56	30.41	58.41	95.23
4 – Downstream Study Limits at Hickok Street	65.33	146.61	236.76	451.11

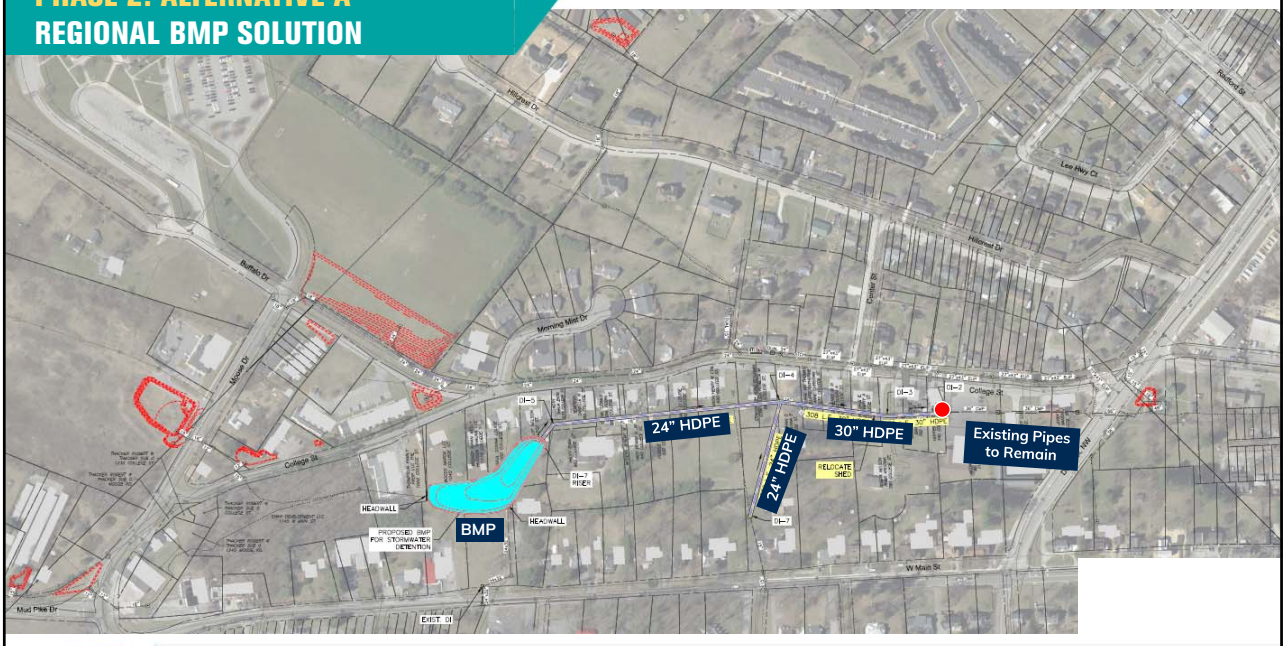
8

PHASE 1: UPPER WATERSHED STORMWATER BMP RETROFITS



9

PHASE 2: ALTERNATIVE A REGIONAL BMP SOLUTION

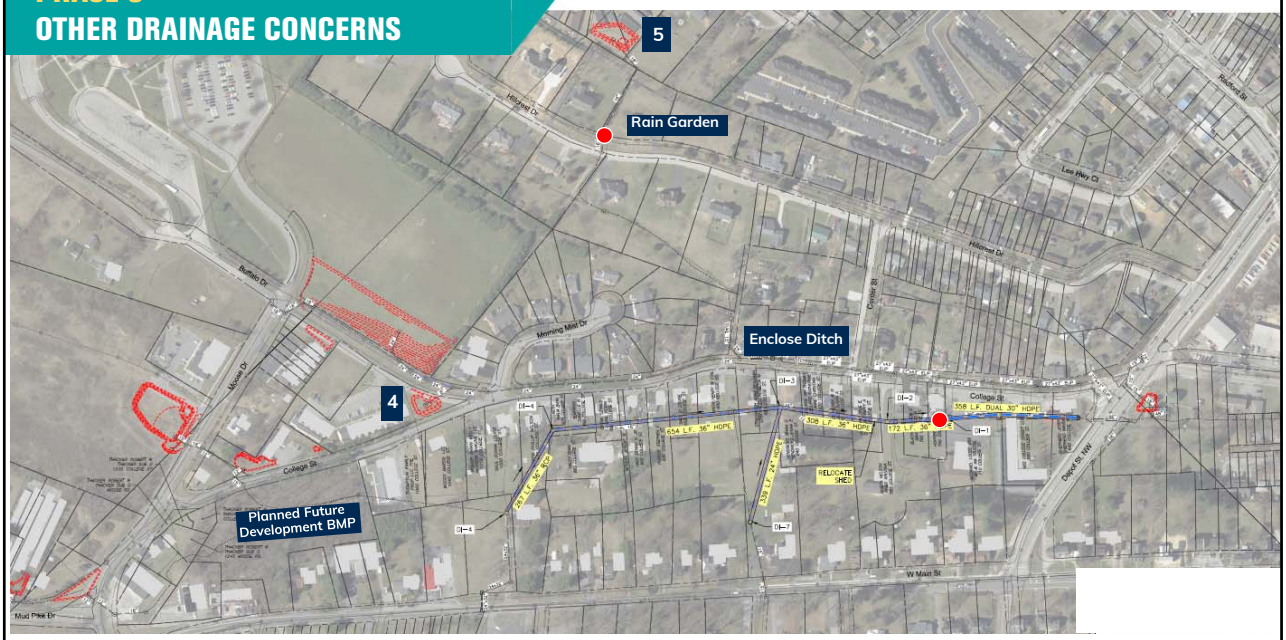


10

PHASE 2: ALTERNATIVE B
LARGER PIPE SOLUTION

11

PHASE 3
OTHER DRAINAGE CONCERNS



12

PROPOSED CONDITIONS

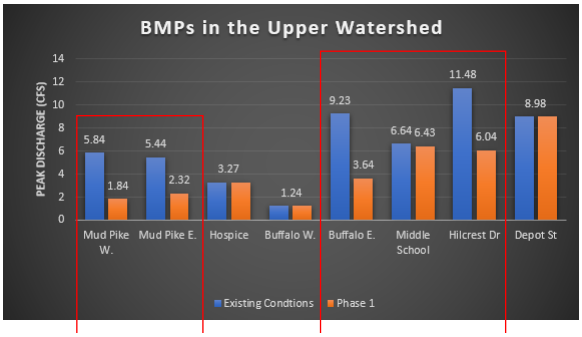


Chart #1

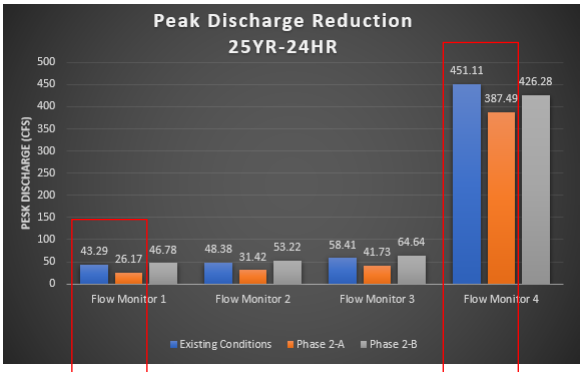


Chart #2

63% Reduction in Peak Discharges (7cfs less)

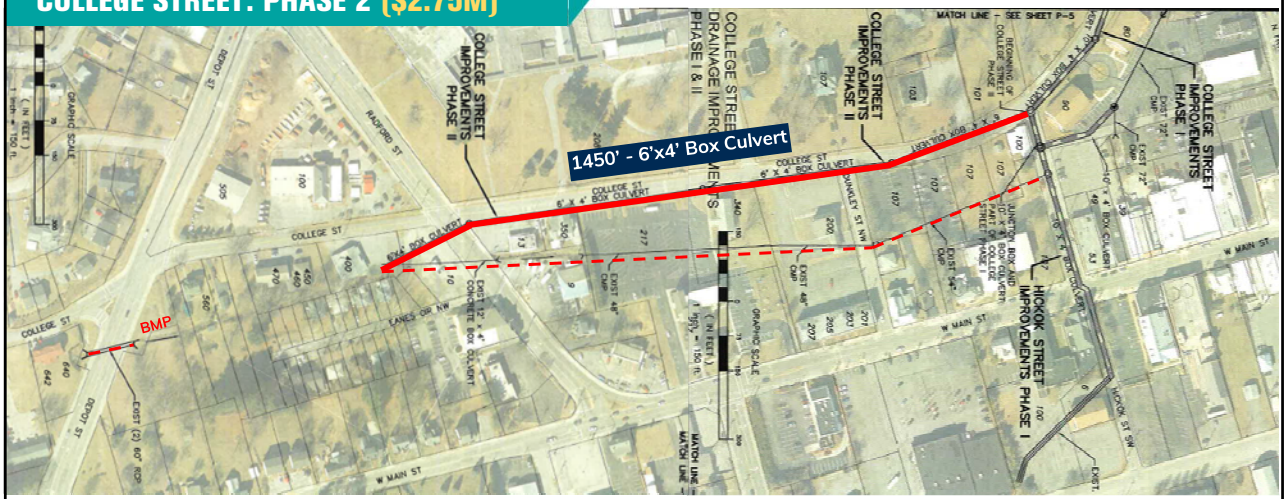
41% Reduction in Peak Discharges (11cfs less)

40% Reduction in Peak Discharges (17cfs less)

14% Reduction in Peak Discharges (64cfs less)

13

DOWNTOWN WATERSHED STUDY
COLLEGE STREET: PHASE 2 ($2.75M)



14

RECOMMENDATIONS ($3.3 M)

Phase 1: BMP Retrofits

- Field Verify, Design and Build Modifications to 3 Stormwater BMP Outfalls.
- Consider utilizing Town Staff for a Quick Fix to these BMP's.
- Town Staff to also help inspect, clean and repair existing drainage systems downstream.

Phase 2A: Regional BMP

- Refine Concept Plans
- Secure Drainage Easements
- Secure Environmental Permits
- Secure Funding. Consider Water Quality Funds such as the DEQ Stormwater Local Assistance Funds for a 50% Match. Consider FEMA BRIC and other funds for the flood mitigation benefits.
- Design & Build the Project

Phase 3: Other Drainage Concerns

- Carefully consider negative impacts from the future planned development project.
- Replace the asphalt ditch along College Street with a Culvert.
- Enlarge and Increase Detention Storage for 2 BMP's (4 & 5).
- Build a Rain Garden along Hillcrest Drive where there are Standing Water Issues

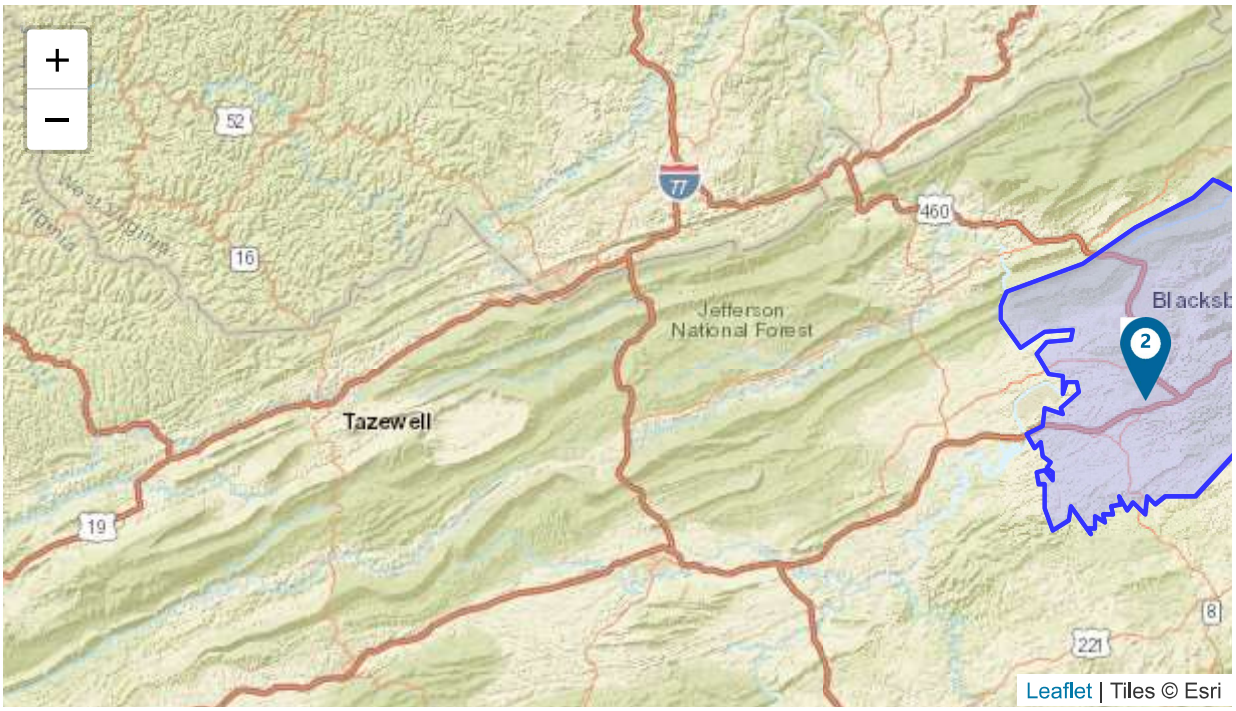
15

Benefit-Cost Calculator

V.6.0 (Build 20231011.1703 | Release Notes)

Benefit-Cost Analysis

Project Name: College Street Drainage Phase I and II



				Using 7% Discount Rate			Using 3% Discount Rate (For BRIC and FMA only)			
Map Marker ▲	Mitigation Title	Property Type	Hazard	Benefits (B)	Costs (C)	BCR (B/C)	Benefits (B)	Costs (C)	BCR (B/C)	
1	Bioretention @ 37.1278550; -80.4133500		DFA - Riverine Flood	$ 258,953	$ 0	0.00	$ 429,744	$ 0	0.00	
2	Bioretention @ College St, Christiansburg, Virginia, 24073		DFA - Riverine Flood	$ 4,315,886	$ 4,000,000	1.08	$ 7,162,400	$ 4,000,000	1.79	
TOTAL (SELECTED)				**$ 4,574,839**	**$ 4,000,000**	**1.14**	**$ 7,592,144**	**$ 4,000,000**	**1.90**	
TOTAL				**$ 4,574,839**	**$ 4,000,000**	**1.14**	**$ 7,592,144**	**$ 4,000,000**	**1.90**	

Property Configuration

Property Title:	Bioretention @ 37.1278550; -80.4133500
Property Location:	24073, Montgomery, Virginia
Property Coordinates:	37.127854985710165, -80.41334999744471
Hazard Type:	Riverine Flood
Mitigation Action Type:	Bioretention
Property Type:	Green Infrastructure
Analysis Method Type:	Professional Expected Damages

Cost Estimation

Bioretention @ 37.1278550; -80.4133500

Project Useful Life (years):	35
Project Cost:	$0
Number of Maintenance Years:	35 Use Default:Yes
Annual Maintenance Cost:	$0

Damage Analysis Parameters - Damage Frequency Assessment

Bioretention @ 37.1278550; -80.4133500

Year of Analysis was Conducted:	2023
Year Property was Built:	1970
Analysis Duration:	54 Use Default:Yes

Professional Expected Damages Before Mitigation

Bioretention @ 37.1278550; -80.4133500

	OTHER	OPTIONAL DAMAGES			VOLUNTEER COSTS		TOTAL
Recurrence Interval (years)	Damages ($)	Category 1 ($)	Category 2 ($)	Category 3 ($)	Number of Volunteers	Number of Days	Damages ($)
5	100,000	0	0	0	0	0	100,000

Annualized Damages Before Mitigation

Bioretention @ 37.1278550; -80.4133500

Annualized Recurrence Interval (years)	Damages and Losses ($)	Annualized Damages and Losses ($)
5	100,000	20,000
	Sum Damages and Losses ($)	Sum Annualized Damages and Losses ($)
	100,000	20,000

Professional Expected Damages After Mitigation

Bioretention @ 37.1278550; -80.4133500

	OTHER	OPTIONAL DAMAGES			VOLUNTEER COSTS		TOTAL
Recurrence Interval (years)	Damages ($)	Category 1 ($)	Category 2 ($)	Category 3 ($)	Number of Volunteers	Number of Days	Damages ($)
100	0	0	0	0	0	0	0

Annualized Damages After Mitigation

Bioretention @ 37.1278550; -80.4133500

Annualized Recurrence Interval (years)	Damages and Losses ($)	Annualized Damages and Losses ($)
100	0	0
	Sum Damages and Losses ($)	Sum Annualized Damages and Losses ($)
	0	0

Benefits-Costs Summary

Bioretention @ 37.1278550; -80.4133500

Total Standard Mitigation Benefits:	$258,953
Total Social Benefits:	$0
Total Mitigation Project Benefits:	$258,953
Total Mitigation Project Cost:	$0
Benefit Cost Ratio - Standard:	0
Benefit Cost Ratio - Standard + Social:	0

Property Configuration

Property Title:	Bioretention @ College St, Christiansburg, Virginia, 24073
Property Location:	24073, Montgomery, Virginia
Property Coordinates:	37.127854985710165, -80.41334999744471
Hazard Type:	Riverine Flood
Mitigation Action Type:	Bioretention
Property Type:	Green Infrastructure
Analysis Method Type:	Professional Expected Damages

Cost Estimation

Bioretention @ College St, Christiansburg, Virginia, 24073

Project Useful Life (years):	35
Project Cost:	$4,000,000
Number of Maintenance Years:	35 Use Default:Yes
Annual Maintenance Cost:	$0

Damage Analysis Parameters - Damage Frequency Assessment

Bioretention @ College St, Christiansburg, Virginia, 24073

Year of Analysis was Conducted:	2023
Year Property was Built:	0
Analysis Duration:	10 Use Default:Yes

Professional Expected Damages Before Mitigation

Bioretention @ College St, Christiansburg, Virginia, 24073

	OTHER	OPTIONAL DAMAGES			VOLUNTEER COSTS		TOTAL
Recurrence Interval (years)	Damages ($)	Category 1 ($)	Category 2 ($)	Category 3 ($)	Number of Volunteers	Number of Days	Damages ($)
3	1,000,000	0	0	0	0	0	1,000,000

Annualized Damages Before Mitigation

Bioretention @ College St, Christiansburg, Virginia, 24073

Annualized Recurrence Interval (years)	Damages and Losses ($)	Annualized Damages and Losses ($)
3	1,000,000	333,333
	Sum Damages and Losses ($)	Sum Annualized Damages and Losses ($)
	1,000,000	333,333

Professional Expected Damages After Mitigation

Bioretention @ College St, Christiansburg, Virginia, 24073

	OTHER	OPTIONAL DAMAGES			VOLUNTEER COSTS		TOTAL
Recurrence Interval (years)	Damages ($)	Category 1 ($)	Category 2 ($)	Category 3 ($)	Number of Volunteers	Number of Days	Damages ($)
100	0	0	0	0	0	0	0

Annualized Damages After Mitigation

Bioretention @ College St, Christiansburg, Virginia, 24073

Annualized Recurrence Interval (years)	Damages and Losses ($)	Annualized Damages and Losses ($)
100	0	0
	Sum Damages and Losses ($)	Sum Annualized Damages and Losses ($)
	0	0

Benefits-Costs Summary

Bioretention @ College St, Christiansburg, Virginia, 24073

Total Standard Mitigation Benefits:	$4,315,886
Total Social Benefits:	$0
Total Mitigation Project Benefits:	$4,315,886
Total Mitigation Project Cost:	$4,000,000
Benefit Cost Ratio - Standard:	1.08
Benefit Cost Ratio - Standard + Social:	1.08

THE PLACE TO BE.
CHRISTIANSBURG VA
Established November 10, 1792

100 East Main Street
Christiansburg, VA 24073
p: (540) 382-6128
f: (540) 382-7338

November 8, 2023

Mr. Daryl Glover
Deputy Agency Director of Dam Safety, Flood Preparedness, and Soil and Water Conservation
Department of Conservation and Recreation
60 East Main Street, 24th Floor
Richmond, Virginia 23219

RE: Town of Christiansburg Virginia Community Flood Preparedness Fund (CFPF) Grant Request

Dear Mr. Glover:

The Town of Christiansburg is pleased to submit this grant application for project funding from the CFPF fund. The Town is seeking funding for the College Street Drainage Project Phase I and Phase II project as presented in our Town adopted Flood Resilience Plan and in the College Street Drainage Study. The Town is committed to the match as proposed ($206,865). We appreciate your consideration of our complete application for CFPF funding.

Randy Wingfield
Town Manager

Virginia Department of Conservation & Recreation

VRA Virginia Resources Authority

DCR Virginia Community Flood Preparedness Fund

Grant Program Application

November 12, 2023

Town of Christiansburg

100 E Main Street
Christiansburg, VA 24073

Contact Information

Michael Kelley, PE, Director of Engineering
(Town of Christiansburg)
Office: 540-382-6120 Ext. 1147
mkelley@christiansburg.com

THE PLACE TO BE.
CHRISTIANSBURG VA
Established November 10, 1792

100 East Main Street
Christiansburg, VA 24073
p: (540) 382-6128
f: (540) 382-7338

November 8, 2023

Mr. Daryl Glover
Deputy Agency Director of Dam Safety, Flood Preparedness, and Soil and Water Conservation
Department of Conservation and Recreation
60 East Main Street, 24th Floor
Richmond, Virginia 23219

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Randy Wingfield
Town Manager

GRANT APPLICATION PROJECT NARRATIVE

TOWN OF CHRISTIANSBURG, VIRGINIA

The following narrative is provided to support the Town of Christiansburg's grant application to the DCR/VRA 2023 Community Flood Preparedness Fund (CFPF) for the 2023 Funding Round. The Town is requesting funds to support the engineering and construction of one of the Town's flood resilience projects: College Street Drainage Project - Phase I and Phase II. This project will alleviate flooding along College Street and will also contribute to the continuity of flood mitigation infrastructure and achievement of the Town's flood resilience goals, as determined by the Town of Christiansburg Flood Resilience Plan (see attached as Appendix D), approved by Town Council on October 24th, 2023.

The Town understands the CFPF funds must be utilized in accordance with the following principles:

1. Acknowledge the consequences of climate change, and base decision making on the best available science.
2. Identify and address socioeconomic inequities and work to enhance equity through adaptation and protection efforts for low-income and underserved communities.
3. Utilize community and regional scale planning to the maximum extent possible, seeking region-specific approaches tailored to the needs of individual communities.
4. Understand fiscal realities and focus on the most cost-effective solutions for the protection and adaptation of our communities, businesses, and public infrastructure. The solutions will, to the extent possible, prioritize effective natural solutions.
5. Recognize the importance of protecting and enhancing nature-based solutions in all regions, natural coastal barriers, and fish and wildlife habitat by prioritizing nature-based solutions.

The project was identified as a high priority in the Town's Flood Resilience Plan which was developed in accordance with these principles.

The following narrative includes a scope of work and budget discussion and is supported with an attachment, as noted above.

SCOPE OF WORK / NARRATIVE

The Town of Christiansburg Flood Resiliency Plan posed several potential projects that could promote flood resilience. These projects were identified based on drainage studies performed by the Town to assess recurring flooding and drainage issues within the Town. Utilizing DCR CFPF Manual scoring criterion for "Project Eligible for Consideration", potential projects were ranked alongside of construction and engineering cost data. Among these potential projects, College Street Drainage Projects – Phase I and Phase II were determined to be the most optimal for both flood resilience and cost-effectiveness. These two phases of the College Street Drainage project are connected; implementation of both phases will alleviate flooding on College Street.

Specifically, the College Street Drainage Project - Phase I and Phase II originated as project recommendations from the drainage study and report titled, Town of Christiansburg College Street

Drainage Alternatives Analysis, published in June of 2021 (linked here). This report developed and ranked project recommendations to address long-standing drainage and flooding issues along the College Street Corridor. College Street Drainage Project - Phase I and Phase II were selected by the Town as the most effective solution to the drainage issues along College Street.

The College Street Drainage Project - Phase I and Phase II were prioritized and highly ranked in drainage effectiveness per the College Street Drainage Alternatives Analysis study. Subsequently, the Town of Christiansburg Flood Resilience Plan identified this project as an effective flood resilience project. Commencing work on these projects as soon as possible will be of great benefit to the Town.

The scope of each College Street project phase is as follows:

College Street Drainage Project – Phase I

Drainage Improvements will be made at the nearby school, a reach along the opposite side of College Street, and a detention pond with several hundred feet of the outlet pipe downstream, which will terminate upstream of the first driveway that crosses the drainage ditch. The installed pipe system below the pond will be installed at a flatter grade. The drainage will then re-enter the existing drainage ditch behind the residences along College Street. Trees and landscaping will be planted to enhance the drainage capabilities of the project and to provide an aesthetic for residents.

College Street Drainage Project – Phase II

The pipe and structures previously installed below the pond in Phase I will be re-installed at their originally planned deeper elevations along with the rest of the Phase II construction that extends to Depot Street (and also captures a large inflow from Main Street). This will involve a small amount of redesign for this reach of the pipe installation immediately below the pond.

The projects include the following elements:

1. Flood control and resilience.
2. They will incorporate a nature-based approach to the maximum extent possible.
3. They will provide community scale benefit to a low-income geographic area.
4. Trees and landscaping will enhance drainage capabilities and provide an aesthetic for the project site.

BUDGET NARRATIVE

The College Street Drainage Project Phase I and Phase II engineering and construction cost estimate is $4,081,906. The Phase I estimate is provided below and is at 90% design. The Phase II estimate is also provided below and is at 60% design at the writing of this grant application. The Town of Christiansburg will manage and administer this project, which will require Town staff time for project management and inspection during project mobilization and construction. Additionally, post-construction maintenance as detailed in the maintenance plan will require Public Works time for inspection and performance of maintenance as needed. Implementation of the maintenance plan will also require equipment to perform periodic mowing and removal of any accumulated trash or debris in the completed project area. The total project estimate incorporating these costs is $4,097,246.

Applicants must have prior approval from the Department to submit applications, forms, and supporting documents by mail in lieu of the WebGrants portal.

Appendix A: Application Form for Grant and Loan Requests for All Categories

---

Virginia Department of Conservation and Recreation
Virginia Community Flood Preparedness Fund Grant Program

Name of Local Government: Town of Christiansburg, Virginia

Category Being Applied for (check one):

☐ **Capacity Building/Planning**

☒ **Project**

☐ **Study**

NFIP/DCR Community Identification Number (CID) 510101

Name of Authorized Official and Title: Randy Wingfield, Town Manager

Signature of Authorized Official: R. Wingfield

Mailing Address (1): 100 East Main Street

Mailing Address (2): _____

City: Christiansburg **State:** VA **Zip:** 24073

Telephone Number: (540) 382-6128 x1119 **Cell Phone Number:** (____) _____

Email Address: rwingfield@christiansburg.org

Contact and Title (If different from authorized official): _____

Mailing Address (1): _____

Mailing Address (2): _____

City: _____ State: _____ Zip: _____

Telephone Number: (____) _____ Cell Phone Number: (____) _____

Email Address: _____

Is the proposal in this application intended to benefit a low-income geographic area as defined in the Part 1 Definitions? Yes _X_ No ____

Categories (select applicable activities that will be included in the project and used for scoring criterion):

Capacity Building and Planning Grants

☐ Floodplain Staff Capacity.

☐ Resilience Plan Development

- ☐ Revisions to existing resilience plans and modifications to existing comprehensive and hazard mitigation plans.
- ☐ Resource assessments, planning, strategies, and development.
  - Policy management and/or development.
  - Stakeholder engagement and strategies.

☐ Other: _____

Study Grants (Check All that Apply)

☐ Studies to aid in updating floodplain ordinances to maintain compliance with the NFIP, or to incorporate higher standards that may reduce the risk of flood damage. This must include establishing processes for implementing the ordinance, including but not limited to, permitting, record retention, violations, and variances. This may include revising a floodplain ordinance when the community is getting new Flood Insurance Rate Maps (FIRMs), updating a floodplain ordinance to include floodplain setbacks, freeboard, or other

higher standards, RiskMAP public noticing requirements, or correcting issues identified in a Corrective Action Plan.

- ☐ Revising other land use ordinances to incorporate flood protection and mitigation goals, standards, and practices.
- ☐ Conducting hydrologic and hydraulic (H&H) studies of floodplains. *Changes to the base flood, as demonstrated by the H&H must be submitted to FEMA within 6 months of the data becoming available.*
- ☐ Studies and Data Collection of Statewide and Regional Significance.
- ☐ Revisions to existing resilience plans and modifications to existing comprehensive and hazard.
- ☐ Other relevant flood prevention and protection project or study.

Project Grants and Loans (Check All that Apply – Hybrid Solutions will include items from both the "Nature-Based" and "Other" categories)

Nature-based solutions

- ☒ Acquisition of property (or interests therein) and/or structures for purposes of allowing floodwater inundation, strategic retreat of existing land uses from areas vulnerable to flooding; the conservation or enhancement of natural flood resilience resources; or acquisition of structures, provided the acquired property will be protected in perpetuity from further development, and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition.
- ☐ Wetland restoration.
- ☒ Floodplain restoration.
- ☐ Construction of swales and settling ponds.
- ☐ Living shorelines and vegetated buffers.
- ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by *ConserveVirginia* Floodplain and Flooding Resilience layer or a similar data driven analytic tool, or the acquisition of developed land for future conservation.
- ☐ Dam removal.
- ☐ Stream bank restoration or stabilization.
- ☐ Restoration of floodplains to natural and beneficial function.

Other Projects

- ☐ Structural floodwalls, levees, berms, flood gates, structural conveyances.
- ☒ Storm water system upgrades.
- ☐ Medium and large-scale Low Impact Development (LID) in urban areas.

- ☐ Developing flood warning and response systems, which may include gauge installation, to notify residents of potential emergency flooding events.
- ☐ Dam restoration.
- ☐ Beneficial reuse of dredge materials for flood mitigation purposes
- ☐ Removal or relocation of structures from flood-prone areas where the land will not be returned to open space.
- ☒ Acquisition of property (or interests therein) and/or structures for purposes of allowing floodwater inundation, strategic retreat of existing land uses from areas vulnerable to flooding; the conservation or enhancement of natural flood resilience resources; or acquisition of structures, provided the acquired property will be protected in perpetuity from further development, and where the flood mitigation benefits will **not be** achieved as a part of the same project as the property acquisition.
- ☐ Other project identified in a DCR-approved Resilience Plan.

Location of Project or Activity (Include Maps): See Included Map: Appendix C: Checklist All Categories - Detailed Map of Project Area

NFIP Community Identification Number (CID#) : _____

Is Project Located in an NFIP Participating Community? ☒ Yes ☐ No

Is Project Located in a Special Flood Hazard Area? ☐ Yes ☐ No

Flood Zone(s) (If Applicable): _____

Flood Insurance Rate Map Number(s) (If Applicable): _____

Total Cost of Project: $4,097,246.00

Total Amount Requested $3,892,384.00

Amount Requested as Grant $3,892,384.00

Amount Requested as Project Loan (not including short-term loans for up-front costs) $0.00

Amount Requested as Short-Term loan for Up-Front Costs (not to exceed 20% of amount requested as Grant) $0.00

For projects, planning, capacity building, and studies in low-income geographic areas: Are you requesting that match be waived? □ Yes ☒ No

Additional Information for Loan Requests

Requested Loan Security: _____

(General Obligation, Lease, Revenue, Special Fund Revenue, and/or Moral obligation from other government entity)

Desired loan term: _____

Since the date of your latest financial statements, did the applicant issue any new debt? _____
(If yes, provide details)

Is there any pending or potential litigation by or against the applicant? _____

Attach five years of current audited financial statements (FY18-22) or refer to website if posted
(Not necessary for existing VRA borrowers)

Attach FY2024 adopted budget or refer to website

Attach current Capital Improvement Plan

Attach adopted Financial Policies

Attach a list of the ten largest employers in the Applicant's jurisdiction.

Attach a list of the ten largest taxpayers in the Applicant's jurisdiction

Appendix B: Budget Narrative Template

Applicant Name:
Community Flood Preparedness Fund &
Resilient Virginia Revolving Loan Fund
Detailed Budget Narrative
Period of Performance: January 2024 through July 2026
Submission Date: November 21 2023

Grand Total State Funding Request	$ 3,892,384
Grand Total Local Share of Project	$ 204,862
Federal Funding (if applicable)	$
Project Grand Total	$ 4,097,246
Locality Cost Match	% 5

Breakout By Cost Type	Personnel	Fringe	Travel	Equipment	Supplies	Contracts	Indirect Costs	Other Costs	Total
Federal Share (if applicable)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Local Share	$0.00	$0.00	$0.00	$0.00	$0.00	$204,095	$0.00	$2,770	$206,865
State Share	$0.00	$0.00	$0.00	$0.00	$0.00	$3,877,811	$0.00	$0.00	$3,877,811
Pre-Award/Startup	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$250.00	$250.00
Maintenance	$0.00	$0.00	$0.00	$5,000	$5,000	$0.00	$0.00	$2,320	$12,320
Total	$ 0.00	$ 0.00	$ 0.00	$ 5,000	$ 5,000	$4,081,906	$ 0.00	$5,340	$ 4,097,246

Appendix C: Checklist All Categories

(Benefit-cost analysis must be included if the proposed Project is over $2 million.)

Virginia Department of Conservation and Recreation

Community Flood Preparedness Fund Grant Program

☒ Detailed map of the project area(s) (Projects/Studies)
- See included map of project area
- See included conceptual plans containing project area

☒ FIRMette of the project area(s) (Projects/Studies)
- See included FIRMette of the project area

☒ Historic flood damage data and/or images (Projects/Studies)
- See included images of historic flood damage

☒ A link to or a copy of the current floodplain ordinance

https://library.municode.com/VA/Christiansburg/CODES/Code_of_Ordinances?nodeId=SPBLADERE_CH42ZO_ARTXVFLDIFP_S42-440OFFLDIZOMA

☒ Non-Fund financed maintenance and management plan for project extending a minimum of 10 years from project close
- See included non-Fund financed maintenance and management plan for the project

☒ A link to or a copy of the current comprehensive plan

https://www.christiansburg.org/DocumentCenter/View/6316

☒ Social vulnerability index score(s) for the project area from VFRIS SVI Layer
- See included social vulnerability index scores

☐ If applicant is not a town, city, or county, letters of support from affected localities

☐ Letter of support from impacted stakeholders

☒ Budget Narrative
- See included budget narrative

☒ Supporting Documentation, including the Benefit-Cost Analysis tool/narrative (for projects over $2 million)
- See included FEMA Benefit-Cost Analysis tool output for this project

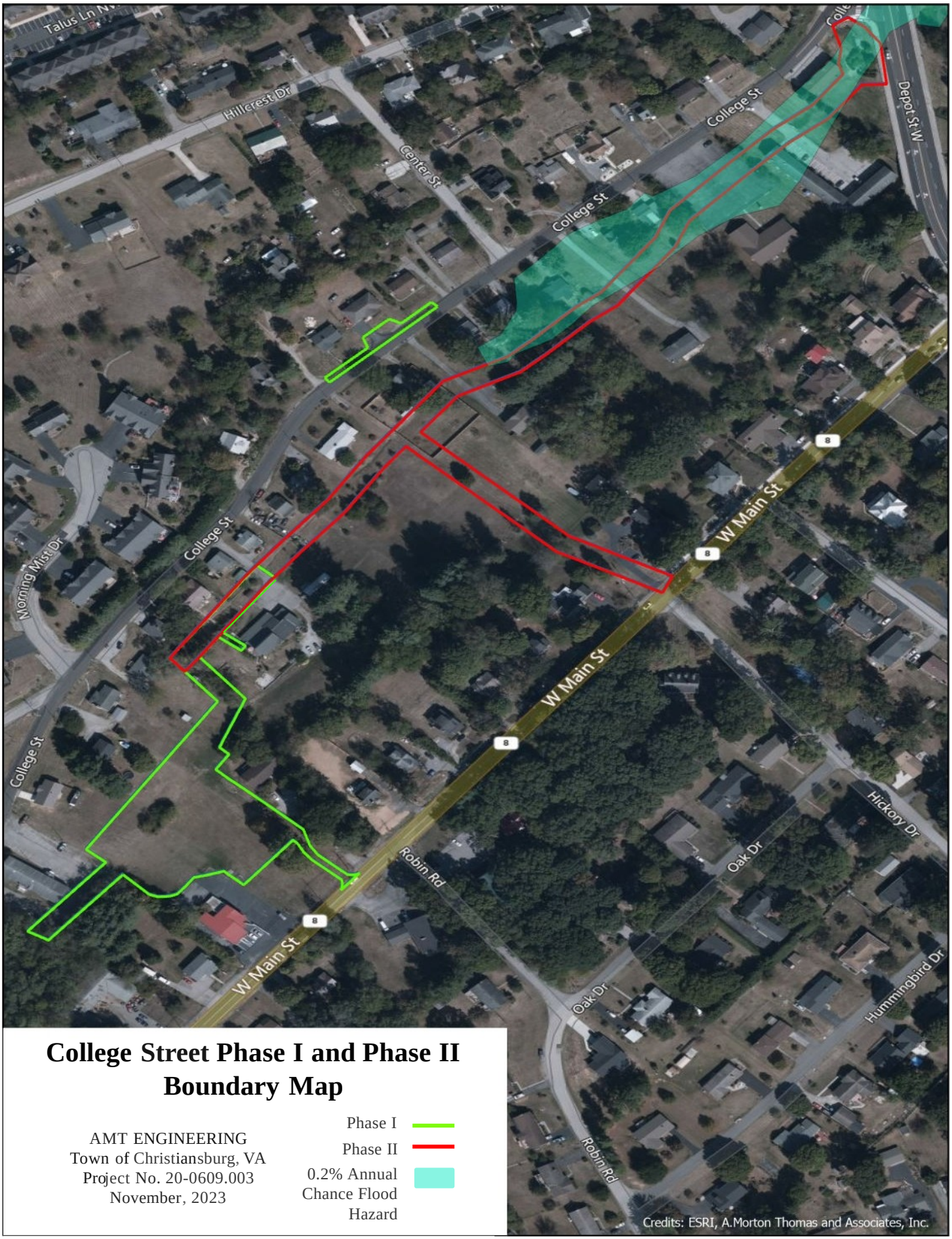
☒ Authorization to request funding from the Fund from governing body or chief executive of the local government
- See included authorization to request funding from the Fund from governing body or chief executive of the local government
- See included authorization to request funding from the Fund from governing body or chief executive of the local government - Approval of the Town of Christiansburg Flood Resilience Plan

☐ Signed pledge agreement from each contributing organization

☒ Detailed budget and narrative for all costs

- See included detailed budget and narrative for all cost

Appendix C: Checklist All Categories - Detailed Map of Project Area



College Street Phase I and Phase II Boundary Map

AMT ENGINEERING
Town of Christiansburg, VA
Project No. 20-0609.003
November, 2023

Phase I
Phase II
0.2% Annual Chance Flood Hazard

Christiansburg Middle School
Melody Dr
Wingsong Ln
Underwood St
Queensberry St
Power St
Clearview Dr
James St
Brackens St
Sullivan St
New St
Depot St. NW
EX. BMP WINDSONG HEIGHTS
Hillcrest Dr
Lee Hwy Ct
Radford St
Taylor St
Shelman St
EX. BMP MIDDLE COURT TOWNHOMES
NEW BMP FOR FUTURE DEVELOPMENT
EX. BMP CHRISTIANSBURG MIDDLE SCHOOL
EX. BMP KYLE MANOR
Buffalo Dr
Morning Mist Dr
Center St
FLOW MONITOR LOCATION 4
EX. BMP GOOD SAMARITAN HOSPICE
Moose Dr
College St
FLOW MONITOR LOCATION 3
EX. BMP DEPOT STREET
Eans Cir
Dunkley St
Hickok St
EX. BMP MUD PIKE STORAGE
FLOW MONITOR LOCATION 2
FLOW MONITOR LOCATION 1
EX. BMP COLLEGE STREET APARTMENTS
Mud Pike
W Main St
EX. BMP MUD PIKE AT MOOSE DR
FUTURE DEVELOPMENT PROJECT
South Hill Dr
Auburn Dr
Robin Rd
Hickory Dr
Grove Ln
Cherry Ln
Highview St
Oak Dr
1st ST SW
Angle Dr
Longview Dr
Chrisman St
Phlegar St
1st St
Floyd St
Hummingbird Dr
2nd St
Mitchell St
Cooper Ln
3rd St
LOWER WATERSHED (80± ACRES)
Cardinal Dr
EX. BMP SOUTH HILL PARK
Mountainway Dr
UPPER WATERSHED (198± ACRES)
Roseland Dr
4th St
Carson Dr
Roundhill Dr
I-81
Atkinson Rd

LEGEND

- PROPERTY LINE
- EXISTING EDGE OF PAVEMENT
- EXISTING SANITARY SEWER
- EXISTING WATER LINE
- EXISTING STORM SEWER
- EXISTING CREEK LINE
- EXISTING CATCH BASIN
- EXISTING FIRE HYDRANT
- EXISTING WATER VALVE
- EXISTING SANITARY MANHOLE
- EXISTING BMP
- DRAINAGE AREA BOUNDARY
- 25 YEAR FLOODPLAIN BOUNDARY
- 25 YEAR FLOOD LIMITS (ESTIMATED)

0 200' 400'
SCALE: 1"=200'

Date	D. PAPA	L. LANGLOIS	D. RISSMEYER	–
	05/21	05/21	05/21	
	Designed	Drawn	Checked	Approved

COMMONWEALTH OF VIRGINIA
DONALD J. RISSMEYER
No. 26104
PROFESSIONAL ENGINEER
NOT FOR CONSTRUCTION

Town of Christiansburg – College Street
Existing Conditions
Conceptual Design Plans
Town of Christiansburg, VA

A. MORTON THOMAS AND ASSOCIATES, INC.
CONSULTING ENGINEERS

AMT Project No.
20-0609.001

Drawing Name
C1-1

Sheet 1 of 5

X:\RICHMOND\20-0609.001 - TOWN OF CHRISTIANSBURG COLLEGE STREET\05-CAD\20609.001-EXIST.DWG, 4/22/2021 10:05 AM, DPAPA

OPTIMIZE EXISTING BMP IN PHASE 3

OPTIMIZE EXISTING BMP

CLEAN AND REPAIR EXISTING STORM DRAIN SYSTEM (1,090± L.F.)

EXISTING BMP TO REMAIN

OPTIMIZE EXISTING BMP IN PHASE 3

EXISTING BMP TO REMAIN

Q25 FLOOD LIMITS

CLEAN AND REPAIR EXISTING CMP NEAR THE MASONIC LODGE (380± L.F.)

EXISTING BMP TO REMAIN

BMPS TO BE OPTIMIZED

Christiansburg Middle School

Melody Dr

Wingsong Ln

Underwood St

Quesenberry St

Clearview Dr

Radford St

Hillcrest Dr

Lee Hwy Ct

Center St

Buffalo Dr

Morning Mist Dr

Moose Dr

College St

Depot St NW

W Main St

Mud Pike Dr

South Hill Dr

Auburn Dr

Robin Rd

Hickory Dr

Grove Ln

Cherry Ln

Oak Dr

LEGEND

- PROPERTY LINE
- EXISTING EDGE OF PAVEMENT
- EXISTING SANITARY SEWER
- EXISTING WATER LINE
- EXISTING STORM SEWER
- EXISTING CREEK LINE
- EXISTING CATCH BASIN
- EXISTING FIRE HYDRANT
- EXISTING WATER VALVE
- EXISTING SANITARY MANHOLE
- EXISTING BMP
- PROPOSED STORM SEWER

0 62.5' 125'
SCALE: 1"=125'

	D. PAPA	L. LANGLOIS	D. RISSMEYER	–
Designed				
Drawn				
Checked				
Approved				
Date	05/21	05/21	05/21	

COMMONWEALTH OF VIRGINIA
DONALD J. RISSMEYER
No. 26104
PROFESSIONAL ENGINEER

Town of Christiansburg – College Street
Alternative 1
Conceptual Design Plans
Town of Christiansburg, VA

A. MORTON THOMAS AND ASSOCIATES, INC.
CONSULTING ENGINEERS

AMT Project No.
20-0609.001

Drawing Name
C1-2

Sheet 2 of 5

X:\RICHMOND\20-0609.001 - TOWN OF CHRISTIANSBURG COLLEGE STREET\05-CAD\20609.001-ALT-1.DWG, 4/22/2021 2:50 PM, DPAPA

Christiansburg Middle School
Melody Dr
Wingsong Ln
Underwood St
Quesenberry St
Clearview Dr
Radford St
Hillcrest Dr
Lee Hwy Ct
Buffalo Dr
Morning Mist Dr
Center St
Moose Dr
College St
Depot St NW
W Main St
Mud Pike Dr
South Hill Dr
Auburn Dr
Robin Rd
Hickory Dr
Grove Ln
Cherry Ln
Oak Dr
DI-2
DI-3
DI-4
DI-5
DI-7
DI-7 RISER
704 L.F. 24" HDPE
308 L.F. 30" HDPE
172 L.F. 30" HDPE
339 L.F. 24" HDPE
RELOCATE SHED
HEADWALL
HEADWALL
PROPOSED BMP FOR STORMWATER DETENTION
EXIST. DI

LEGEND

- PROPERTY LINE
- EXISTING EDGE OF PAVEMENT
- EXISTING SANITARY SEWER
- EXISTING WATER LINE
- EXISTING STORM SEWER
- EXISTING CREEK LINE
- EXISTING CATCH BASIN
- EXISTING FIRE HYDRANT
- EXISTING WATER VALVE
- EXISTING SANITARY MANHOLE
- EXISTING BMP
- PROPOSED STORM SEWER
- PROPOSED DI-7
- PROPOSED STORM SEWER ALIGNMENT

0 62.5' 125'
SCALE: 1"=125'

Date	Designed	Drawn	Checked	Approved
05/21	D. PAPA	L. LANGLOIS	D. RISSMEYER	–

COMMONWEALTH OF VIRGINIA
DONALD J. RISSMEYER
No. 26104
PROFESSIONAL ENGINEER
NOT FOR CONSTRUCTION

Town of Christiansburg – College Street
Alternative 2A
Conceptual Design Plans
Town of Christiansburg, VA

A. Morton Thomas and Associates, Inc.
Consulting Engineers

AMT Project No.
20-0609.001

Drawing Name
C1-3

Sheet 3 of 5

X:\RICHMOND\20-0609.001 - TOWN OF CHRISTIANSBURG COLLEGE STREET\05-CAD\20609.001-ALT-2.DWG, 4/22/2021 3:09 PM, DPAPA

Christiansburg Middle School
Melody Dr
Wingsong Ln
Underwood St
Quesenberry St
Clearview Dr
Radford St
Hillcrest Dr
Lee Hwy Ct
Center St
Buffalo Dr
Morning Mist Dr
Moose Dr
College St
Depot St NW
W Main St
Mud Pike Dr
South Hill Dr
Auburn Dr
Robin Rd
Hickory Dr
Grove Ln
Cherry Ln
Oak Dr

DI-1
DI-2
DI-3
DI-4
DI-7

654 L.F. 36" HDPE
267 L.F. 36" RCP
308 L.F. 36" HDPE
172 L.F. 36" HDPE
358 L.F. DUAL 30" HDPE
339 L.F. 24" HDPE
RELOCATE SHED

LEGEND

- PROPERTY LINE
- EXISTING EDGE OF PAVEMENT
- EXISTING SANITARY SEWER
- EXISTING WATER LINE
- EXISTING STORM SEWER
- EXISTING CREEK LINE
- EXISTING CATCH BASIN
- EXISTING FIRE HYDRANT
- EXISTING WATER VALVE
- EXISTING SANITARY MANHOLE
- EXISTING BMP
- PROPOSED STORM SEWER
- PROPOSED DI-7
- PROPOSED STORM SEWER ALIGNMENT

0 62.5' 125'
SCALE: 1"=125'

Date	Designed	Drawn	Checked	Approved
05/21	D. PAPA	L. LANGLOIS	D. RISSMEYER	–

COMMONWEALTH OF VIRGINIA
DONALD J. RISSMEYER
No. 26104
PROFESSIONAL ENGINEER

Town of Christiansburg – College Street
Alternative 2B
Conceptual Design Plans
Town of Christiansburg, VA

A. Morton Thomas and Associates, Inc.
Consulting Engineers

AMT Project No.
20-0609.001

Drawing Name
C1-4

Sheet 4 of 5

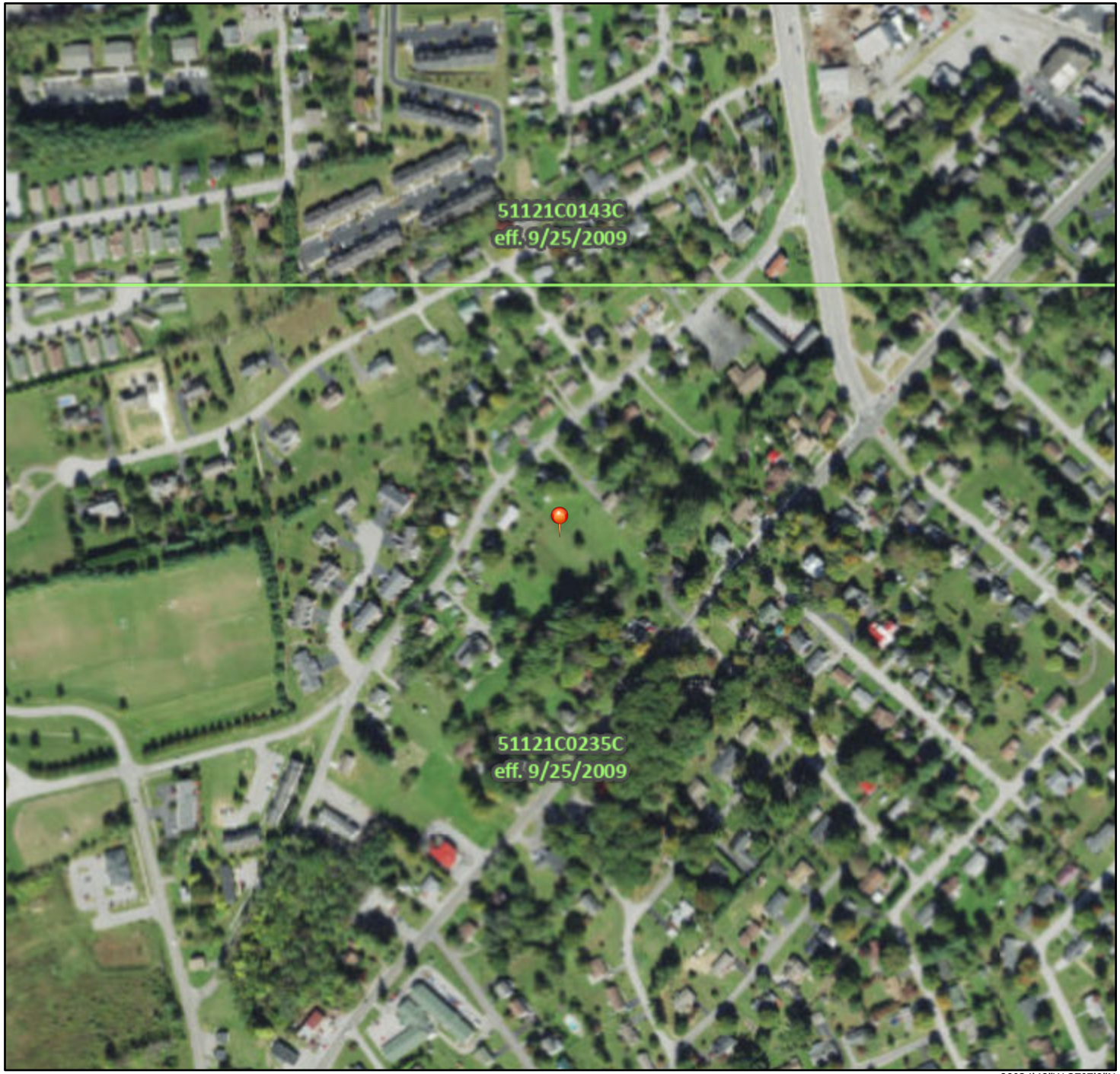
X:\RICHMOND\20-0609.001 - TOWN OF CHRISTIANSBURG COLLEGE STREET\05-CAD\20609.001-ALT-3NEW.DWG, 4/22/2021 2:05 PM, DPAPA


EXPAND EXISTING BMP TO PROVIDE MORE DETENTION
RAIN GARDEN TO ELIMINATE PONDING
ADD 2' BERM TO PROVIDE MORE DETENTION AND PROTECT COLLEGE ST
192 L.F. 27"x43" ELIP
277 L.F. 48" HDPE
187 L.F. 48" HDPE
383 L.F. 48" HDPE
Christiansburg Middle School
College St
W Main St
Depot St NW
Hillcrest Dr
Mud Pike Dr
LEGEND
PROPERTY LINE
EXISTING EDGE OF PAVEMENT
EXISTING SANITARY SEWER
EXISTING WATER LINE
EXISTING STORM SEWER
EXISTING CREEK LINE
EXISTING CATCH BASIN
EXISTING FIRE HYDRANT
EXISTING WATER VALVE
EXISTING SANITARY MANHOLE
EXISTING BMP
PROPOSED STORM SEWER
0 200 400
SCALE: 1"=200'
Designed D. PAPA 05/21
Drawn L. LANGLOIS 05/21
Checked D. RISSMEYER 05/21
Approved
COMMONWEALTH OF VIRGINIA
DONALD J. RISSMEYER
Lic. No. 26104
PROFESSIONAL ENGINEER
NOT FOR CONSTRUCTION
Town of Christiansburg – College Street
Alternative 3
Conceptual Design Plans
Town of Christiansburg, VA
AMT
A. MORTON THOMAS AND ASSOCIATES, INC.
CONSULTING ENGINEERS
AMT Project No.
20-0609.001
Drawing Name
C1-5
Sheet 5 of 5
X:\RICHMOND\20-0609.001 - TOWN OF CHRISTIANSBURG COLLEGE STREET\05-CAD\200609.001-ALT-4.DWG, 4/22/2021 11:00 AM, DPAPA

National Flood Hazard Layer FIRMette

FEMA

80°25'25"W 37°7'38"N



80°24'48"W 37°7'9"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/8/2023 at 9:19 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

May 2020 College St. Flooding

Appendix C: Checklist All Categories - Non-Fund financed maintenance and management plan for project extending a minimum of 10 years from project close

Maintenance and Management Plan

College Street Drainage Project Phase I and II

Town of Christiansburg

The College Street Drainage Project Phase I and Phase II project will create a new pond and landscaping that will be the responsibility of the Town's Department of Public Works to maintain. The Town has an existing maintenance program (linked here) for its facilities and assets and this site will be added to the inventory. The area will require minimal maintenance other than periodic mowing of the BMP to remove unwanted vegetation. Inspections of the BMP including trees and vegetation will be performed by Public Works to ensure continued functionality. Periodic trash and debris removal will also be required.

Appendix C: Checklist All Categories - Social Vulnerability Index Score(s) For The Project Area

College Street Drainage Project - Phase I

Project Eligible for Consideration		
Scoring Information		
Criterion	**Point Value**	**Points Awarded**
Projects may have components of both a. and b. below; however, only one category may be chosen. The category chosen must be identified as the primary project in the application.		
a. Acquisition of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures (and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition).	30	
☐ Wetland restoration. ☐ Floodplain restoration. ☐ Construction of swales and settling ponds. ☐ Living shorelines and vegetated buffers. ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by ConserveVirginia Floodplain and Flooding Resilience layer or a similar data driven analytic tool. ☐ Dam removal ☐ Stream bank restoration or stabilization. ☐ Restoration of floodplains to natural and beneficial function.	25	**25**
b. any other nature-based approach	20	**5**
Is the project area socially vulnerable? (Based on ADAPT VA's Social Vulnerability Index Score.)		
Very High Social Vulnerability (More than 1.5)	10	
High Social Vulnerability (1.0 to 1.5)	8	
Moderate Social Vulnerability (0.0 to 1.0)	5	
Low Social Vulnerability (-1.0 to 0.0)	0	**0**
Low Social Vulnerability (-1.0 to 0.0)	0	
Is the proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?		
Yes	5	
No	0	**0**
Is the proposed project in a low-income geographic area as defined in the DCR manual?		
Yes	10	**10**
No	0	
Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?		
Yes	5	
No	0	**0**
Does this project provide "community scale" benefits?		
Yes	30	**30**
No	0	
Total Points		**70**

Appendix C: Checklist All Categories - Social Vulnerability Index Score(s) For The Project Area

College Street Drainage Project - Phase II

Project Eligible for Consideration		
Scoring Information		
Criterion	**Point Value**	**Points Awarded**
Projects may have components of both a. and b. below; however, only one category may be chosen. The category chosen must be identified as the primary project in the application.		
a. Acquisition of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures (and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition).	30	
☐ Wetland restoration. ☐ Floodplain restoration. ☐ Construction of swales and settling ponds. ☐ Living shorelines and vegetated buffers. ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by ConserveVirginia Floodplain and Flooding Resilience layer or a similar data driven analytic tool. ☐ Dam removal ☐ Stream bank restoration or stabilization. ☐ Restoration of floodplains to natural and beneficial function.	25	**25**
b. any other nature-based approach	20	**5**
Is the project area socially vulnerable? (Based on ADAPT VA's Social Vulnerability Index Score.)		
Very High Social Vulnerability (More than 1.5)	10	
High Social Vulnerability (1.0 to 1.5)	8	
Moderate Social Vulnerability (0.0 to 1.0)	5	
Low Social Vulnerability (-1.0 to 0.0)	0	**0**
Low Social Vulnerability (-1.0 to 0.0)	0	
Is the proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?		
Yes	5	
No	0	**0**
Is the proposed project in a low-income geographic area as defined in the DCR manual?		
Yes	10	**10**
No	0	
Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?		
Yes	5	
No	0	**0**
Does this project provide "community scale" benefits?		
Yes	30	**30**
No	0	
Total Points		**70**

Budget Narrative

College Street Drainage Project Phase I and II

Town of Christiansburg

The College Street Drainage Project Phase I and Phase II engineering and construction cost estimate is $4,081,906. The Phase I estimate is provided below and is at 90% design. The Phase II estimate is also provided below and is at 60% design at the writing of this grant application. The Town of Christiansburg will manage and administer this project, which will require Town staff time for project management and inspection during project mobilization and construction. Additionally, post-construction maintenance as detailed in the maintenance plan will require Public Works time for inspection and performance of maintenance as needed. Implementation of the maintenance plan will also require equipment to perform periodic mowing and removal of any accumulated trash or debris in the completed project area. The total project estimate incorporating these costs is $4,097,246.

COLLEGE STREET DRAINAGE IMPROVEMENTS - PHASE I

October 2023 - 90% COST ESTIMATE

ITEM NO.	DESCRIPTION	UNIT PRICE	QUANTITY	UNIT	COST
	ENGINEERING COSTS				
1	AMT Surveying & Engineering Design	$230,380.00	0.6	LS	$138,228.00
2	AMT Property Acquisition Assistance	$70,495.00	1	LS	$70,495.00
	ENGINEERING COSTS SUBTOTAL				**$208,723.00**
	GENERAL CONDITIONS				
3	Mobilization and Temporary Facilities	$140,000.00	0.5	LS	$70,000.00
4	Bonds, Taxes, Permits, and Insurance	$50,000.00	0.5	LS	$25,000.00
5	As-Builts/Survey Stakeout	$30,000.00	0.5	LS	$15,000.00
6	Traffic Control Measures	$50,000.00	0.5	LS	$25,000.00
	GENERAL CONDITIONS SUBTOTAL				**$135,000.00**
	SITE PREPARATION & EROSION AND SEDIMENT CONTROL				
7	Erosion and Sediment Control Measures	$125,285.65	1	LS	$125,285.65
8	Site Clearing & Grubbing	$75,000.00	0.5	LS	$37,500.00
	SITE PREPARATION & EROSION AND SEDIMENT CONTROL SUBTOTAL				**$162,785.65**
	PHASE I				
9	30" Diameter - HDPE	$170.70	420	LF	$71,694.00
10	30" Diameter - RCP	$250.00	170	LF	$42,500.00
11	4 ft Square Conc. Manhole Structures	$8,000.00	8	ea	$64,000.00
12	6 ft Square Conc. Manhole Structures	$14,000.00	1	ea	$14,000.00
13	VDOT SWM-DR Trash Rack for 4 ft Square	$5,000.00	1	ea	$5,000.00
14	30" HDPE Flared End Section	$1,500.00	3	ea	$4,500.00
15	30" Concrete Flared End Section	$2,500.00	1	ea	$2,500.00
16	Drop Inlet Structures DI-7	$6,942.06	1	ea	$6,942.06
17	Drop Inlet Structures DI-5	$5,983.82	6	ea	$35,902.92
18	Standard flat manhole top with frame and cover	$4,000.00	1	ea	$4,000.00
19	Flexamat-Plus Erosion Control Mat	$50.00	220	SY	$11,000.00
20	VDOT Class I Riprap	$201.26	0	tons	$0.00
21	Concrete Retaining Wall	$200,436.00	1	LS	$200,436.00
22	48" Picket Fence (Brushed Bronze)	$120.00	800	LF	$96,000.00
23	Basin Excavation/Waste	$67.74	7400	CY	$501,276.00
24	24"x35" Elliptical Concrete Pipe	$200.00	192	LF	$38,400.00
25	24" Diameter - HDPE	$121.51	22	LF	$2,673.22
26	Trench Excavation/Backfill or Waste	$67.74	822	CY	$55,682.28
	PHASE I				**$1,156,506.48**
	SITE & UTILITY RESTORATION WORK				
27	Asphalt Pavement Replacements	$150.00	110	SY	$16,500.00
28	Existing Structure Relocation/Removals	$15,000.00		LS	$0.00
29	Dry Utilities Relocation	$5,000.00	1	LS	$5,000.00
30	Wet Utilities Relocation (SS)	$5,000.00	1	LS	$5,000.00
31	8" Diameter - PVC (SS)	$80.00	260	LF	$20,800.00
32	6" Diameter - PVC (SS)	$60.00	130	LF	$7,800.00
33	6" Diameter - PVC Cleanout (SS)	$1,000.00	1	LS	$1,000.00
34	4 ft Diameter Conc. Manhole Structures (SS)	$8,000.00	3	ea	$24,000.00
35	Topsoil and Permanent Stabilization	$15,000.00	0.75	LS	$11,250.00
36	Residence Pump Station for 962 College St	$5,000.00	1	LS	$5,000.00
	SITE & UTILITY RESTORATION SUBTOTAL				**$96,350.00**
	SUBTOTAL CONSTRUCTION COST				**$1,759,365.13**
	Construction Engineering & Inspection	8%	1	LS	$140,749.21
	Construction Contingency	15%	1	LS	$263,905.00
	CONSTRUCTION COST				**$2,164,019.34**
	Land Acquisition Budget (3 Parcels)	$100,000			$100,000.00
	TOTAL PROJECT COST				**$2,264,019.34**

Appendix C: Checklist All Categories - Budget Narrative

COLLEGE STREET DRAINAGE IMPROVEMENTS - PAHASE II

May 2023 - 60% COST ESTIMATE

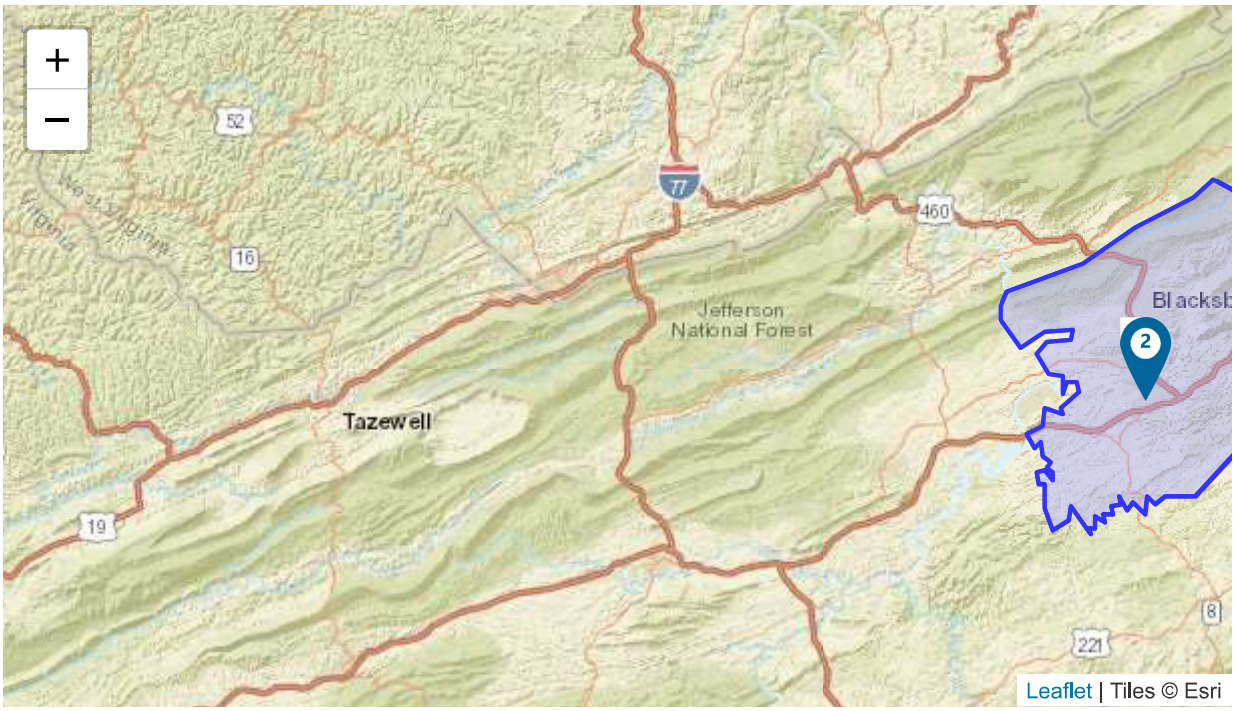
ITEM NO.	DESCRIPTION	UNIT PRICE	QUANTITY	UNIT	COST
	ENGINEERING COSTS				
1	AMT Surveying & Engineering Design	$230,380.00	0.6	LS	$138,228.00
2	AMT Property Acquisition Assistance	$70,495.00	0.7	LS	$49,346.50
	ENGINEERING COSTS SUBTOTAL				**$187,574.50**
	GENERAL CONDITIONS				
3	Mobilization and Temporary Facilities	$140,000.00	0.5	LS	$70,000.00
4	Bonds, Taxes, Permits, and Insurance	$50,000.00	0.5	LS	$25,000.00
5	As-Builts/Survey Stakeout	$30,000.00	0.5	LS	$15,000.00
6	Traffic Control Measures	$50,000.00	0.5	LS	$25,000.00
	GENERAL CONDITIONS SUBTOTAL				**$135,000.00**
	SITE PREPARATION & EROSION AND SEDIMENT CONTROL				
7	Erosion and Sediment Control Measures	$96,377.14	1	LS	$96,377.14
8	Site Clearing & Grubbing	$75,000.00	0.5	LS	$37,500.00
	SITE PREPARATION & EROSION AND SEDIMENT CONTROL SUBTOTAL				**$133,877.14**
	STORMWATER POND AND PERIPHERALS				
9	30" Diameter - HDPE	$170.70		LF	$0.00
10	4 ft Diameter Conc. Manhole Structures	$8,000.00		ea	$0.00
11	Drop Inlet Structures DI-7	$6,942.06		ea	$0.00
12	Class 1 Riprap - Outlet Protection	$201.26		tons	$0.00
13	Concrete Retaining Wall	$1,000.00		LF	$0.00
14	48" Picket Fence (Brushed Bronze)	$120.00		LF	$0.00
15	Basin Excavation/Waste	$67.74		CY	$0.00
16	Trench Excavation/Backfill or Waste	$67.74		CY	$0.00
	STORMWATER POND AND PERIPHERALS SUBTOTAL				**$0.00**
	STORMWATER SYSTEM BELOW THE POND				
17	24" Diameter - HDPE	$121.51	23	LF	$2,794.73
18	30" Diameter - HDPE	$170.70	788	LF	$134,511.60
19	36" Diameter - HDPE	$214.67	344	LF	$73,846.48
20	42" Diameter - HDPE	$370.41	102	LF	$37,781.82
21	48" Diameter - HDPE	$352.34	737	LF	$259,674.58
22	27"x43" Elliptical Concrete Pipe	$235.81		LF	$0.00
23	34"x53" Elliptical Concrete Pipe	$453.71	105	LF	$47,639.55
24	Drop Inlet Structures DI-5	$5,983.82		ea	$0.00
25	Drop Inlet Structures DI-7	$6,942.06	18	ea	$124,957.08
26	Curb Inlet Structures DI-2A, 2D	$3,000.00	2	ea	$6,000.00
27	Concrete Headwalls	$5,000.00	2	ea	$10,000.00
28	Miscellaneous Concrete Slabs	$600.00	15	CY	$9,000.00
29	Trench Excavation/Backfill or Waste	$67.74	2720.9259	CY	$184,315.52
	STORMWATER SYSTEM BELOW THE POND SUBTOTAL				**$890,521.36**
	SITE & UTILITY RESTORATION WORK				
30	Asphalt Pavement Replacements	$150.00	330	SY	$49,500.00
31	Existing Structure Relocation/Removals	$15,000.00	1	LS	$15,000.00
32	Dry Utilities Relocation	$5,000.00	1	LS	$5,000.00
33	Wet Utilities Relocation	$5,000.00		LS	$0.00
34	8" Diameter - PVC	$80.00		LF	$0.00
35	4 ft Diameter Conc. Manhole Structures	$8,000.00		ea	$0.00
36	Topsoil and Permanent Stabilization	$15,000.00	0.25	LS	$3,750.00
	SITE & UTILITY RESTORATION SUBTOTAL				**$73,250.00**
	SUBTOTAL CONSTRUCTION COST				**$1,420,223.00**
	Construction Engineering & Inspection	8%	1	LS	$113,617.84
	Construction Contingency	20%	1	LS	$284,045.00
	CONSTRUCTION COST				**$1,817,885.84**
	Land Acquisition Budget (3 Parcels)	$100,000			$0.00
	TOTAL PROJECT COST				**$1,817,885.84**

FEMA Benefit-Cost Calculator

V.6.0 (Build 20231011.1703 | Release Notes)

Benefit-Cost Analysis

Project Name: College Street Drainage Phase I and II



				Using 7% Discount Rate			Using 3% Discount Rate (For BRIC and FMA only)		
Map Marker ▲	Mitigation Title	Property Type	Hazard	Benefits (B)	Costs (C)	BCR (B/C)	Benefits (B)	Costs (C)	BCR (B/C)
1	Bioretention @ 37.1278550; -80.4133500		DFA - Riverine Flood	$ 258,953	$ 0	0.00	$ 429,744	$ 0	0.00
2	Bioretention @ College St, Christiansburg, Virginia, 24073		DFA - Riverine Flood	$ 4,315,886	$ 4,000,000	1.08	$ 7,162,400	$ 4,000,000	1.79
TOTAL (SELECTED)				**$ 4,574,839**	**$ 4,000,000**	**1.14**	**$ 7,592,144**	**$ 4,000,000**	**1.90**
TOTAL				**$ 4,574,839**	**$ 4,000,000**	**1.14**	**$ 7,592,144**	**$ 4,000,000**	**1.90**

Appendix C: Checklist All Categories - Supporting Documentation, including the Benefit-Cost Analysis tool/narrative (for projects over $2 million)

Property Configuration

Property Title:	Bioretention @ 37.1278550; -80.4133500
Property Location:	24073, Montgomery, Virginia
Property Coordinates:	37.127854985710165, -80.41334999744471
Hazard Type:	Riverine Flood
Mitigation Action Type:	Bioretention
Property Type:	Green Infrastructure
Analysis Method Type:	Professional Expected Damages

Cost Estimation

Bioretention @ 37.1278550; -80.4133500

Project Useful Life (years):	35
Project Cost:	$0
Number of Maintenance Years:	35 Use Default:Yes
Annual Maintenance Cost:	$0

Damage Analysis Parameters - Damage Frequency Assessment

Bioretention @ 37.1278550; -80.4133500

Year of Analysis was Conducted:	2023
Year Property was Built:	1970
Analysis Duration:	54 Use Default:Yes

Professional Expected Damages Before Mitigation

Bioretention @ 37.1278550; -80.4133500

	OTHER	OPTIONAL DAMAGES			VOLUNTEER COSTS		TOTAL
Recurrence Interval (years)	Damages ($)	Category 1 ($)	Category 2 ($)	Category 3 ($)	Number of Volunteers	Number of Days	Damages ($)
5	100,000	0	0	0	0	0	100,000

Annualized Damages Before Mitigation

Bioretention @ 37.1278550; -80.4133500

Annualized Recurrence Interval (years)	Damages and Losses ($)	Annualized Damages and Losses ($)
5	100,000	20,000
	Sum Damages and Losses ($)	Sum Annualized Damages and Losses ($)
	100,000	20,000

Professional Expected Damages After Mitigation

Bioretention @ 37.1278550; -80.4133500

	OTHER	OPTIONAL DAMAGES			VOLUNTEER COSTS		TOTAL
Recurrence Interval (years)	Damages ($)	Category 1 ($)	Category 2 ($)	Category 3 ($)	Number of Volunteers	Number of Days	Damages ($)
100	0	0	0	0	0	0	0

Annualized Damages After Mitigation

Bioretention @ 37.1278550; -80.4133500

Annualized Recurrence Interval (years)	Damages and Losses ($)	Annualized Damages and Losses ($)
100	0	0
	Sum Damages and Losses ($)	Sum Annualized Damages and Losses ($)
	0	0

Benefits-Costs Summary

Bioretention @ 37.1278550; -80.4133500

Total Standard Mitigation Benefits:	$258,953
Total Social Benefits:	$0
Total Mitigation Project Benefits:	$258,953
Total Mitigation Project Cost:	$0
Benefit Cost Ratio - Standard:	0
Benefit Cost Ratio - Standard + Social:	0

Appendix C: Checklist All Categories - Supporting Documentation, including the Benefit-Cost Analysis tool/narrative (for projects over $2 million)

Property Configuration

Property Title:	Bioretention @ College St, Christiansburg, Virginia, 24073
Property Location:	24073, Montgomery, Virginia
Property Coordinates:	37.127854985710165, -80.41334999744471
Hazard Type:	Riverine Flood
Mitigation Action Type:	Bioretention
Property Type:	Green Infrastructure
Analysis Method Type:	Professional Expected Damages

Cost Estimation

Bioretention @ College St, Christiansburg, Virginia, 24073

Project Useful Life (years):	35
Project Cost:	$4,000,000
Number of Maintenance Years:	35 Use Default:Yes
Annual Maintenance Cost:	$0

Damage Analysis Parameters - Damage Frequency Assessment

Bioretention @ College St, Christiansburg, Virginia, 24073

Year of Analysis was Conducted:	2023
Year Property was Built:	0
Analysis Duration:	10 Use Default:Yes

Professional Expected Damages Before Mitigation

Bioretention @ College St, Christiansburg, Virginia, 24073

	OTHER	OPTIONAL DAMAGES			VOLUNTEER COSTS		TOTAL
Recurrence Interval (years)	Damages ($)	Category 1 ($)	Category 2 ($)	Category 3 ($)	Number of Volunteers	Number of Days	Damages ($)
3	1,000,000	0	0	0	0	0	1,000,000

Annualized Damages Before Mitigation

Bioretention @ College St, Christiansburg, Virginia, 24073

Annualized Recurrence Interval (years)	Damages and Losses ($)	Annualized Damages and Losses ($)
3	1,000,000	333,333
	Sum Damages and Losses ($)	Sum Annualized Damages and Losses ($)
	1,000,000	333,333

Professional Expected Damages After Mitigation

Bioretention @ College St, Christiansburg, Virginia, 24073

	OTHER	OPTIONAL DAMAGES			VOLUNTEER COSTS		TOTAL
Recurrence Interval (years)	Damages ($)	Category 1 ($)	Category 2 ($)	Category 3 ($)	Number of Volunteers	Number of Days	Damages ($)
100	0	0	0	0	0	0	0

Annualized Damages After Mitigation

Bioretention @ College St, Christiansburg, Virginia, 24073

Annualized Recurrence Interval (years)	Damages and Losses ($)	Annualized Damages and Losses ($)
100	0	0
	Sum Damages and Losses ($)	Sum Annualized Damages and Losses ($)
	0	0

Benefits-Costs Summary

Bioretention @ College St, Christiansburg, Virginia, 24073

Total Standard Mitigation Benefits:	$4,315,886
Total Social Benefits:	$0
Total Mitigation Project Benefits:	$4,315,886
Total Mitigation Project Cost:	$4,000,000
Benefit Cost Ratio - Standard:	1.08
Benefit Cost Ratio - Standard + Social:	1.08

THE PLACE TO BE.
CHRISTIANSBURG VA
Established November 10, 1792

100 East Main Street
Christiansburg, VA 24073
p: (540) 382-6128
f: (540) 382-7338

November 8, 2023

Mr. Daryl Glover
Deputy Agency Director of Dam Safety, Flood Preparedness, and Soil and Water Conservation
Department of Conservation and Recreation
60 East Main Street, 24th Floor
Richmond, Virginia 23219

RE: Town of Christiansburg Virginia Community Flood Preparedness Fund (CFPF) Grant Request

Dear Mr. Glover:

The Town of Christiansburg is pleased to submit this grant application for project funding from the CFPF fund. The Town is seeking funding for the College Street Drainage Project Phase I and Phase II project as presented in our Town adopted Flood Resilience Plan and in the College Street Drainage Study. The Town is committed to the match as proposed ($206,865). We appreciate your consideration of our complete application for CFPF funding.

Randy Wingfield
Town Manager

TOWN OF CHRISTIANSBURG
TOWN COUNCIL
AGENDA COVER SHEET

AGENDA LOCATION:
Discussion and Action by Mayor and Council

Meeting Date:
October 24, 2023

ITEM TITLE:
Discussion and Approval of the Town of Christiansburg Flood Resilience Plan

DESCRIPTION:
The Flood Resilience Plan for the Town of Christiansburg provides an overview of the flood resilience planning efforts undertaken by the Town of Christiansburg. The Flood Resilience Plan provides opportunities for improvement to current defenses and assesses the suitability of new projects and policies for the Town. The Plan examines historical flooding in the Town and reviews current and proposed strategies for flood prevention and resilience. Current and prospective projects were reviewed, scored, and placed in a ranking matrix. Communities may apply for grant funding for projects through the Virginia Community Flood Preparedness Fund (CFPF). An approved Resilience Plan is a prerequisite for submitting a funding application to the CFPF. Approval of this plan will enable the Town to tap into an additional source of funding for projects that will help to mitigate flooding in the Town.

POTENTIAL ACTION:
Request approval of the Town of Christiansburg Flood Resilience Plan

DEPARTMENT:
Administration

PRESENTER:
Town Manager Randy Wingfield

ITEM HISTORY:
The Virginia Community Flood Preparedness Fund (CFPF) was established in the Code of Virginia during the 2020 session of the General Assembly. In December 2021, the Town received a grant award in the amount of $44,520.30 from the CFPF for the development of a Resilience Plan. This grant award required a Town match of $4,946.70. On August 10, 2022, the Town entered into a contract with A. Morton Thomas and Associates, Inc. (AMT) to develop the Town of Christiansburg Flood Resilience Plan. Town Staff has work with AMT to develop this plan and the draft Flood Resilience Plan was presented to the Water and Waste Committee on August 21, 2023. The Water and Waste Committee has reviewed the Flood Resilience Plan as attached.

INFORMATION PROVIDED:

Flood Resilience Plan

AGENDA

REGULAR MEETING OF TOWN COUNCIL
CHRISTIANSBURG TOWN HALL
100 EAST MAIN STREET
OCTOBER 24, 2023 – 7:00 P.M.

(The meeting will be in-person and streamed on YouTube Live)

The meeting will be streamed live on the Town of Christiansburg's YouTube page at www.christiansburg.org/YouTube and will remain on the Town's YouTube page once the meeting concludes.

If you do not want or cannot attend the meeting in-person, there are several contactless methods for submitting public comment. To submit public comments, please visit www.christiansburg.org/publichearings. You may also leave a voicemail with your comments at 540-382-6128, ext. 1109; mail a letter to Town Hall, ATTN: Town Council, 100 E. Main Street, Christiansburg, VA 24073; use the drop box to the left of the front doors at Town Hall to leave a letter; or email info@christiansburg.org. Regardless of the method you use, please include your full name and address with your comments. Please provide comments prior to 6:00 p.m. on Tuesday, October 24, 2023, for the comments to be distributed to Town Council before the meeting.

REGULAR MEETING

I. CALL TO ORDER

A. Moment of Reflection

B. Pledge of Allegiance

II. ADJUSTMENT OF THE AGENDA

III. PUBLIC HEARINGS

A. FY 2023-24 Budget Amendment #1

B. An Exchange of Property request by the Town of Christiansburg that an approximately 0.2665-acre (11,609 square feet) southwest portion of a certain tract or parcel of land at 1025 W. Main Street (Tax Map 556 – ((A)) – 48A; Parcel ID 020000) situate, lying and being located along W. Main Street in the Town of Christiansburg, Virginia; with an equal Exchange of Property request by Jimmy Martin that the approximately 0.2665 acres (11,609 square feet) northeast portion of a certain tract or parcel of land (Tax Map 556 – ((A)) – 47; Parcel ID 004777) situate, lying and being located along W. Main Street in the Town of Christiansburg, Virginia. The exchange is for the College Street Stormwater Project.

C. 2022 U.S. Department of Housing and Urban Development (HUD) Community Development Block Grant (CDBG) Consolidated Annual Performance and Evaluation Report (CAPER)

IV. CONSENT AGENDA

A. Approval of Minutes of September 26, 2023

B. Monthly Bill List

C. Resolution Recognizing Craig Meadows for his service as Montgomery County Administrator

D. Resolution to recognize October 28, 2023 as National First Responders Day

E. Proclamation to recognize November 1, 2023 as Extra Mile Day

F. Contract Amendment #1 with CHA Consulting, Inc. for the renewal of Water, Sewer, and Wastewater Treatment Term Services in excess of $100,000 not to exceed $500,000 per task order and not to exceed $2,500,000 per annual contract term per Virginia Public Procurement Act

G. Contract Amendment #1 with Hurt and Proffitt for the renewal of Water, Sewer, and Wastewater Treatment Term Services in excess of $100,000 not to exceed $500,000 per task order and not to exceed $2,500,000 per annual contract term per Virginia Public Procurement Act

H. Contract Amendment #1 with Hazen and Sawyer for the renewal of Water, Sewer, and Wastewater Treatment Term Services in excess of $100,000 not to exceed $500,000 per task order and not to exceed $2,500,000 per annual contract term per Virginia Public Procurement Act

I. Contract Amendment #1 with McGill Associates, PA. for the renewal of Water, Sewer, and Wastewater Treatment Term Services in excess of $100,000 not to exceed $500,000 per task order and not to exceed $2,500,000 per annual contract term per Virginia Public Procurement Act

J. Contract Amendment #1 with Whitman, Requardt & Associates, LLP, for the renewal of Water, Sewer, and Wastewater Treatment Term Services in excess of $100,000 not to exceed $500,000 per task order and not to exceed $2,500,000 per annual contract term per Virginia Public Procurement Act

K. Contract with Rummel, Klepper & Kahl, LLP (RK&K) for Professional Services for the Town's North Franklin Sidewalk In-Fill project in the amount of $232,340

V. INTRODUCTIONS AND PRESENTATIONS

A. Ginny Snead, A. Morton Thomas and Associates, Inc., to present the Town of Christiansburg Flood Resilience Plan

B. Police Chief Chris Ramsey to introduce new command staff

VI. CITIZEN COMMENTS

VII. COMMITTEE REPORTS

A. Street Committee Report – Bishop, Hockett

1. Subdivision Plat and Dedication of Easements for NRV Marketplace, LLC at 2705 Market Street, NE showing Parcels G, H, N, O, P, Q, R, S, T, U, and Revised Lot 1 (creating 10 lots)

VIII. DISCUSSION AND ACTION BY MAYOR AND COUNCIL

A. Request for street closures for the Christiansburg High School Veterans Day Parade for Friday, November 10, 2023 with street closures from 8:30 a.m. - noon to include Main Street from Park Street, N.E. to Dunkley, N.W., Roanoke Street from E. Main Street to First Street, Pepper Street, S.E. from E. Main Street to First Street, Pepper Street, N.E. from E. Main Street to Hill Street, Franklin Street from First Street to Commerce Street, N.W., Hickok Street from Commerce Street, N.W. to First Street, S.W.

B. Adoption of Town of Christiansburg Flood Resilience Plan

IX. STAFF REPORTS

A. Town Manager

B. Town Attorney

C. Other Staff

X. COUNCIL REPORTS

XI. OTHER BUSINESS

XII. ADJOURNMENT

Upcoming meetings of Council:
November 14, 2023, 7:00 p.m. – Regular Meeting
November 28, 2023, 7:00 p.m. – Regular Meeting

Appendix C: Checklist All Categories - Detailed Budget and Narrative For All Cost

Budget Narrative

College Street Drainage Project Phase I and II

Town of Christiansburg

The College Street Drainage Project Phase I and Phase II engineering and construction cost estimate is $4,081,906. The Phase I estimate is provided below and is at 90% design. The Phase II estimate is also provided below and is at 60% design at the writing of this grant application. The Town of Christiansburg will manage and administer this project, which will require Town staff time for project management and inspection during project mobilization and construction. Additionally, post-construction maintenance as detailed in the maintenance plan will require Public Works time for inspection and performance of maintenance as needed. Implementation of the maintenance plan will also require equipment to perform periodic mowing and removal of any accumulated trash or debris in the completed project area. The total project estimate incorporating these costs is $4,097,246.

COLLEGE STREET DRAINAGE IMPROVEMENTS - PHASE I

October 2023 - 90% COST ESTIMATE

ITEM NO.	DESCRIPTION	UNIT PRICE	QUANTITY	UNIT	COST
	ENGINEERING COSTS				
1	AMT Surveying & Engineering Design	$230,380.00	0.6	LS	$138,228.00
2	AMT Property Acquisition Assistance	$70,495.00	1	LS	$70,495.00
	ENGINEERING COSTS SUBTOTAL				**$208,723.00**
	GENERAL CONDITIONS				
3	Mobilization and Temporary Facilities	$140,000.00	0.5	LS	$70,000.00
4	Bonds, Taxes, Permits, and Insurance	$50,000.00	0.5	LS	$25,000.00
5	As-Builts/Survey Stakeout	$30,000.00	0.5	LS	$15,000.00
6	Traffic Control Measures	$50,000.00	0.5	LS	$25,000.00
	GENERAL CONDITIONS SUBTOTAL				**$135,000.00**
	SITE PREPARATION & EROSION AND SEDIMENT CONTROL				
7	Erosion and Sediment Control Measures	$125,285.65	1	LS	$125,285.65
8	Site Clearing & Grubbing	$75,000.00	0.5	LS	$37,500.00
	SITE PREPARATION & EROSION AND SEDIMENT CONTROL SUBTOTAL				**$162,785.65**
	PHASE I				
9	30" Diameter - HDPE	$170.70	420	LF	$71,694.00
10	30" Diameter - RCP	$250.00	170	LF	$42,500.00
11	4 ft Square Conc. Manhole Structures	$8,000.00	8	ea	$64,000.00
12	6 ft Square Conc. Manhole Structures	$14,000.00	1	ea	$14,000.00
13	VDOT SWM-DR Trash Rack for 4 ft Square	$5,000.00	1	ea	$5,000.00
14	30" HDPE Flared End Section	$1,500.00	3	ea	$4,500.00
15	30" Concrete Flared End Section	$2,500.00	1	ea	$2,500.00
16	Drop Inlet Structures DI-7	$6,942.06	1	ea	$6,942.06
17	Drop Inlet Structures DI-5	$5,983.82	6	ea	$35,902.92
18	Standard flat manhole top with frame and cover	$4,000.00	1	ea	$4,000.00
19	Flexamat-Plus Erosion Control Mat	$50.00	220	SY	$11,000.00
20	VDOT Class I Riprap	$201.26	0	tons	$0.00
21	Concrete Retaining Wall	$200,436.00	1	LS	$200,436.00
22	48" Picket Fence (Brushed Bronze)	$120.00	800	LF	$96,000.00
23	Basin Excavation/Waste	$67.74	7400	CY	$501,276.00
24	24"x35" Elliptical Concrete Pipe	$200.00	192	LF	$38,400.00
25	24" Diameter - HDPE	$121.51	22	LF	$2,673.22
26	Trench Excavation/Backfill or Waste	$67.74	822	CY	$55,682.28
	PHASE I				**$1,156,506.48**
	SITE & UTILITY RESTORATION WORK				
27	Asphalt Pavement Replacements	$150.00	110	SY	$16,500.00
28	Existing Structure Relocation/Removals	$15,000.00		LS	$0.00
29	Dry Utilities Relocation	$5,000.00	1	LS	$5,000.00
30	Wet Utilities Relocation (SS)	$5,000.00	1	LS	$5,000.00
31	8" Diameter - PVC (SS)	$80.00	260	LF	$20,800.00
32	6" Diameter - PVC (SS)	$60.00	130	LF	$7,800.00
33	6" Diameter - PVC Cleanout (SS)	$1,000.00	1	LS	$1,000.00
34	4 ft Diameter Conc. Manhole Structures (SS)	$8,000.00	3	ea	$24,000.00
35	Topsoil and Permanent Stabilization	$15,000.00	0.75	LS	$11,250.00
36	Residence Pump Station for 962 College St	$5,000.00	1	LS	$5,000.00
	SITE & UTILITY RESTORATION SUBTOTAL				**$96,350.00**
	SUBTOTAL CONSTRUCTION COST				**$1,759,365.13**
	Construction Engineering & Inspection	8%	1	LS	$140,749.21
	Construction Contingency	15%	1	LS	$263,905.00
	CONSTRUCTION COST				**$2,164,019.34**
	Land Acquisition Budget (3 Parcels)	$100,000			$100,000.00
	TOTAL PROJECT COST				**$2,264,019.34**

COLLEGE STREET DRAINAGE IMPROVEMENTS - PAHASE II

May 2023 - 60% COST ESTIMATE

ITEM NO.	DESCRIPTION	UNIT PRICE	QUANTITY	UNIT	COST
	ENGINEERING COSTS				
1	AMT Surveying & Engineering Design	$230,380.00	0.6	LS	$138,228.00
2	AMT Property Acquisition Assistance	$70,495.00	0.7	LS	$49,346.50
	ENGINEERING COSTS SUBTOTAL				**$187,574.50**
	GENERAL CONDITIONS				
3	Mobilization and Temporary Facilities	$140,000.00	0.5	LS	$70,000.00
4	Bonds, Taxes, Permits, and Insurance	$50,000.00	0.5	LS	$25,000.00
5	As-Builts/Survey Stakeout	$30,000.00	0.5	LS	$15,000.00
6	Traffic Control Measures	$50,000.00	0.5	LS	$25,000.00
	GENERAL CONDITIONS SUBTOTAL				**$135,000.00**
	SITE PREPARATION & EROSION AND SEDIMENT CONTROL				
7	Erosion and Sediment Control Measures	$96,377.14	1	LS	$96,377.14
8	Site Clearing & Grubbing	$75,000.00	0.5	LS	$37,500.00
	SITE PREPARATION & EROSION AND SEDIMENT CONTROL SUBTOTAL				**$133,877.14**
	STORMWATER POND AND PERIPHERALS				
9	30" Diameter - HDPE	$170.70		LF	$0.00
10	4 ft Diameter Conc. Manhole Structures	$8,000.00		ea	$0.00
11	Drop Inlet Structures DI-7	$6,942.06		ea	$0.00
12	Class 1 Riprap - Outlet Protection	$201.26		tons	$0.00
13	Concrete Retaining Wall	$1,000.00		LF	$0.00
14	48" Picket Fence (Brushed Bronze)	$120.00		LF	$0.00
15	Basin Excavation/Waste	$67.74		CY	$0.00
16	Trench Excavation/Backfill or Waste	$67.74		CY	$0.00
	STORMWATER POND AND PERIPHERALS SUBTOTAL				**$0.00**
	STORMWATER SYSTEM BELOW THE POND				
17	24" Diameter - HDPE	$121.51	23	LF	$2,794.73
18	30" Diameter - HDPE	$170.70	788	LF	$134,511.60
19	36" Diameter - HDPE	$214.67	344	LF	$73,846.48
20	42" Diameter - HDPE	$370.41	102	LF	$37,781.82
21	48" Diameter - HDPE	$352.34	737	LF	$259,674.58
22	27"x43" Elliptical Concrete Pipe	$235.81		LF	$0.00
23	34"x53" Elliptical Concrete Pipe	$453.71	105	LF	$47,639.55
24	Drop Inlet Structures DI-5	$5,983.82		ea	$0.00
25	Drop Inlet Structures DI-7	$6,942.06	18	ea	$124,957.08
26	Curb Inlet Structures DI-2A, 2D	$3,000.00	2	ea	$6,000.00
27	Concrete Headwalls	$5,000.00	2	ea	$10,000.00
28	Miscellaneous Concrete Slabs	$600.00	15	CY	$9,000.00
29	Trench Excavation/Backfill or Waste	$67.74	2720.9259	CY	$184,315.52
	STORMWATER SYSTEM BELOW THE POND SUBTOTAL				**$890,521.36**
	SITE & UTILITY RESTORATION WORK				
30	Asphalt Pavement Replacements	$150.00	330	SY	$49,500.00
31	Existing Structure Relocation/Removals	$15,000.00	1	LS	$15,000.00
32	Dry Utilities Relocation	$5,000.00	1	LS	$5,000.00
33	Wet Utilities Relocation	$5,000.00		LS	$0.00
34	8" Diameter - PVC	$80.00		LF	$0.00
35	4 ft Diameter Conc. Manhole Structures	$8,000.00		ea	$0.00
36	Topsoil and Permanent Stabilization	$15,000.00	0.25	LS	$3,750.00
	SITE & UTILITY RESTORATION SUBTOTAL				**$73,250.00**
	SUBTOTAL CONSTRUCTION COST				**$1,420,223.00**
	Construction Engineering & Inspection	8%	1	LS	$113,617.84
	Construction Contingency	20%	1	LS	$284,045.00
	CONSTRUCTION COST				**$1,817,885.84**
	Land Acquisition Budget (3 Parcels)	$100,000			$0.00
	TOTAL PROJECT COST				**$1,817,885.84**

Appendix D: Town of Christiansburg Flood Resilience Plan

TOWN OF CHRISTIANSBURG
TOWN COUNCIL
AGENDA COVER SHEET

AGENDA LOCATION:
Discussion and Action by Mayor and Council

Meeting Date:
October 24, 2023

ITEM TITLE:
Discussion and Approval of the Town of Christiansburg Flood Resilience Plan

DESCRIPTION:
The Flood Resilience Plan for the Town of Christiansburg provides an overview of the flood resilience planning efforts undertaken by the Town of Christiansburg. The Flood Resilience Plan provides opportunities for improvement to current defenses and assesses the suitability of new projects and policies for the Town. The Plan examines historical flooding in the Town and reviews current and proposed strategies for flood prevention and resilience. Current and prospective projects were reviewed, scored, and placed in a ranking matrix. Communities may apply for grant funding for projects through the Virginia Community Flood Preparedness Fund (CFPF). An approved Resilience Plan is a prerequisite for submitting a funding application to the CFPF. Approval of this plan will enable the Town to tap into an additional source of funding for projects that will help to mitigate flooding in the Town.

POTENTIAL ACTION:
Request approval of the Town of Christiansburg Flood Resilience Plan

DEPARTMENT:
Administration

PRESENTER:
Town Manager Randy Wingfield

ITEM HISTORY:
The Virginia Community Flood Preparedness Fund (CFPF) was established in the Code of Virginia during the 2020 session of the General Assembly. In December 2021, the Town received a grant award in the amount of $44,520.30 from the CFPF for the development of a Resilience Plan. This grant award required a Town match of $4,946.70. On August 10, 2022, the Town entered into a contract with A. Morton Thomas and Associates, Inc. (AMT) to develop the Town of Christiansburg Flood Resilience Plan. Town Staff has work with AMT to develop this plan and the draft Flood Resilience Plan was presented to the Water and Waste Committee on August 21, 2023. The Water and Waste Committee has reviewed the Flood Resilience Plan as attached.

INFORMATION PROVIDED:

Flood Resilience Plan

TOWN OF CHRISTIANSBURG

Flood Resilience Plan

October 10, 2023

Town of Christiansburg

100 E Main Street
Christiansburg, VA 24073
540.382.6128

A. Morton Thomas and Associates, Inc.

1166 Jamestown Road, Suite D
Williamsburg, VA 23185
757.345.3851
amtengineering.com

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Definitions

General Definitions

Gray Infrastructure – "Gray infrastructure is traditional stormwater infrastructure in the built environment such as gutters, drains, pipes, and retention basin" (EPA, 2023).

Green Infrastructure – "A strategically planned and managed network of natural lands, working landscapes, and other open spaces that conserves ecosystem values and functions and provides associated benefits to human populations" (Benedict, Allen, and McMahon, 2006). "Green infrastructure planning involves the coordination of "conservation values and actions in concert with land development and growth management" (Benedict, Allen, and McMahon, 2004). Examples include raingardens, rainwater harvesting systems, permeable pavement, and constructed wetlands.

Heat Island Effect – "Urbanized areas that experience higher temperatures than outlying areas. Structures such as buildings, roads, and other infrastructure absorb and re-emit the sun's heat more than natural landscapes such as forests and water bodies. Urban areas, where these structures are highly concentrated and greenery is limited, become "islands" of higher temperatures relative to outlying areas" (EPA, 2023-c).

Nature Based Approach/Solution – "An approach that reduces the impacts of flood and storm events through environmental processes and natural systems. A nature-based solution may provide additional benefits beyond flood control, including recreational opportunities and improved water quality. This includes a project that reduces these impacts by protecting, restoring, or emulating natural features (DCR.gov, n.d.).

Rainfall-derived infiltration and inflow – "is the increased portion of water flow in a sanitary sewer system that occurs during and after a rainfall as a source of operation problems in sanitary sewer systems. RDII is the main cause of sanitary sewer overflows" (EPA, 2023-b).

Resilience / Resiliency – Resilience is the ability of citizens and the institutions that shape our communities to identify risks, positively adapt, and build the capacity to respond to environmental stressors that impact our built infrastructure. Successful implementation of resilience efforts allows communities to rapidly regain functionality and vitality in the face of chronic stressors or severe disturbances.

Town / the Town – The Town of Christiansburg, Virginia

FEMA Definitions

The following definitions are derived from FEMA.gov if residential properties are added to the project list in the future:

Property Damage – Damage to personal property resulting from flooding. "Damage caused by falling water and wind is not considered flood damage" (FEMA.org, 2010).

Repetitive Loss Property – "Any insurable building for which two or more claims of more than $1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. A RL property may or may not be currently insured by the NFIP. Currently there are over 122,000 RL properties nationwide," (FEMA.gov, 2005).

Roadway Flooding – Flooding of "The portion of roads designed to carry traffic. Roads are paved or unpaved. Other public facilities may include bike paths, pedestrian ways, sidewalks and maintained trails" (FEMA.org, 2022).

Severe Repetitive Loss Property – "A single family property (consisting of 1 to 4 residences) that is covered under flood insurance by the NFIP and has incurred flood-related damage for which 4 or more separate claims payments have been paid under flood insurance coverage, with the amount of each claim payment exceeding $5,000 and with cumulative amount of such claims payments exceeding $20,000; or for which at least 2 separate claims payments have been made with the cumulative amount of such claims exceeding the reported value of the property"(FEMA.gov, 2005).

Matrix Definitions

The following definitions are derived from DCR's 2021 Criteria for ranking community projects for flood funding:

Acquisition of Property – "Acquisition of property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures" (DCR.gov, n.d.).

Community Scale Benefit/ Community Scale Project – "A project that provides demonstrable flood reduction benefits at the US census block level or greater" (DCR.gov, n.d.).

Impact NFIP Participation – (NFIP = Nation Flood Insurance Program) - This criterion answers the question, "Is this proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?" (DCR.gov, n.d.).

Low-income Geographic Area – "Any locality, or community within a locality, that has a median household income that is not greater than 80 percent of the local median household income, or any area in the Commonwealth designated as a qualified opportunity zone by the U.S. Secretary of the Treasury via his delegation of authority to the Internal Revenue Service. A project of any size within a low-income geographic area will be considered" (DCR.gov, n.d.).

Project Area Socially Vulnerable – (Based on ADAPT VA's Social Vulnerability Index Score.) (DCR.gov, n.d.). Alternatively, socially vulnerable can be defined as "the susceptibility of social groups to the adverse impacts of natural hazards, including disproportionate death, injury, loss, or disruption of livelihood" (FEMA, n.d).

TMDL Benefit – (TMDL = Total Maximum Daily Load) Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan? (DCR.gov, n.d.).

Acronyms

CFPF	Community Flood Preparedness Fund
CIP	Capital Improvement Plan
CMP	Corrugated Metal Pipe
DCR	Virginia Department of Conservation and Recreation
DEQ	Virginia Department of Environmental Quality
ESC	Erosion and Sediment Control
EPA	United States Environmental Protection Agency
GI	Green Infrastructure
GIS	Geographic Information System
MS4	Municipal Separate Storm Sewer System
n.d.	"No Date" (an abbreviation used for citations when a source does not contain a publication date).
RCP	Reinforced Concrete Pipe
RDII	Rainfall-derived infiltration and inflow
SWM	Stormwater Management
TMDL	Total Maximum Daily Load
VDOT	Virginia Department of Transportation
WLA	Waste Load Allocation

Executive Summary

This Flood Resilience Plan for the Town of Christiansburg (Plan) provides an overview of the flood resilience planning efforts undertaken by the Town of Christiansburg, Virginia (Town). The Plan examines historical flooding in the Town and reviews current and proposed strategies for flood prevention and resilience. Flooding in the Town poses significant threats to public safety, infrastructure, and local economy. An increase of storm events with greater rainfall intensity and duration compounds these impacts. This Plan aims to reduce vulnerabilities and promote flood resilience in the Town through policy and sound engineering practices and maintenance.

Recognition of the need to implement flood resilience in communities across the Commonwealth has increased. The increasing frequency, intensity and duration of rainfall has proven to hinder the functionality of current infrastructure and flood prevention measures within the Town. Prior to 2014, stormwater runoff regulations were limited or nonexistent. Limited past stormwater regulations, geological conditions, and more frequent rain events are all concerns for flood resilience and prevention.

Assessment of current defenses within the Town found opportunities for improvement of stormwater quantity and quality. Rehabilitation and maintenance to gray infrastructure within Town watersheds can alleviate or prevent flooding. It is anticipated that the Town's Comprehensive Plan can recommend policies and practices for promoting flood resilience will be updated in the 2023-2024 edition. Some of these policies will include increased use of green techniques and infrastructure; operation and maintenance of SWM and sewer infrastructure; and construction of new stormwater management infrastructure that helps to reduce run-off and pollution. Increased use of green techniques and green infrastructure will promote stormwater quantity and quality. The Plan also explores future projects to promote or improve the Town's flood resilience.

Current and prospective projects were reviewed, scored, and placed in a ranking matrix. Gray infrastructure project recommendations will help mitigate or prevent flooding events, create more connectedness to a greater stormwater system, and ensure that engineered solutions are maintained for functionality. In addition, green infrastructure should be utilized as often as possible to enhance gray infrastructure capabilities. Incorporating other green infrastructure techniques will assist in flood prevention and resilience.

The Town, like many other communities will continue to experience the impacts of severe weather and frequent rainfall events. This Plan provides opportunities for improvement to current defenses and assesses the suitability of new projects and policies for the Town.

Chapter 1: Introduction

Flooding caused by rainfall events combined with inadequate stormwater infrastructure can cause damage to life and property. The Town of Christiansburg (Town) is undertaking this flood resilience planning effort to gain a better understanding of flooding and related infrastructure impacts in its watersheds to better protect its citizens and their property from flooding. The goal of this plan is to promote flood resilience. Resilience is the ability of citizens and the institutions that shape our communities to identify risks, positively adapt, and build the capacity to respond to environmental stressors that impact our built infrastructure. Successful implementation of flood resilience efforts allows communities to rapidly regain functionality and vitality in the face of chronic stressors or severe disturbances such as severe or frequent rainfall events.

A flood resilience plan provides an assessment of current or potential future projects and policies that promote effective solutions and future prevention measures, tailored to geographical region, climate, infrastructure, and available resources. Well-developed flood resilience plans not only provide current and future flood reduction and prevention, but with the implementation of these strategies, can reduce the degradation of infrastructure, preserve habitat for species that live within the floodplain, and in some cases, increase the aesthetic beauty of the Town through green infrastructure and streetscape design.

Christiansburg, like many localities in the Commonwealth, is looking to flood resilience planning to aid in measures to not only mitigate current flooding and stormwater issues, but to alleviate potential future flood events due to increased rainfall frequencies and durations that are occurring in Virginia (ASCE, 2021).

Plan Development Process

This Flood Resilience Plan for the Town of Christiansburg (Plan) will first discuss regional and state efforts made towards flood resilience. This Plan will then discuss the history of the Town in relation to flooding and rainfall events, and previous resilience coverage measures set in place for reduction or prevention.

Following this chapter, the Plan will discuss the measures that the Town is currently taking to address their stormwater and flooding issues. Current flood resilience measures have been evaluated through the analysis of current Town plans, studies, and policies.

For the final chapter of this Plan, suggested green and gray infrastructure projects from Town documents will be extracted and ranked in accordance with overall flood resilience effectiveness, determined by a score card/matrix system. Recommendations of the most effective projects will be accompanied with implementation details, and other helpful resources.

Regional and State Efforts

Recognition of the need to implement flood resilience in communities has been increasing in recent years in the United States as there has been an increase in storm duration and frequency. The Commonwealth of Virginia has undertaken some specific and intentional initiatives to better prepare the state and its communities for increased rainfall frequency and other various factors of climate change. One such initiative is the Department of Conservation and Recreation (DCR) Community Flood Preparedness Fund (CFPF) that funds studies, planning efforts (including this one) and projects that are implemented to mitigate flooding and to enable more resilient communities.

Another state initiative is the Coastal Resilience Master Plan developed by the Commonwealth in 2022. This plan was developed based on a Master Planning Framework which was produced in December 2021. While this effort focused on coastal areas, both this plan and the DCR CFPF recognized the threats of flooding at a statewide level. The CFPF funds are available and utilized throughout the Commonwealth and are partially funding the development of the Town's Plan.

Most recently, the Virginia Department of Transportation (VDOT) released the VDOT Resilience Plan at the end of 2022. In addition to the VDOT Resilience Plan and the Coastal Resilience Plan development efforts, the Commonwealth also partially funded an Environmental Protection Agency (EPA) initiative to better assess storm frequency and duration across the state. This study provides specific numeric comparisons to the currently used data set (ATLAS 14) at the County level.

Christiansburg's Flood History

One of the major events that kick-started the discussion for water management planning initiatives within the Town in recent years was the flooding event that occurred in September of 2015. Phlegar and Chrisman Streets, and Reading Road were especially affected, as they are located along the Town Branch Watershed. As a result, approximately $1.5 million was budgeted towards developing improved drainage in the downtown area (AMT, 2018).

Figure 1: Historic Flooding in the Town

However, the Town Branch Watershed and its confluence with Crab Creek are not the only watersheds that influence the flooding in Christiansburg. Various watersheds in and surrounding the Town are also components that contribute to and affect the Town's flooding issues. Historically, standing water, flooding issues with public drainage systems, and overtopping of streets have been prevalent issues at various times and locations in the Town.

Even earlier, a flood event occurred in Christiansburg in May of 2009; this event was one of the worst historically for the Town's historical district of Cambria. A local tributary of Crab Creek flooded the area after consistent rain events over a series of weeks. Unfortunately, this event occurred before many of the Town's stormwater flood mitigation projects had been implemented. This flood caused damages to the Oak Tree Townhomes area, College Street, and several other surrounding areas. The rainfall intensity was estimated to be a 200-year event.

To better understand these events, the Town has undertaken several studies to assess areas of flood concern in the Town's watersheds. The map on the following page depicts the areas where these efforts have concentrated. Of note, the Town has assessed each watershed within its boundaries in recent years. These studies have led the Town to have a strong understanding of potential flood concerns within the entire community.

History of Stormwater Management in Virginia

In recent years, laws and regulations in Virginia have undergone significant changes aimed at improving the management of stormwater runoff and reducing negative environmental impacts. These updated regulations went into effect in 2014 and impose more stringent criteria for the management of stormwater after construction to better protect properties adjacent to and downstream from development. Development that occurred before 2014 had less stringent or no requirement to manage runoff from created impervious surfaces, resulting in stormwater infrastructure that is inadequate to handle significant rainfall events. These issues with older infrastructure are compounded today through the occurrence of more frequent storms with increased rainfall intensity and duration.

Virginia's 2014 regulations also have more stringent criteria for new development projects compared to older development. The primary reason for this discrepancy lies in the fact that older properties were typically built before these modern environmental concerns became a priority. Therefore, they were not subject to the same level of scrutiny regarding storm drainage systems and potential flooding.

Retrofitting existing properties to meet the new criteria or to add in additional flood mitigation can be a complex and costly process. As a result, the focus has primarily been on implementing more stringent storm drainage requirements for new developments to ensure they adhere to the latest standards and mitigate potential adverse effects on property, water quality and local ecosystems.

Specifically, Christiansburg experiences increased risk to flooding after the construction of the interstate highway system where drainage was primarily designed to remove runoff from the roadway surface as quickly as possible. At the time, there were no regulations to address the additional runoff volume and rate onto adjacent properties and downstream facilities. As such, during heavy rain events, downstream channels and systems are currently at or beyond their capacity.

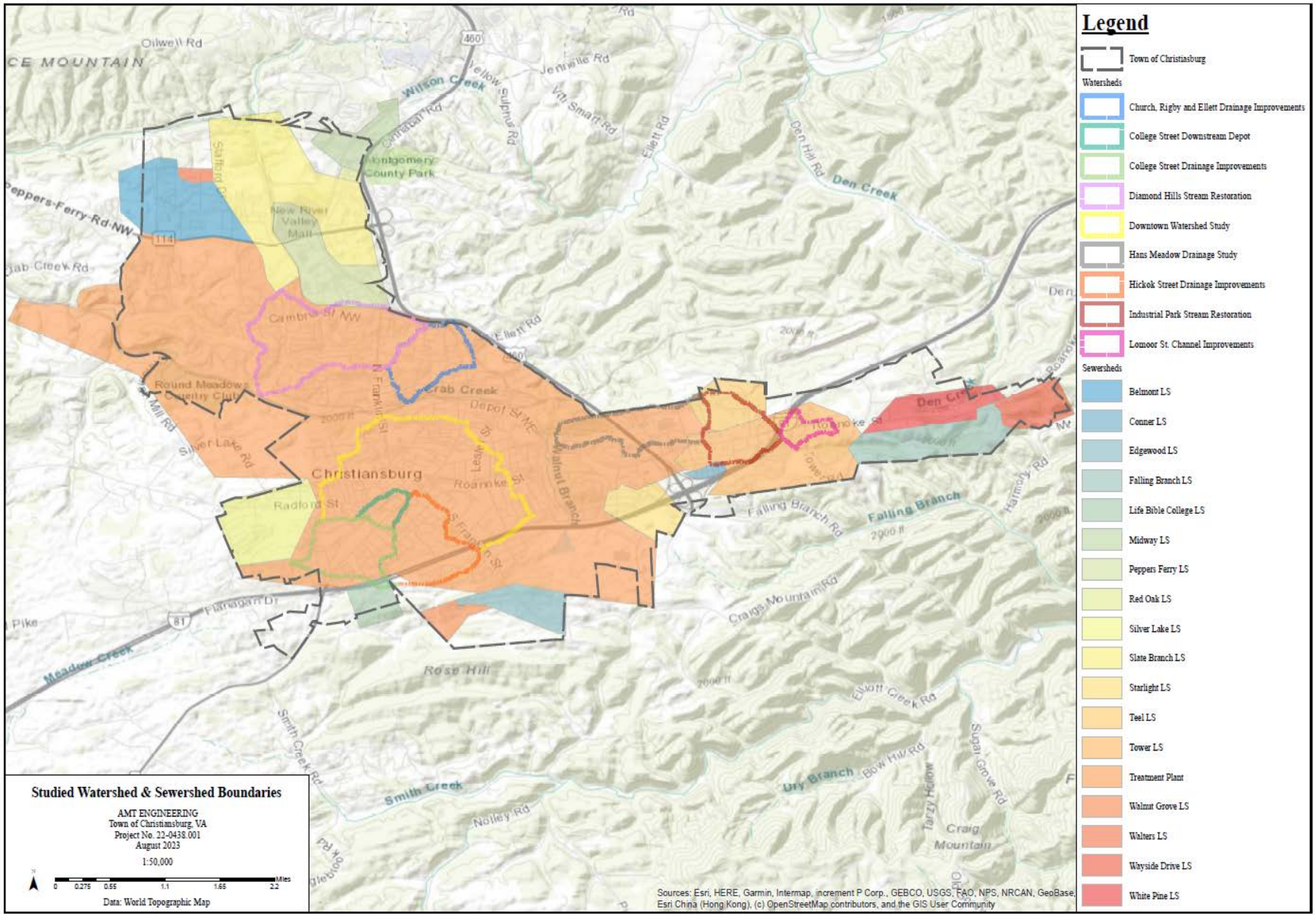

Figure 2: Studied Watershed & Sewershed Boundaries

Chapter 2: Current vs. Future Flood Prevention and Flood Resilience Efforts

Throughout the Commonwealth, including the Town of Christiansburg, Virginians have experienced the increase of storms events with greater rainfall intensity and duration. In addition, the landscape specific to Christiansburg can be characterized by its karst topography, steep slopes and prevalence of shallow soils which limits rain permeability (Town of Christiansburg, 2017). Combining these elements with heavy rains not only increases the concentration of flooding which leads to the clogging and overflowing of Town drainage infrastructure. These elements also lead to a cascading effect of other issues such as water contamination and impaired water bodies), but it can also lead to landslides and the formation or further degradation of sinkholes.

These hazards to infrastructure and human well-being have been pinpointed in areas of Christiansburg through continuous studies and improvement projects issued by the Town. Many of these projects have been associated with the greater downtown area and its associated streets and residential communities. More socially vulnerable populations living within this flood prone area are faced with the aftermath of damaged homes, sometimes on a reoccurring basis. Not all citizens can recuperate from these kinds of losses and may even be forced to move out of their homes and leave their communities.

Figure 3: Downtown Christiansburg Flooding

In recent years, the Town has increased their focus on flood reduction/prevention efforts in the form of projects and policies. Types of projects that help define the Town's flooding reduction/prevention efforts can be categorized as green infrastructure (natural-based solutions such as stream restorations, wetland installations, rainwater harvesting, etc.) and gray infrastructure (solutions such as inlets, outlets, culverts, and drainage solutions). These two types of projects are most effective when implemented in tandem with one another. Christiansburg's policies that mitigate/prevent flooding can often fall under the green

and/or gray infrastructure categories as well. These policies are framed as general goals and strategies that underline the Town's strong stance on policy goals- for both current strategies and future goals.

These current projects and policies can be found within the numerous Town documents and data files reviewed in preparation for this Plan. These documents include comprehensive plans; preliminary engineering reports; as-built monitoring reports; Erosion and Sediment Control (ESC) and Stormwater Management (SWM) plans and assessments; Stormwater Local Assistance Fund applications; drainage improvement studies; watershed studies; and all associated technical specifications, modeling, and Geographic Information System (GIS) data that come with these documents.

Current projects and policies can help to provide data for what flood prevention defenses are in use, and their effectiveness. The Town documents also provide project recommendations for future projects ("prospective projects") and suggests "goals" or policies to be expanded upon. The objective of the following section is to analyze current efforts in the form of current projects and policies, and then to compare these current defenses to future/prospective projects and future goals/policies.

Current Defenses – Studies, Projects, and Policies

Sewershed Studies

The Town's sewer system evaluation studies conducted for Arrowhead, College Street and Phlegar Street Sewersheds, and the Crab Creek Inceptor were aimed at reducing rainfall-derived infiltration and inflow (RDII) through evaluating which sewer systems had high RDII rates, and then providing rehabilitation recommendations (Town of Christiansburg, 2019). This evaluation resulted in the detection of high RDII rates for every sewer system in the study. Recommendations included manhole rehabilitation and replacement; sewer line and lateral rehabilitation; maintenance rehabilitation and on-going monitoring. Alleviating high rates of inflow can reduce the likelihood of a flood event, making these sewershed studies an important part of understanding Christiansburg's current flood resilience defenses.

Watershed Studies

Two major watershed studies conducted by the Town includes the Downtown Watershed Study (2018), and the Diamond Hills Basin Watershed Study (2013). The purpose of these studies was to analyze the current conditions of these watersheds and to provide potential outcomes of different stormwater solutions for the watersheds. The Diamond Hills Basin Watershed Study provided 2-year and 10-year storm event data that confirmed the water quantity and water quality benefits of the Diamond Hills Park Stream Restoration project, and the Diamond Hills Upper Basin Stormwater Management Facility (Balzer and Associates, 2013). The Downtown Watershed Study focused specifically on drainage and flooding concerns issues along the Town Branch Tributary that flows through Christiansburg's Downtown area. Based on review of previous Town drainage improvement studies, surveys, community meetings, and the addition of a new hydrology analysis of the watershed, 10 drainage improvement projects were recommended, prioritized, and scored.

Targeted Drainage Studies

Like the Town's watershed studies, targeted drainage Improvements projects and studies have been ramping up over the past decade to help assess specific "hotspots" where flooding occurs most often. These study areas include College Street, W. Main Street (Hickock Street), Sleepy Hollow Road, and Hans Meadow Drive. These studies have assessed current conditions, followed by recommendations derived

from projected hydrology calculations, and include design/conceptual plans with projected cost estimates. These drainage and watershed studies resulted in a variety of recommended improvements ranging from native vegetation installation, demolition of drainage infrastructure, installation of drainage infrastructure, earthwork and ESC measures, BMP installations and upgrades.

Run-Off /Pollution Studies

Identifying and recommending flooding solutions is instrumental in flood resilience planning, but further assessment of these approved projects may be needed to ensure water quality and flow functionality. Follow up studies involving approved (but not yet built) stream restorations, floodplain/overbank wetlands installations and detention ponds installations, confirm the proposed-BMP's effectiveness of keeping the local watersheds clean, which can also indicate improved stormwater overflow prevention and floodplain management. Three of the Town's drainage basins: Diamond Hills, Towne Branch (Depot Street), and Christiansburg Industrial Park were studied for their effectiveness in runoff and pollution reduction (EEE, 2013). These studies determined that these approved improvements would be effective in reducing Waste Load Allocations for the Crab Creek and New River Basins, which also indicated improved flow functionality.

Projects as a Result of the Towns Studies

As a result of the Town's plans and studies, several of the project recommendations were approved and are at various stages of design and construction. The project recommendations derived from the Hickok Street and College Street Drainage Improvement studies are still being implemented as well as several of the recommended projects from the Downtown Watershed Study. (Town of Christiansburg, n.d.). Construction for Hans Meadow Drainage Project (Phase II) and Diamond Hills Park Stream Restoration was completed in 2019, and Town Branch Stream Restoration was completed in 2018 (Town of Christiansburg, n.d.).

Figure 4: College Street Flooding

Other recently completed drainage improvements and stream restoration projects includes Church, Rigby, and Ellett Storm Drainage Improvements (completed in 2019); Blue Leaf Stream Restoration Project (2017); Brown, Church and Lucas Streets Storm Drain Improvements (2017); and North Franklin Street Drainage Improvements (2017).

Figure 5: Church Street - Drainage Issues

These projects provide a start to achieve long-lasting results that will continue to improve flooding resilience for the Town. However, other identified projects lack funding to move forward, but would further the Town's goal of increasing flood resilience if implemented.

Current Policies

Periodically, the Town of Christiansburg outlines their flooding-related policies in their Comprehensive Plan. The current 2013 version will soon be replaced by a revised edition. For brevity, below is a summary of policy themes within the 2013 Comprehensive Plan that assist in the promotion of flooding resilience, currently being implemented by the Town:

- Increased use of green techniques and infrastructure
- Water quality improvement
- Operation and maintenance of SWM and sewer infrastructure
- Execution of the MS4 plan
- Improvement or replacing of existing SWM and sewer infrastructure
- Construction of new SWM infrastructure that helps to reduce run off and pollution

These policies are designed to fully encompass the various factors that come into play regarding flooding resilience needs.

Future Projects – Studies, Projects, and Policies

Future Studies and Projects

To date, several potential projects identified in the watershed and sewershed plans have not been implemented, for various reasons. This Plan will evaluate and prioritize these potential projects to determine if they can assist the Town in its goal of increasing flood resilience.

Additionally, other projects may be considered that could provide greater flood control capabilities. Proposed mixed-use developments near Uptown Christiansburg (formerly New River Mall), Hickok Street, W. Main Street, Phlegar Street, N. Franklin Street, and College Street as proposed in the Town's Urban Development Areas document (2016) provide several opportunities to implement new and/or improved stormwater or drainage solutions for the Town.

Future Policies

Earlier in this chapter, current policies to promote the Town's flood resilience were summarized. These policies remain general to allow the easy application of flooding resilience action items. This plan will evaluate these current policies for improvement or enhancement, in addition to other policies that have not yet been pursued. For brevity, summaries of Town policies not yet explored or pursued are included in the list below:

- Landscape improvement
- Pollution reduction
- Mitigation of stormwater runoff by increasing tree canopy
- Limiting development on steep slopes (to slow down stormwater flow velocity, and decrease instances of erosion, sedimentation, and landslides)
- Increased awareness of development opportunities and restrictions on varying soil types.
- Protection of floodplains
- Creation, preservation, and maintenance of open space (including parkland)
- Design criteria using more conservative storm intensity, duration, and frequency data (IDF Curves)
- Updated subdivision guidelines encouraging best practices for stormwater collection, conveyance, and infiltration
- Consideration of karst hydrology

Chapter 3: A Plan for Flood Resilience

Methodology of Matrix/Score Card Ranking System

Based on the collection and review of Town literature (i.e., studies, plans, reports, GIS files), flood prevention and mitigation measures currently in place (current projects and policies) were identified. Potential future projects were also identified in this literature review and additional suggestions were added on by the Town Staff. The list of prospective projects and policies were then narrowed down based on optimal effectiveness, determined by the Town, and the consulting engineers assisting with this Resilience Plan.

The list of the Town's resources reviewed for determining current projects, potential projects, and other additional findings, can be found in the Appendix of this plan. Graphical representation of current resilience project coverage is demonstrated on page 9 of Chapter 1. For purposes of this resilience plan, the potential projects evaluated were based on flood and watershed studies and did not focus on sewershed based projects.

These potential projects were then ranked in accordance with a customized resilience matrix with weighted criteria, resulting in a numerical score. The matrix criteria were derived from DCR project ranking criteria that was developed by the state for the Community Flood Preparedness Fund (CFPF). The potential projects with the higher scores demonstrate a greater benefit to the Town's resilience efforts.

Some pre-existing flood prevention and mitigation projects were also evaluated using this prioritization methodology as a way for the Town to conceptualize the matrix process, its criteria, and its weighted scoring system.

Ranking Matrix Clarifications

The following caveats are to be considered when reviewing the Christiansburg Flood Resilience Ranking Matrix:

- It is important to note that the ranking of projects through this matrix scoring does not imply the order in which projects are carried out to completion. The timeline of each project depends on several factors including funding availability and project feasibility.
- Project costs for engineering and construction listed in the matrix have not been re-calculated with consideration to current-day inflation data. The matrix lists the year in which cost data was derived and is subject to change if projects are selected and implemented in the future.
- Project data displaying as "N/A" indicates that the cost to design, or remediate project is undetermined as this time.
- The following projects were not included in the matrix, as each of these involved several sub-projects, rendering the data values in the table as unquantifiable:
    - Public Works ditch work priority list
    - Public Works culvert replacement priority list
    - Other residential properties taking street water
    - Possible urban development areas designed for mixed use developments
- An additional matrix criterion to be considered for the future is the "acquisition of property" category. Acquisition can at times be the most cost-effective solution for reoccurring flooding

issues for residential properties. However, for privacy purposes, properties that specify addresses have been removed from this report.

- FEMA criteria can be added to this matrix for future grant funding consideration regarding residential properties.
    - Categories such as "Severe Repetitive Loss", "Repetitive Loss Property", "Property Damage", "Roadway Flooding", and "Potential Roadway Flooding", accompanied by a maximum point valuation can be added to this matrix, if residential properties are added to the project list in the future.
- Projects listed in the matrix that are currently marked as "*" or "**" (projects located in the floodplain and floodway, respectively) should be separately evaluated for FEMA grant funding.
- Please see the Christiansburg Floodplain/Floodway Map further along in this Chapter in the section titled "Resilience Score Card Results".
- The DCR ranking criteria can be found in Appendix A.
- Additional criteria were added to the final ranking matrix to account for estimated costs and the readiness of the project to proceed. For example, there are projects in the matrix that may score high based on the DCR criteria but do not have engineering and/or construction costs developed or may only be conceptual in design. These projects may need more development to be eligible for consideration for implementation.
- The focused list of recommended projects includes more shovel-ready projects that score highly and will also best address recurring flood issues in the Town based on the drainage studies.

Resilience Score Card Results

Detailed in the table below, are the top-ranked projects accompanied by a brief narrative and their final score. These projects represent shovel-ready projects that have been identified in previous drainage studies as the best options to alleviate recurrent flooding in the Town. An opinion of probable cost was developed for each of the recommended resilience projects based on available data. In each case, soft costs and a 30% contingency were included in the estimates as a conservative approach to budgeting. Details for each estimate can be found in the Appendix.

Potential Project	Project Description	Project Source	Points
Recommended Projects			
Chrisman / Phlegar Street Drainage Improvements: Phase II	Starting at the intersection of Phlegar Street and 3rd Street SW, this project is a series of small box culverts and open channels that convey runoff from the upper watershed to an existing triple 5'x3' box culvert under 1st Street. The channel alignment requires easements across some private properties, and may include stream stabilization measures.	Downtown Watershed Study	**75**

Chrisman / Phlegar Street Drainage Improvements: Phase I	This project collects runoff from existing 30" RCP and 48" RCP pipes under Interstate 81, and conveys the runoff in a closed drainage system along Chrisman Street, then crossing over to Phlegar Street following the alignment of the existing pipes. Recommended pipe sizes increase from 36" initially, to between 48" and 60" in diameter at 3rd Street SW.	Downtown Watershed Study	**73**
College Street Drainage Project - Phase I	Improvements at the nearby school, a reach along the opposite side of College Street, and the Detention Pond with several hundred feet of the outlet pipe downstream which will terminate upstream of the first driveway that crosses the drainage ditch. The installed pipe system below the pond will need to be installed at a flatter grade in Phase I than the final design until Phase II portion may be installed. The drainage will then re-enter the existing drainage ditch behind the residences along College Street.	College Street Drainage Study (scope revised on 06/2023)	**70**
College Street Drainage Project - Phase II	The pipe and structures previously installed below the pond will be re-installed at their originally planned deeper elevations along with the rest of the Phase II construction that extends to Depot St and also captures a large inflow from Main St. This will involve a small amount of redesign for this reach of the pipe installation immediately below the pond.	College Street Drainage Study (scope revised on 06/2023)	**70**
Hickok Street Drainage Improvements	This project conveys runoff in a proposed 10'x4' box culvert under Hickok Street SW to the intersection with Commerce Street, removing a section of drainage conveyance that goes under the existing buildings on West Main Street. Runoff is conveyed either north along Commerce Street to a connection with the existing 72" CMP or west along Hickok Street to College Street, where it connects to the College Street Drainage Improvements (Phase I).	Downtown Watershed Study	**65**

The map on the following page depicts Christiansburg Floodplain/Floodway areas, and a sampling of the top ranked projects per the ranking matrix.

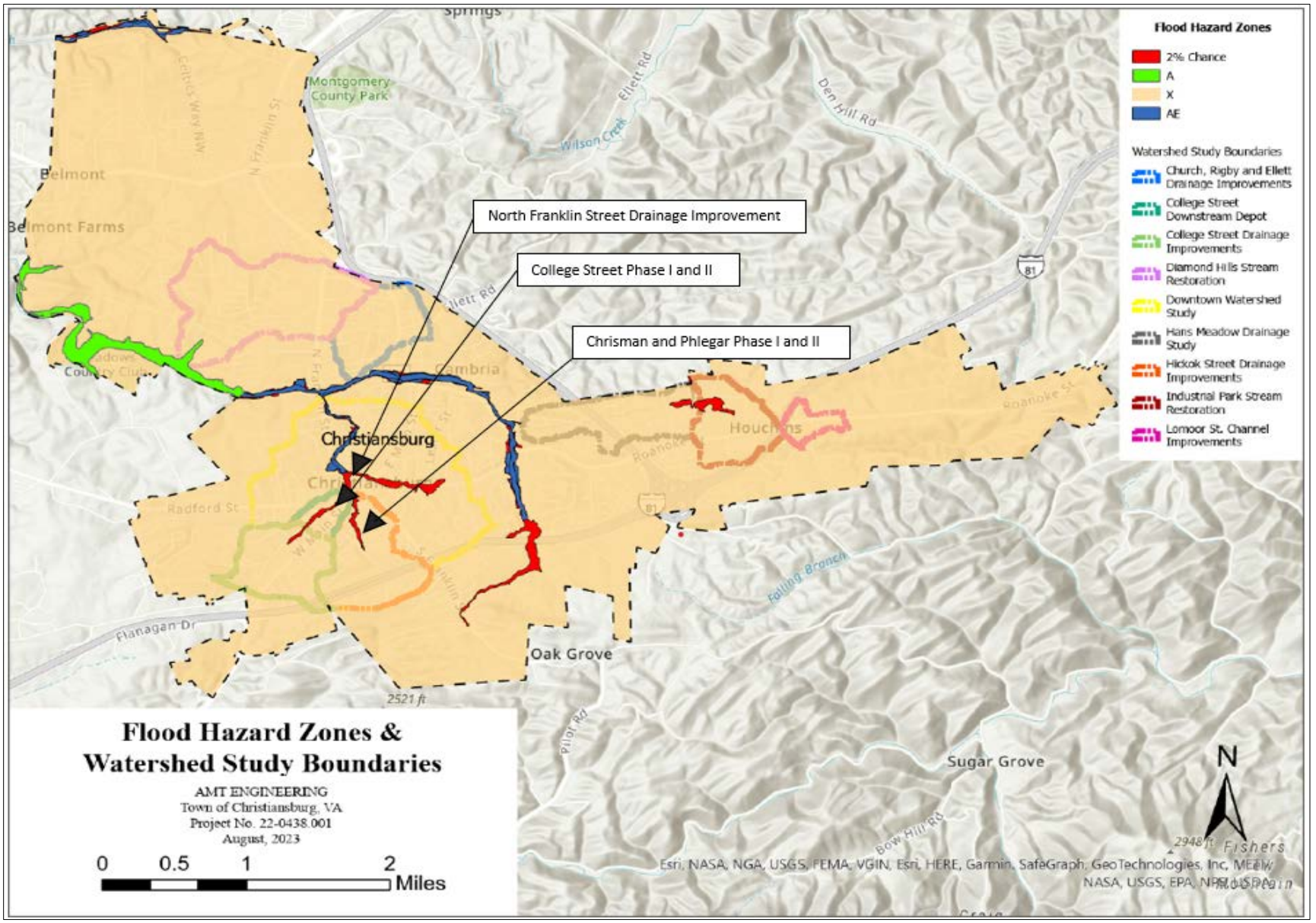

Figure 6: Christiansburg Flood Hazard Zone Map Displaying some Potential Projects and Watershed Study Boundaries

Continuation of Gray Infrastructure Implementation

The resulting gray infrastructure project recommendations from this study will help create more connectedness to a greater stormwater system, preventing or mitigating flooding events. Future new builds and retrofits alike should be designed with specifications that address increased precipitation, intensity and frequency storms, and the potential to mitigate flooding events. Additionally, maintenance protocols should be updated to ensure that these engineered solutions reliably maintain functionality. Lastly, to increase adaptive capacity, gray infrastructure should be designed in tandem with green infrastructure and nature-based solutions.

Continuation of Green Infrastructure Implementation

In addition to the project recommendations in the table above, green infrastructure should be utilized as often as possible to augment gray infrastructures capabilities if time and budgets allow. Green infrastructure is Implementing stream restorations and wetland and riparian buffer installations, and other green infrastructure techniques such as rainwater harvesting systems and pervious pavement will help to extend and reinforce the natural features that assist with flood resilience defense. Making sure our natural environmental is healthy and functional improves human well-being, creating the most immediate benefit to vulnerable communities and providing opportunities for recreation, education, and decreased heat island effect. Included with these implemented green infrastructure solutions should be updated maintenance protocols to ensure that they are functioning as designed.

RESOURCES

A. Morton Thomas and Associates. (AMT). (2018). *Town of Christiansburg Downtown Watershed Study*

American Society of Civil Engineers (ASCE). (2021) Adapting intensity-duration-frequency curves to improve climate resilience. Adapting intensity-duration-frequency curves to improve climate resilience | ASCE

Town of Christiansburg. (2017). *Town of Christiansburg 2013 Comprehensive Plan.* https://christiansburg.app.box.com/s/iqrvxh7e0kbiy6xwgyeyw5q4rvqn7f2a/file/1056208918079

Town of Christiansburg. (2019). *Town of Christiansburg, Virginia Arrowhead Sewer System Evaluation Survey.* https://christiansburg.app.box.com/s/iqrvxh7e0kbiy6xwgyeyw5q4rvqn7f2a/file/1056208918079

Town of Christiansburg. (2016). *Town of Christiansburg Interceptor Model & Preliminary Engineering Report.* https://christiansburg.app.box.com/s/iqrvxh7e0kbiy6xwgyeyw5q4rvqn7f2a/file/1056224097944

Town of Christiansburg. (2014). *Diamond Hills Park As-Built and Year 1 Monitoring.* https://christiansburg.app.box.com/s/iqrvxh7e0kbiy6xwgyeyw5q4rvqn7f2a/file/1056220870760

EEE Consulting (EEE). (2013). Christiansburg Stream Restoration and Stormwater BMP Assessment https://christiansburg.app.box.com/s/iqrvxh7e0kbiy6xwgyeyw5q4rvqn7f2a/file/1056220870760

Balzar and Associates, Inc. (2013). *Diamond Hills Basin Watershed Study.* https://christiansburg.app.box.com/s/iqrvxh7e0kbiy6xwgyeyw5q4rvqn7f2a/file/1056216341472

Town of Christiansburg, Michael Baker International. (2016). *Urban Development Areas.* https://christiansburg.app.box.com/s/iqrvxh7e0kbiy6xwgyeyw5q4rvqn7f2a/file/1056205375704

Town of Christiansburg, (n.d.). *Capital Projects* https://www.christiansburg.org/479/Capital-Project

Water Infrastructure Improvements for the Nation Act (2017)., Public Law 114-322

Benedict, M. A., W. Allen, and E.T. McMahon (2004). Advancing Strategic Conservation in the Commonwealth of Virginia: Using a Green Infrastructure Approach to Conserving and Managing the Commonwealth's Natural Areas, Working Landscapes, Open Space, and Other Critical Resources. Washington, D.C., The Conservation Fund. 2004.

Benedict, M. A. and E.T. McMahon. (2006). Green Infrastructure: Linking Landscapes and Communities. Washington, D.C., Island Press.

Green and Gray Infrastructure Research. (2023). EPA. https://www. epa.gov/water-research/green-and-gray-infrastructure-research#:~:text=Gray%20infrastructure%20is%20traditional%20stormwater,%2C%20pipes%2C%20and%20retention%20basins.

Community Flood Preparedness Fund Grants and Loans. (n.d.). https://www.dcr.virginia.gov/dam-safety-and-floodplains/dsfpm-cfpf

Social Vulnerability | National Risk Index. (n.d.). https://hazards.fema.gov/nri/social-vulnerability

Virginia Department of Conservation & Recreation. (n.d.). 2023 Grant Manual for the Virginia Community Flood Preparedness Fund. https://www.dcr.virginia.gov/dam-safety-and-floodplains/document/Round-4-2023-CFPF-Manual-DRAFT-Final.pdf

Fema.gov. (2022, March). Hurricane and Flood Mitigation Handbook for Public Facilities - Fact Sheet 1.0: Roads. www.fema.gov

Damage to Property? (2020, February). FEMA.gov. https://www.fema.gov/faq/damage-property

National Flood Insurance Program: Frequently Asked Questions - Repetitive Loss. (2005, October).www.fema.gov. https://www.fema.gov/pdf/rebuild/repetitive_loss_faqs.pdf

Sanitary Sewer Overflow Analysis and Planning (SSOAP) Toolbox. EPA. (2023-B). US EPA. https://www.epa.gov/water-research/sanitary-sewer-overflow-analysis-and-planning-ssoap-toolbox

Heat Island Effect. (2023-C). EPA. https://www.epa.gov/heatislands

Appendix

DCR Scoring Criteria

Project Eligible for Consideration		
Scoring Information		
Criterion	**Point Value**	**Points Awarded**
Projects may have components of both a. and b. below; however, only one category may be chosen. The category chosen must be identified as the primary project in the application.		
a. Acquisition of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures (and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition).	30	
☐ Wetland restoration. ☐ Floodplain restoration. ☐ Construction of swales and settling ponds. ☐ Living shorelines and vegetated buffers. ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by ConserveVirginia Floodplain and Flooding Resilience layer or a similar data driven analytic tool. ☐ Dam removal ☐ Stream bank restoration or stabilization. ☐ Restoration of floodplains to natural and beneficial function.	25	
b. any other nature-based approach	20	
Is the project area socially vulnerable? (Based on ADAPT VA's Social Vulnerability Index Score.)		
Very High Social Vulnerability (More than 1.5)	10	
High Social Vulnerability (1.0 to 1.5)	8	
Moderate Social Vulnerability (0.0 to 1.0)	5	
Low Social Vulnerability (-1.0 to 0.0)	0	
Low Social Vulnerability (-1.0 to 0.0)	0	
Is the proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?		
Yes	5	
No	0	
Is the proposed project in a low-income geographic area as defined in the DCR manual?		
Yes	10	

No	0	
Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?		
Yes	5	
No	0	
Does this project provide "community scale" benefits?		
Yes	30	
No	0	
Total Points		

Top Ranking Project Scorecards

Chrisman / Phlegar Street Drainage Improvements: Phase II

Project Eligible for Consideration		
Scoring Information		
Criterion	**Point Value**	**Points Awarded**
Projects may have components of both a. and b. below; however, only one category may be chosen. The category chosen must be identified as the primary project in the application.		
a. Acquisiion of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures (and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition).	30	
☐ Wetland restoration. ☐ Floodplain restoration. ☐ Construction of swales and settling ponds. ☐ Living shorelines and vegetated buffers. ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by ConserveVirginia Floodplain and Flooding Resilience layer or a similar data driven analytic tool. ☐ Dam removal ☐ Stream bank restoration or stabilization. ☐ Restoration of floodplains to natural and beneficial function.	25	**25**
b. any other nature-based approach	20	**5**

Is the project area socially vulnerable? (Based on ADAPT VA's Social Vulnerability Index Score.)		
Very High Social Vulnerability (More than 1.5)	10	
High Social Vulnerability (1.0 to 1.5)	8	
Moderate Social Vulnerability (0.0 to 1.0)	5	
Low Social Vulnerability (-1.0 to 0.0)	0	**0**
Low Social Vulnerability (-1.0 to 0.0)	0	
Is the proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?		
Yes	5	
No	0	**0**
Is the proposed project in a low-income geographic area as defined in the DCR manual?		
Yes	10	**10**
No	0	
Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?		
Yes	5	**5**
No	0	
Does this project provide "community scale" benefits?		
Yes	30	**30**
No	0	
Total Points		**75**

Chrisman / Phlegar Street Drainage Improvements: Phase I

Project Eligible for Consideration		
Scoring Information		
Criterion	**Point Value**	**Points Awarded**
Projects may have components of both a. and b. below; however, only one category may be chosen. The category chosen must be identified as the primary project in the application.		

a. Acquisition of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures (and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition).	30	
☐ Wetland restoration. ☐ Floodplain restoration. ☐ Construction of swales and settling ponds. ☐ Living shorelines and vegetated buffers. ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by ConserveVirginia Floodplain and Flooding Resilience layer or a similar data driven analytic tool. ☐ Dam removal ☐ Stream bank restoration or stabilization. ☐ Restoration of floodplains to natural and beneficial function.	25	**25**
b. any other nature-based approach	20	**5**
Is the project area socially vulnerable? (Based on ADAPT VA's Social Vulnerability Index Score.)		
Very High Social Vulnerability (More than 1.5)	10	
High Social Vulnerability (1.0 to 1.5)	8	
Moderate Social Vulnerability (0.0 to 1.0)	5	
Low Social Vulnerability (-1.0 to 0.0)	0	**0**
Low Social Vulnerability (-1.0 to 0.0)	0	**0**
Is the proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?		
Yes	5	
No	0	**0**
Is the proposed project in a low-income geographic area as defined in the DCR manual?		
Yes	10	**10**
No	0	
Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?		
Yes	5	**3**
No	0	
Does this project provide "community scale" benefits?		
Yes	30	**30**
No	0	

Total Points	73

College Street Drainage Project - Phase I

Project Eligible for Consideration		
Scoring Information		
Criterion	**Point Value**	**Points Awarded**
Projects may have components of both a. and b. below; however, only one category may be chosen. The category chosen must be identified as the primary project in the application.		
a. Acquisition of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures (and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition).	30	
☐ Wetland restoration. ☐ Floodplain restoration. ☐ Construction of swales and settling ponds. ☐ Living shorelines and vegetated buffers. ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by ConserveVirginia Floodplain and Flooding Resilience layer or a similar data driven analytic tool. ☐ Dam removal ☐ Stream bank restoration or stabilization. ☐ Restoration of floodplains to natural and beneficial function.	25	**25**
b. any other nature-based approach	20	**5**
Is the project area socially vulnerable? (Based on ADAPT VA's Social Vulnerability Index Score.)		
Very High Social Vulnerability (More than 1.5)	10	
High Social Vulnerability (1.0 to 1.5)	8	
Moderate Social Vulnerability (0.0 to 1.0)	5	
Low Social Vulnerability (-1.0 to 0.0)	0	**0**
Low Social Vulnerability (-1.0 to 0.0)	0	
Is the proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?		
Yes	5	
No	0	**0**
Is the proposed project in a low-income geographic area as defined in the DCR manual?		
Yes	10	**10**

No	0	
Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?		
Yes	5	
No	0	**0**
Does this project provide "community scale" benefits?		
Yes	30	**30**
No	0	
Total Points		**70**

College Street Drainage Project - Phase II

Project Eligible for Consideration		
Scoring Information		
Criterion	**Point Value**	**Points Awarded**
Projects may have components of both a. and b. below; however, only one category may be chosen. The category chosen must be identified as the primary project in the application.		
a. Acquisition of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures (and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition).	30	
☐ Wetland restoration. ☐ Floodplain restoration. ☐ Construction of swales and settling ponds. ☐ Living shorelines and vegetated buffers. ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by ConserveVirginia Floodplain and Flooding Resilience layer or a similar data driven analytic tool. ☐ Dam removal ☐ Stream bank restoration or stabilization. ☐ Restoration of floodplains to natural and beneficial function.	25	**25**
b. any other nature-based approach	20	**5**
Is the project area socially vulnerable? (Based on ADAPT VA's Social Vulnerability Index Score.)		
Very High Social Vulnerability (More than 1.5)	10	

High Social Vulnerability (1.0 to 1.5)	8	
Moderate Social Vulnerability (0.0 to 1.0)	5	
Low Social Vulnerability (-1.0 to 0.0)	0	**0**
Low Social Vulnerability (-1.0 to 0.0)	0	
Is the proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?		
Yes	5	
No	0	**0**
Is the proposed project in a low-income geographic area as defined in the DCR manual?		
Yes	10	**10**
No	0	
Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?		
Yes	5	
No	0	**0**
Does this project provide "community scale" benefits?		
Yes	30	**30**
No	0	
Total Points		**70**

Hickok Street Drainage Improvements

Project Eligible for Consideration		
Scoring Information		
Criterion	**Point Value**	**Points Awarded**
Projects may have components of both a. and b. below; however, only one category may be chosen. The category chosen must be identified as the primary project in the application.		
a. Acquisition of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures (and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition).	30	

☐ Wetland restoration. ☐ Floodplain restoration. ☐ Construction of swales and settling ponds. ☐ Living shorelines and vegetated buffers. ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by ConserveVirginia Floodplain and Flooding Resilience layer or a similar data driven analytic tool. ☐ Dam removal ☐ Stream bank restoration or stabilization. ☐ Restoration of floodplains to natural and beneficial function.	25	**25**
b. any other nature-based approach	20	
Is the project area socially vulnerable? (Based on ADAPT VA's Social Vulnerability Index Score.)		
Very High Social Vulnerability (More than 1.5)	10	
High Social Vulnerability (1.0 to 1.5)	8	
Moderate Social Vulnerability (0.0 to 1.0)	5	
Low Social Vulnerability (-1.0 to 0.0)	0	**0**
Low Social Vulnerability (-1.0 to 0.0)	0	
Is the proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?		
Yes	5	
No	0	**0**
Is the proposed project in a low-income geographic area as defined in the DCR manual?		
Yes	10	**10**
No	0	
Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?		
Yes	5	
No	0	
Does this project provide "community scale" benefits?		
Yes	30	**30**
No	0	
Total Points		**65**

Project Ranking Matrix - 10/09/2023

Project Ranking Criteria			Acquisition of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures	Nature Based Approach	Project Area Socially Vulnerable	Impact NFIP Participation	Low Income Geographic Area	TMDL Benefit? (e.g., N or P)	Community Scale Benefit		Estimated Engineering Cost	Estimated Construction Cost	Total Cost	Cost Notes (*year of cost estimate, does plan include cost?*)	**Total Points**
Categorical Weight			30	20	10	5	10	5	30						
Potential Project	**Project Description**	**Project Source**													
Recommended Projects															
College Street Drainage Project - Phase I	Improvements at the nearby school, a reach along the opposite side of College Street, and the Detention Pond with several hundred feet of the outlet pipe downstream which will terminate upstream of the first driveway that crosses the drainage ditch. The installed pipe system below the pond will need to be installed at a flatter grade in Phase I than the final design until Phase II portion may be installed. The drainage will then re-enter the existing drainage ditch behind the residences along College Street.	College Street Drainage Study (scope revised on 06/2023)	25	5	0	0	10	0	30		$155,852	$2,188,034	$2,238,034	2023	**70**
College Street Drainage Project - Phase II	The pipe and structures previously installed below the pond will be re-installed at their originally planned deeper elevations along with the rest of the Phase II construction that extends to Depot St and also captures a large inflow from Main St. This will involve a small amount of redesign for this reach of the pipe installation immediately below the pond.	College Street Drainage Study (scope revised on 06/2023)	25	5	0	0	10	0	30		$191,099	$1,457,017	$1,864,981	2023	**70**
Hickok Street Drainage Improvements	This project conveys runoff in a proposed 10'x4' box culvert under Hickok Street SW to the intersection with Commerce Street, removing a section of drainage conveyance that goes under the existing buildings on West Main Street. Runoff is conveyed either north along Commerce Street to a connection with the existing 72" CMP or west along Hickok Street to College Street, where it connects to the College Street Drainage Improvements (Phase I).	Downtown Watershed Study	25	0	0	0	10	0	30		$404,000	$2,271,722	$2,675,722 (stated as $2,700,000 in Watershed study)	2017 and later in watershed study in 2018	**65**
Chrisman / Phlegar Street Drainage Improvements: Phase I	This project collects runoff from existing 30" RCP and 48" RCP pipes under Interstate 81, and conveys the runoff in a closed drainage system along Chrisman Street, then crossing over to Phlegar Street following the alignment of the existing pipes. Recommended pipe sizes increase from 36" initially, to between 48" and 60" in diameter at 3rd Street SW.	Downtown Watershed Study	25	5	0	0	10	3	30		$378,000	$2,413,000	$2,800,000	2018	**73**
Chrisman / Phlegar Street Drainage Improvements: Phase II	Starting at the intersection of Phlegar Street and 3rd Street SW, this project is a series of small box culverts and open channels that convey runoff from the upper watershed to an existing triple 5'x3' box culvert under 1st Street. The channel alignment requires easements across some private properties, and may include stream stabilization measures.	Downtown Watershed Study	25	5	0	0	10	5	30		$187,000	$1,113,000	$1,300,000	2018	**75**
Potential Future Projects															
Gray Infrastructure															
Existing SWM Facility with Independence Boulevard Upgrade - project completed but may need further evaluation	N/A	Diamond Hills Basin Watershed Study	0	0	0	0	10	0	30		N/A	N/A	N/A	N/A	**40**
Radford Street Drainage Improvements	This project is smaller than some others in the downtown area, and addresses clogged inlets and undersized pipes along the north side of Radford Street. By increasing the pipe size from 15" to 24" and adding adequately sized throat lengths on the drainage inlets, runoff can be intercepted and conveyed into the existing 36" RCP at Lee Hy Court, then draining along Radford Street to Depot Street and into the downtown area. New sidewalks may also be considered for this area.	Downtown Watershed Study	25	0	0	0	10	0	30		$158,000	$942,000	$1,100,000	2018	**65**
Alleghany St / Canaan Rd / Epperly Drive: Drainage Improvements	This project helps address surface water and groundwater concerns from the Sunset Cemetery and Alleghany Street in areas along Canaan Road and Epperly Drive, by replacing existing 15" pipes with 24" and 30" pipes. Runoff is then conveyed into the rear yards on the south side of Epperly Drive, behind the First Church of God, with a pipe extension to an existing stormwater management basin (dry detention). During engineering design, the Town may choose to retrofit the existing basin to help proect existing drainage systems downstream and to promote improved water quality in the watershed.	Downtown Watershed Study	25	0	0	0	10	5	30		$105,000	$645,000	$750,000	2018	**70**
Stone Street Culvert Replacement at Town Branch	This project replaces an existing quadruple 48" CMP with a dual 10'x5' box culvert, providing increased capacity to convey the 2-year storm under Stone Street without overtopping onto Depot Street. 10-year and 100-year flood depths are reduced with this culvert replacement. Possible impacts of the larger pipes on the stream restoration project in Depot Park will need to be evaluated, as well as the flood reduction benefits of eliminating the abandoned bridge near Stone Street. Enhanced water quality can also be considered with this project, by developing a stream restoration project from Stone Street to North Franklin Street, creating a linear park or greenway concept	Downtown Watershed Study	30	0	5	0	10	5	30		$114,000	$526,000	$640,000	2018	**80**
Roanoke Street Drainage Improvements (near wades)	This project begins at an existing curb inlet near Wade's Foods which has a small diameter pipe draining to Craig Street. The recommendation is to eliminate runoff from Craig Street into the open channel behind 500 Roanoke Street by installing a storm drain system that conveys runoff from the Wade's Foods parking lot and Craig Street to Roanoke Street, where it ties into the existing storm drain system	Downtown Watershed Study	25	0	5	0	10	5	30		$42,000	$168,000	$210,000	2018	**75**
Sherwood Culvert Replacement	Replacement of existing storm drain culvert under Sherwood Drive which is beyond useful life and causing maintenance issues.	Town's Addition (no document source)	25	0	5	0	10	0	30		$25,000	$100,000	$125,000	2022	**70**
Glade Culvert Replacement	Replacement of existing storm drain culvert along Glade Drive which is beyond useful life and causing maintenance issues.	Town's Addition (no document source)	25	0	0	0	10	0	30		N/A	N/A	N/A	N/A	**65**
Public Works Operation Center	Public Works Operation Center is within the 100 year flood plain since it is the location of the old sewer treatment facility. Relocation is the best alternative.	Town's Addition (no document source)	30	20	5	0	10	0	30		N/A	N/A	N/A	N/A	**95**
Evans Street Drainage	Piping of road drainage through a new storm drain system to prevent drainage between and behind residences.	Town's Addition (no document source)	25	0	5	0	10	0	30		$75,000	$325,000	$400,000	2022	**70**
Overhill Drainage	Piping of road drainage through a new storm drain system to prevent drainage between and behind residences.	Town's Addition (no document source)	25	0	0	0	10	0	30		N/A	N/A	N/A	N/A	**65**
Reading Road Drainage	Research and Public outreach is required to address maintenance of drainage infrastructure and/or larger replacement projects to address capacity may be necessary.	Town's Addition (no document source)	25	0	0	0	10	0	30		N/A	N/A	N/A	N/A	**65**
Teel Street	Piping of road drainage through a new storm drain system to prevent drainage between and behind residences.	Town's Addition (no document source)	25	0	5	0	10	0	30		N/A	N/A	N/A	N/A	**70**
N Franklin Street Drainage near Conston	Roadway flooding occurs here frequently with heavy rains. The system is most likely undersized for the area it drains	Town's Addition (no document source)	25	0	0	0	10	0	30		N/A	N/A	N/A	N/A	**65**
West Main Street Drainage (near 1010 W Main, drainage from Robin Rd / Interstate)	Piping of road drainage through a new storm drain system to prevent drainage between and behind residences.	Hickock Drainage Study	25	0	0	0	10	0	30		$404,000	$2,271,722	$2,675,722	2017	**65**
Infrastructure															
Diamond Hills Basin Evaluation of Ultimate Development (including: Stream Restoration & Independence Blvd Upgrade, and Upstream SWM Facility a BMPs);	there are potential projects to come from this basin, work on various stormwater facilities and conveyance channels	Description provided by Town notes	25	0	0	0	10	5	30		N/A	N/A	N/A	N/A	**70**
Christiansburg Industrial Park Restoration and Stormwater BMP Assessment(Town is at 100% design on this and plans to go to construction in the fall…we have the costs available)	Maintenance / Upsizing of existing stormwater quantity pond and channel improvements upstream of facility.	Stream Benefits Analysis Christiansburg Industrial ParkStream Restoration	25	20	5	0	10	5	30		N/A	N/A	$700,000	N/A	**95**
Sleepy Hollow SWM BMP Modification	Maintance or removal of BMP. The embankment is not constructed properly and would need to be rebuit.	WSSI Sleepy Hollow Powerpoint	25	20	0	0	10	5	30		N/A	N/A	N/A	N/A	**90**
Kiwanas Park	Corrective work to address stream erosion along park.	Town's Addition	25	0	0	0	10	5	30		N/A	N/A	N/A	N/A	**70**
Diamond Hills SWM BMP Modification (Food Lion N Franklin St Facility)	Potential modification to address flow through pond to protect downstream channel and Blue Leaf Stream Restoration	Town's Addition (no document source)	25	0	0	0	10	5	30		N/A	N/A	N/A	N/A	**70**

Table Notes:
Project data displaying as "N/A" indicates that the cost to construct, design, or remediate project is undetermined as this time.
Project Name (* = project that is in the floodplain. ** = a project that is in the floodway)
Preferred projects are based on total points, cost considerations and shovel-ready nature of the proposed project.

Virginia Department of Conservation & Recreation

VRA Virginia Resources Authority

DCR Virginia Community Flood Preparedness Fund

Grant Program Application

November 12, 2023

Town of Christiansburg

100 E Main Street
Christiansburg, VA 24073

Contact Information

Michael Kelley, PE, Director of Engineering
(Town of Christiansburg)
Office: 540-382-6120 Ext. 1147
mkelley@christiansburg.com

THE PLACE TO BE.
CHRISTIANSBURG VA
Established November 10, 1792

100 East Main Street
Christiansburg, VA 24073
p: (540) 382-6128
f: (540) 382-7338

November 8, 2023

Mr. Daryl Glover
Deputy Agency Director of Dam Safety, Flood Preparedness, and Soil and Water Conservation
Department of Conservation and Recreation
60 East Main Street, 24th Floor
Richmond, Virginia 23219

RE: Town of Christiansburg Virginia Community Flood Preparedness Fund (CFPF) Grant Request

Dear Mr. Glover:

The Town of Christiansburg is pleased to submit this grant application for project funding from the CFPF fund. The Town is seeking funding for the College Street Drainage Project Phase I and Phase II project as presented in our Town adopted Flood Resilience Plan and in the College Street Drainage Study. The Town is committed to the match as proposed ($206,865). We appreciate your consideration of our complete application for CFPF funding.

Randy Wingfield
Town Manager

GRANT APPLICATION PROJECT NARRATIVE

TOWN OF CHRISTIANSBURG, VIRGINIA

The following narrative is provided to support the Town of Christiansburg's grant application to the DCR/VRA 2023 Community Flood Preparedness Fund (CFPF) for the 2023 Funding Round. The Town is requesting funds to support the engineering and construction of one of the Town's flood resilience projects: College Street Drainage Project - Phase I and Phase II. This project will alleviate flooding along College Street and will also contribute to the continuity of flood mitigation infrastructure and achievement of the Town's flood resilience goals, as determined by the Town of Christiansburg Flood Resilience Plan (see attached as Appendix D), approved by Town Council on October 24th, 2023.

The Town understands the CFPF funds must be utilized in accordance with the following principles:

1. Acknowledge the consequences of climate change, and base decision making on the best available science.
2. Identify and address socioeconomic inequities and work to enhance equity through adaptation and protection efforts for low-income and underserved communities.
3. Utilize community and regional scale planning to the maximum extent possible, seeking region-specific approaches tailored to the needs of individual communities.
4. Understand fiscal realities and focus on the most cost-effective solutions for the protection and adaptation of our communities, businesses, and public infrastructure. The solutions will, to the extent possible, prioritize effective natural solutions.
5. Recognize the importance of protecting and enhancing nature-based solutions in all regions, natural coastal barriers, and fish and wildlife habitat by prioritizing nature-based solutions.

The project was identified as a high priority in the Town's Flood Resilience Plan which was developed in accordance with these principles.

The following narrative includes a scope of work and budget discussion and is supported with an attachment, as noted above.

SCOPE OF WORK / NARRATIVE

The Town of Christiansburg Flood Resiliency Plan posed several potential projects that could promote flood resilience. These projects were identified based on drainage studies performed by the Town to assess recurring flooding and drainage issues within the Town. Utilizing DCR CFPF Manual scoring criterion for "Project Eligible for Consideration", potential projects were ranked alongside of construction and engineering cost data. Among these potential projects, College Street Drainage Projects – Phase I and Phase II were determined to be the most optimal for both flood resilience and cost-effectiveness. These two phases of the College Street Drainage project are connected; implementation of both phases will alleviate flooding on College Street.

Specifically, the College Street Drainage Project - Phase I and Phase II originated as project recommendations from the drainage study and report titled, Town of Christiansburg College Street

Drainage Alternatives Analysis, published in June of 2021 (linked here). This report developed and ranked project recommendations to address long-standing drainage and flooding issues along the College Street Corridor. College Street Drainage Project - Phase I and Phase II were selected by the Town as the most effective solution to the drainage issues along College Street.

The College Street Drainage Project - Phase I and Phase II were prioritized and highly ranked in drainage effectiveness per the College Street Drainage Alternatives Analysis study. Subsequently, the Town of Christiansburg Flood Resilience Plan identified this project as an effective flood resilience project. Commencing work on these projects as soon as possible will be of great benefit to the Town.

The scope of each College Street project phase is as follows:

College Street Drainage Project – Phase I

Drainage Improvements will be made at the nearby school, a reach along the opposite side of College Street, and a detention pond with several hundred feet of the outlet pipe downstream, which will terminate upstream of the first driveway that crosses the drainage ditch. The installed pipe system below the pond will be installed at a flatter grade. The drainage will then re-enter the existing drainage ditch behind the residences along College Street. Trees and landscaping will be planted to enhance the drainage capabilities of the project and to provide an aesthetic for residents.

College Street Drainage Project – Phase II

The pipe and structures previously installed below the pond in Phase I will be re-installed at their originally planned deeper elevations along with the rest of the Phase II construction that extends to Depot Street (and also captures a large inflow from Main Street). This will involve a small amount of redesign for this reach of the pipe installation immediately below the pond.

The projects include the following elements:

1. Flood control and resilience.
2. They will incorporate a nature-based approach to the maximum extent possible.
3. They will provide community scale benefit to a low-income geographic area.
4. Trees and landscaping will enhance drainage capabilities and provide an aesthetic for the project site.

BUDGET NARRATIVE

The College Street Drainage Project Phase I and Phase II engineering and construction cost estimate is $4,081,906. The Phase I estimate is provided below and is at 90% design. The Phase II estimate is also provided below and is at 60% design at the writing of this grant application. The Town of Christiansburg will manage and administer this project, which will require Town staff time for project management and inspection during project mobilization and construction. Additionally, post-construction maintenance as detailed in the maintenance plan will require Public Works time for inspection and performance of maintenance as needed. Implementation of the maintenance plan will also require equipment to perform periodic mowing and removal of any accumulated trash or debris in the completed project area. The total project estimate incorporating these costs is $4,097,246.

Applicants must have prior approval from the Department to submit applications, forms, and supporting documents by mail in lieu of the WebGrants portal.

Appendix A: Application Form for Grant and Loan Requests for All Categories

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Virginia Department of Conservation and Recreation
Virginia Community Flood Preparedness Fund Grant Program

Name of Local Government: Town of Christiansburg, Virginia

Category Being Applied for (check one):

☐ **Capacity Building/Planning**

☒ **Project**

☐ **Study**

NFIP/DCR Community Identification Number (CID) 510101

Name of Authorized Official and Title: Randy Wingfield, Town Manager

Signature of Authorized Official: R. Wingfield

Mailing Address (1): 100 East Main Street

Mailing Address (2): _____

City: Christiansburg **State:** VA **Zip:** 24073

Telephone Number: (540) 382-6128 x1119 **Cell Phone Number:** (____) _____

Email Address: rwingfield@christiansburg.org

Contact and Title (If different from authorized official): _____

Mailing Address (1): _____

Mailing Address (2): _____

City: _____ State: _____ Zip: _____

Telephone Number: (____) _____ Cell Phone Number: (____) _____

Email Address: _____

Is the proposal in this application intended to benefit a low-income geographic area as defined in the Part 1 Definitions? Yes _X_ No ____

Categories (select applicable activities that will be included in the project and used for scoring criterion):

Capacity Building and Planning Grants

☐ Floodplain Staff Capacity.

☐ Resilience Plan Development

- ☐ Revisions to existing resilience plans and modifications to existing comprehensive and hazard mitigation plans.
- ☐ Resource assessments, planning, strategies, and development.
  - Policy management and/or development.
  - Stakeholder engagement and strategies.

☐ Other: _____

Study Grants (Check All that Apply)

☐ Studies to aid in updating floodplain ordinances to maintain compliance with the NFIP, or to incorporate higher standards that may reduce the risk of flood damage. This must include establishing processes for implementing the ordinance, including but not limited to, permitting, record retention, violations, and variances. This may include revising a floodplain ordinance when the community is getting new Flood Insurance Rate Maps (FIRMs), updating a floodplain ordinance to include floodplain setbacks, freeboard, or other

higher standards, RiskMAP public noticing requirements, or correcting issues identified in a Corrective Action Plan.

- ☐ Revising other land use ordinances to incorporate flood protection and mitigation goals, standards, and practices.
- ☐ Conducting hydrologic and hydraulic (H&H) studies of floodplains. *Changes to the base flood, as demonstrated by the H&H must be submitted to FEMA within 6 months of the data becoming available.*
- ☐ Studies and Data Collection of Statewide and Regional Significance.
- ☐ Revisions to existing resilience plans and modifications to existing comprehensive and hazard.
- ☐ Other relevant flood prevention and protection project or study.

Project Grants and Loans (Check All that Apply – Hybrid Solutions will include items from both the "Nature-Based" and "Other" categories)

Nature-based solutions

- ☒ Acquisition of property (or interests therein) and/or structures for purposes of allowing floodwater inundation, strategic retreat of existing land uses from areas vulnerable to flooding; the conservation or enhancement of natural flood resilience resources; or acquisition of structures, provided the acquired property will be protected in perpetuity from further development, and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition.
- ☐ Wetland restoration.
- ☒ Floodplain restoration.
- ☐ Construction of swales and settling ponds.
- ☐ Living shorelines and vegetated buffers.
- ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by *ConserveVirginia* Floodplain and Flooding Resilience layer or a similar data driven analytic tool, or the acquisition of developed land for future conservation.
- ☐ Dam removal.
- ☐ Stream bank restoration or stabilization.
- ☐ Restoration of floodplains to natural and beneficial function.

Other Projects

- ☐ Structural floodwalls, levees, berms, flood gates, structural conveyances.
- ☒ Storm water system upgrades.
- ☐ Medium and large-scale Low Impact Development (LID) in urban areas.

- ☐ Developing flood warning and response systems, which may include gauge installation, to notify residents of potential emergency flooding events.
- ☐ Dam restoration.
- ☐ Beneficial reuse of dredge materials for flood mitigation purposes
- ☐ Removal or relocation of structures from flood-prone areas where the land will not be returned to open space.
- ☒ Acquisition of property (or interests therein) and/or structures for purposes of allowing floodwater inundation, strategic retreat of existing land uses from areas vulnerable to flooding; the conservation or enhancement of natural flood resilience resources; or acquisition of structures, provided the acquired property will be protected in perpetuity from further development, and where the flood mitigation benefits will **not be** achieved as a part of the same project as the property acquisition.
- ☐ Other project identified in a DCR-approved Resilience Plan.

Location of Project or Activity (Include Maps): See Included Map: Appendix C: Checklist All Categories - Detailed Map of Project Area

NFIP Community Identification Number (CID#) : _____

Is Project Located in an NFIP Participating Community? ☒ Yes ☐ No

Is Project Located in a Special Flood Hazard Area? ☐ Yes ☐ No

Flood Zone(s) (If Applicable): _____

Flood Insurance Rate Map Number(s) (If Applicable): _____

Total Cost of Project: $4,097,246.00

Total Amount Requested $3,892,384.00

Amount Requested as Grant $3,892,384.00

Amount Requested as Project Loan (not including short-term loans for up-front costs) $0.00

Amount Requested as Short-Term loan for Up-Front Costs (not to exceed 20% of amount requested as Grant) $0.00

For projects, planning, capacity building, and studies in low-income geographic areas: Are you requesting that match be waived? □ Yes ☒ No

Additional Information for Loan Requests

Requested Loan Security: _____

(General Obligation, Lease, Revenue, Special Fund Revenue, and/or Moral obligation from other government entity)

Desired loan term: _____

Since the date of your latest financial statements, did the applicant issue any new debt? _____
(If yes, provide details)

Is there any pending or potential litigation by or against the applicant? _____

Attach five years of current audited financial statements (FY18-22) or refer to website if posted
(Not necessary for existing VRA borrowers)

Attach FY2024 adopted budget or refer to website

Attach current Capital Improvement Plan

Attach adopted Financial Policies

Attach a list of the ten largest employers in the Applicant's jurisdiction.

Attach a list of the ten largest taxpayers in the Applicant's jurisdiction

Appendix B: Budget Narrative Template

Applicant Name:
Community Flood Preparedness Fund &
Resilient Virginia Revolving Loan Fund
Detailed Budget Narrative
Period of Performance: January 2024 through July 2026
Submission Date: November 21 2023

Grand Total State Funding Request	$ 3,892,384
Grand Total Local Share of Project	$ 204,862
Federal Funding (if applicable)	$
Project Grand Total	$ 4,097,246
Locality Cost Match	% 5

Breakout By Cost Type	Personnel	Fringe	Travel	Equipment	Supplies	Contracts	Indirect Costs	Other Costs	Total
Federal Share (if applicable)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Local Share	$0.00	$0.00	$0.00	$0.00	$0.00	$204,095	$0.00	$2,770	$206,865
State Share	$0.00	$0.00	$0.00	$0.00	$0.00	$3,877,811	$0.00	$0.00	$3,877,811
Pre-Award/Startup	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$250.00	$250.00
Maintenance	$0.00	$0.00	$0.00	$5,000	$5,000	$0.00	$0.00	$2,320	$12,320
Total	$ 0.00	$ 0.00	$ 0.00	$ 5,000	$ 5,000	$4,081,906	$ 0.00	$5,340	$ 4,097,246

Appendix C: Checklist All Categories

(Benefit-cost analysis must be included if the proposed Project is over $2 million.)

Virginia Department of Conservation and Recreation

Community Flood Preparedness Fund Grant Program

☒ Detailed map of the project area(s) (Projects/Studies)
- See included map of project area
- See included conceptual plans containing project area

☒ FIRMette of the project area(s) (Projects/Studies)
- See included FIRMette of the project area

☒ Historic flood damage data and/or images (Projects/Studies)
- See included images of historic flood damage

☒ A link to or a copy of the current floodplain ordinance

https://library.municode.com/VA/Christiansburg/CODES/Code_of_Ordinances?nodeId=SPBLADERE_CH42ZO_ARTXVFLDIFP_S42-440OFFLDIZOMA

☒ Non-Fund financed maintenance and management plan for project extending a minimum of 10 years from project close
- See included non-Fund financed maintenance and management plan for the project

☒ A link to or a copy of the current comprehensive plan

https://www.christiansburg.org/DocumentCenter/View/6316

☒ Social vulnerability index score(s) for the project area from VFRIS SVI Layer
- See included social vulnerability index scores

☐ If applicant is not a town, city, or county, letters of support from affected localities

☐ Letter of support from impacted stakeholders

☒ Budget Narrative
- See included budget narrative

☒ Supporting Documentation, including the Benefit-Cost Analysis tool/narrative (for projects over $2 million)
- See included FEMA Benefit-Cost Analysis tool output for this project

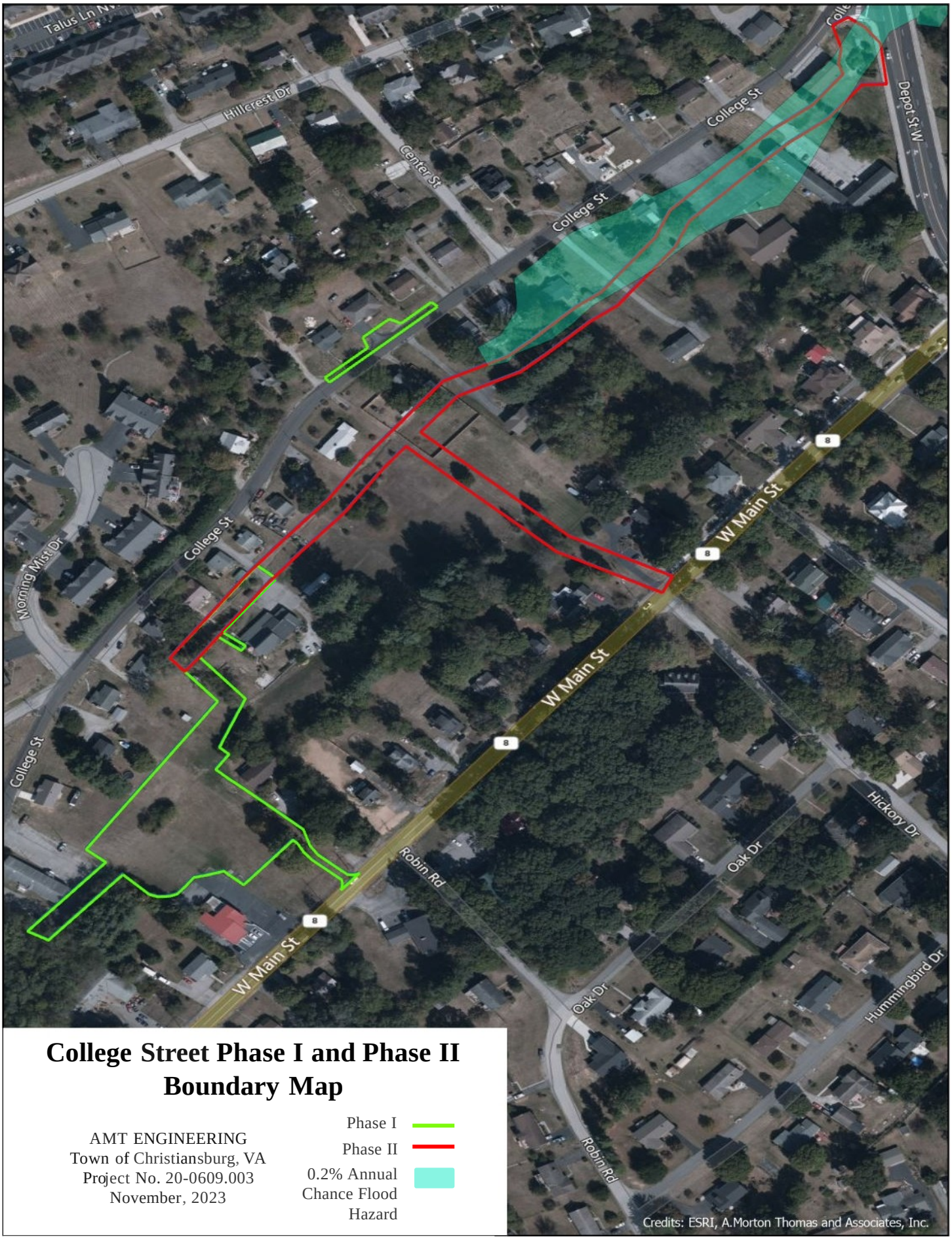
☒ Authorization to request funding from the Fund from governing body or chief executive of the local government
- See included authorization to request funding from the Fund from governing body or chief executive of the local government
- See included authorization to request funding from the Fund from governing body or chief executive of the local government - Approval of the Town of Christiansburg Flood Resilience Plan

☐ Signed pledge agreement from each contributing organization

☒ Detailed budget and narrative for all costs

- See included detailed budget and narrative for all cost

Appendix C: Checklist All Categories - Detailed Map of Project Area



College Street Phase I and Phase II Boundary Map

AMT ENGINEERING
Town of Christiansburg, VA
Project No. 20-0609.003
November, 2023

Phase I
Phase II
0.2% Annual Chance Flood Hazard

Christiansburg Middle School
Melody Dr
Wingsong Ln
Underwood St
Queensberry St
Power St
Clearview Dr
James St
Brackens St
Sullivan St
New St
Depot St. NW
EX. BMP WINDSONG HEIGHTS
Hillcrest Dr
Lee Hwy Ct
Radford St
Taylor St
Shelman St
EX. BMP MIDDLE COURT TOWNHOMES
NEW BMP FOR FUTURE DEVELOPMENT
EX. BMP CHRISTIANSBURG MIDDLE SCHOOL
EX. BMP KYLE MANOR
Buffalo Dr
Morning Mist Dr
Center St
FLOW MONITOR LOCATION 4
EX. BMP GOOD SAMARITAN HOSPICE
Moose Dr
College St
FLOW MONITOR LOCATION 3
EX. BMP DEPOT STREET
Eans Cir
Dunkley St
Hickok St
EX. BMP MUD PIKE STORAGE
FLOW MONITOR LOCATION 2
FLOW MONITOR LOCATION 1
EX. BMP COLLEGE STREET APARTMENTS
Mud Pike
W Main St
EX. BMP MUD PIKE AT MOOSE DR
FUTURE DEVELOPMENT PROJECT
South Hill Dr
Auburn Dr
Robin Rd
Hickory Dr
Grove Ln
Cherry Ln
Highview St
Oak Dr
1st ST SW
Angle Dr
Longview Dr
Chrisman St
Phlegar St
1st St
Floyd St
Hummingbird Dr
2nd St
Mitchell St
Cooper Ln
3rd St
LOWER WATERSHED (80± ACRES)
Cardinal Dr
EX. BMP SOUTH HILL PARK
Mountainway Dr
UPPER WATERSHED (198± ACRES)
Roseland Dr
4th St
Carson Dr
Roundhill Dr
I-81
Atkinson Rd

LEGEND

- PROPERTY LINE
- EXISTING EDGE OF PAVEMENT
- EXISTING SANITARY SEWER
- EXISTING WATER LINE
- EXISTING STORM SEWER
- EXISTING CREEK LINE
- EXISTING CATCH BASIN
- EXISTING FIRE HYDRANT
- EXISTING WATER VALVE
- EXISTING SANITARY MANHOLE
- EXISTING BMP
- DRAINAGE AREA BOUNDARY
- 25 YEAR FLOODPLAIN BOUNDARY
- 25 YEAR FLOOD LIMITS (ESTIMATED)

0 200' 400'
SCALE: 1"=200'

Date	D. PAPA	L. LANGLOIS	D. RISSMEYER	–
	05/21	05/21	05/21	
	Designed	Drawn	Checked	Approved

COMMONWEALTH OF VIRGINIA
DONALD J. RISSMEYER
No. 26104
PROFESSIONAL ENGINEER
NOT FOR CONSTRUCTION

Town of Christiansburg – College Street
Existing Conditions
Conceptual Design Plans
Town of Christiansburg, VA

A. MORTON THOMAS AND ASSOCIATES, INC.
CONSULTING ENGINEERS

AMT Project No.
20-0609.001

Drawing Name
C1-1

Sheet 1 of 5

X:\RICHMOND\20-0609.001 - TOWN OF CHRISTIANSBURG COLLEGE STREET\05-CAD\20609.001-EXIST.DWG, 4/22/2021 10:05 AM, DPAPA

OPTIMIZE EXISTING BMP IN PHASE 3

OPTIMIZE EXISTING BMP

CLEAN AND REPAIR EXISTING STORM DRAIN SYSTEM (1,090± L.F.)

EXISTING BMP TO REMAIN

OPTIMIZE EXISTING BMP IN PHASE 3

EXISTING BMP TO REMAIN

Q25 FLOOD LIMITS

CLEAN AND REPAIR EXISTING CMP NEAR THE MASONIC LODGE (380± L.F.)

EXISTING BMP TO REMAIN

BMPS TO BE OPTIMIZED

Christiansburg Middle School

Melody Dr

Wingsong Ln

Underwood St

Quesenberry St

Clearview Dr

Radford St

Hillcrest Dr

Lee Hwy Ct

Center St

Buffalo Dr

Morning Mist Dr

Moose Dr

College St

Depot St NW

W Main St

Mud Pike Dr

South Hill Dr

Auburn Dr

Robin Rd

Hickory Dr

Grove Ln

Cherry Ln

Oak Dr

LEGEND

- PROPERTY LINE
- EXISTING EDGE OF PAVEMENT
- EXISTING SANITARY SEWER
- EXISTING WATER LINE
- EXISTING STORM SEWER
- EXISTING CREEK LINE
- EXISTING CATCH BASIN
- EXISTING FIRE HYDRANT
- EXISTING WATER VALVE
- EXISTING SANITARY MANHOLE
- EXISTING BMP
- PROPOSED STORM SEWER

0 62.5' 125'
SCALE: 1"=125'

	D. PAPA	L. LANGLOIS	D. RISSMEYER	–
Designed				
Drawn				
Checked				
Approved				
Date	05/21	05/21	05/21	

COMMONWEALTH OF VIRGINIA
DONALD J. RISSMEYER
No. 26104
PROFESSIONAL ENGINEER

Town of Christiansburg – College Street
Alternative 1
Conceptual Design Plans
Town of Christiansburg, VA

A. MORTON THOMAS AND ASSOCIATES, INC.
CONSULTING ENGINEERS

AMT Project No.
20-0609.001

Drawing Name
C1-2

Sheet 2 of 5

X:\RICHMOND\20-0609.001 - TOWN OF CHRISTIANSBURG COLLEGE STREET\05-CAD\20609.001-ALT-1.DWG, 4/22/2021 2:50 PM, DPAPA

Christiansburg Middle School
Melody Dr
Wingsong Ln
Underwood St
Quesenberry St
Clearview Dr
Radford St
Hillcrest Dr
Lee Hwy Ct
Buffalo Dr
Morning Mist Dr
Center St
Moose Dr
College St
Depot St NW
W Main St
Mud Pike Dr
South Hill Dr
Auburn Dr
Robin Rd
Hickory Dr
Grove Ln
Cherry Ln
Oak Dr
DI-2
DI-3
DI-4
DI-5
DI-7
DI-7 RISER
704 L.F. 24" HDPE
308 L.F. 30" HDPE
172 L.F. 30" HDPE
339 L.F. 24" HDPE
RELOCATE SHED
HEADWALL
HEADWALL
PROPOSED BMP FOR STORMWATER DETENTION
EXIST. DI

LEGEND

- PROPERTY LINE
- EXISTING EDGE OF PAVEMENT
- EXISTING SANITARY SEWER
- EXISTING WATER LINE
- EXISTING STORM SEWER
- EXISTING CREEK LINE
- EXISTING CATCH BASIN
- EXISTING FIRE HYDRANT
- EXISTING WATER VALVE
- EXISTING SANITARY MANHOLE
- EXISTING BMP
- PROPOSED STORM SEWER
- PROPOSED DI-7
- PROPOSED STORM SEWER ALIGNMENT

0 62.5' 125'
SCALE: 1"=125'

Date	Designed	Drawn	Checked	Approved
05/21	D. PAPA	L. LANGLOIS	D. RISSMEYER	–

COMMONWEALTH OF VIRGINIA
DONALD J. RISSMEYER
No. 26104
PROFESSIONAL ENGINEER
NOT FOR CONSTRUCTION

Town of Christiansburg – College Street
Alternative 2A
Conceptual Design Plans
Town of Christiansburg, VA

A. Morton Thomas and Associates, Inc.
Consulting Engineers

AMT Project No.
20-0609.001

Drawing Name
C1-3

Sheet 3 of 5

X:\RICHMOND\20-0609.001 - TOWN OF CHRISTIANSBURG COLLEGE STREET\05-CAD\20609.001-ALT-2.DWG, 4/22/2021 3:09 PM, DPAPA

Christiansburg Middle School
Melody Dr
Wingsong Ln
Underwood St
Quesenberry St
Clearview Dr
Radford St
Hillcrest Dr
Lee Hwy Ct
Center St
Buffalo Dr
Morning Mist Dr
Moose Dr
College St
Depot St NW
W Main St
Mud Pike Dr
South Hill Dr
Auburn Dr
Robin Rd
Hickory Dr
Grove Ln
Cherry Ln
Oak Dr

DI-1
DI-2
DI-3
DI-4
DI-7

654 L.F. 36" HDPE
267 L.F. 36" RCP
308 L.F. 36" HDPE
172 L.F. 36" HDPE
358 L.F. DUAL 30" HDPE
339 L.F. 24" HDPE
RELOCATE SHED

LEGEND

- PROPERTY LINE
- EXISTING EDGE OF PAVEMENT
- EXISTING SANITARY SEWER
- EXISTING WATER LINE
- EXISTING STORM SEWER
- EXISTING CREEK LINE
- EXISTING CATCH BASIN
- EXISTING FIRE HYDRANT
- EXISTING WATER VALVE
- EXISTING SANITARY MANHOLE
- EXISTING BMP
- PROPOSED STORM SEWER
- PROPOSED DI-7
- PROPOSED STORM SEWER ALIGNMENT

0 62.5' 125'
SCALE: 1"=125'

Date	Designed	Drawn	Checked	Approved
05/21	D. PAPA	L. LANGLOIS	D. RISSMEYER	–

COMMONWEALTH OF VIRGINIA
DONALD J. RISSMEYER
No. 26104
PROFESSIONAL ENGINEER

Town of Christiansburg – College Street
Alternative 2B
Conceptual Design Plans
Town of Christiansburg, VA

A. Morton Thomas and Associates, Inc.
Consulting Engineers

AMT Project No.
20-0609.001

Drawing Name
C1-4

Sheet 4 of 5

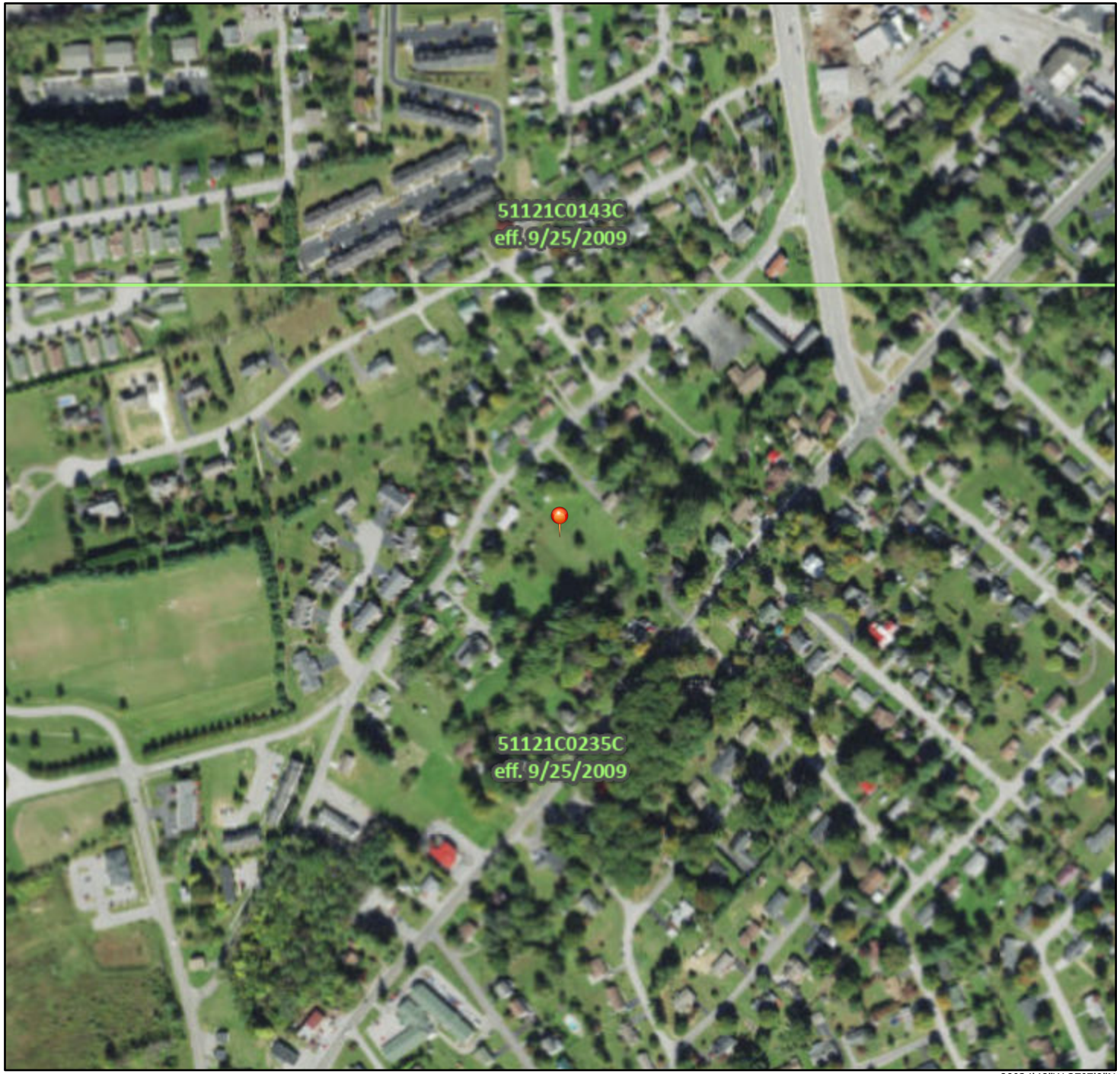
X:\RICHMOND\20-0609.001 - TOWN OF CHRISTIANSBURG COLLEGE STREET\05-CAD\20609.001-ALT-3NEW.DWG, 4/22/2021 2:05 PM, DPAPA

EXPAND EXISTING BMP TO PROVIDE MORE DETENTION
RAIN GARDEN TO ELIMINATE PONDING
ADD 2' BERM TO PROVIDE MORE DETENTION AND PROTECT COLLEGE ST
192 L.F. 27"x43" ELIP
277 L.F. 48" HDPE
187 L.F. 48" HDPE
383 L.F. 48" HDPE
College St
W Main St
Christiansburg Middle School
LEGEND
PROPERTY LINE
EXISTING EDGE OF PAVEMENT
EXISTING SANITARY SEWER
EXISTING WATER LINE
EXISTING STORM SEWER
EXISTING CREEK LINE
EXISTING CATCH BASIN
EXISTING FIRE HYDRANT
EXISTING WATER VALVE
EXISTING SANITARY MANHOLE
EXISTING BMP
PROPOSED STORM SEWER
SCALE: 1"=200'
Designed D. PAPA 05/21
Drawn L. LANGLOIS 05/21
Checked D. RISSMEYER 05/21
Approved –
DONALD J. RISSMEYER Lic. No. 26104 PROFESSIONAL ENGINEER
Town of Christiansburg – College Street
Alternative 3
Conceptual Design Plans
Town of Christiansburg, VA
A. MORTON THOMAS AND ASSOCIATES, INC. CONSULTING ENGINEERS
AMT Project No. 20–0609.001
Drawing Name C1–5
Sheet 5 of 5
X:\RICHMOND\20-0609.001 - TOWN OF CHRISTIANSBURG COLLEGE STREET\05-CAD\200609.001-ALT-4.DWG, 4/22/2021 11:00 AM, DPAPA

National Flood Hazard Layer FIRMette

FEMA

80°25'25"W 37°7'38"N



80°24'48"W 37°7'9"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/8/2023 at 9:19 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

May 2020 College St. Flooding

Appendix C: Checklist All Categories - Non-Fund financed maintenance and management plan for project extending a minimum of 10 years from project close

Maintenance and Management Plan

College Street Drainage Project Phase I and II

Town of Christiansburg

The College Street Drainage Project Phase I and Phase II project will create a new pond and landscaping that will be the responsibility of the Town's Department of Public Works to maintain. The Town has an existing maintenance program (linked here) for its facilities and assets and this site will be added to the inventory. The area will require minimal maintenance other than periodic mowing of the BMP to remove unwanted vegetation. Inspections of the BMP including trees and vegetation will be performed by Public Works to ensure continued functionality. Periodic trash and debris removal will also be required.

Appendix C: Checklist All Categories - Social Vulnerability Index Score(s) For The Project Area

College Street Drainage Project - Phase I

Project Eligible for Consideration		
Scoring Information		
Criterion	**Point Value**	**Points Awarded**
Projects may have components of both a. and b. below; however, only one category may be chosen. The category chosen must be identified as the primary project in the application.		
a. Acquisition of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures (and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition).	30	
☐ Wetland restoration. ☐ Floodplain restoration. ☐ Construction of swales and settling ponds. ☐ Living shorelines and vegetated buffers. ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by ConserveVirginia Floodplain and Flooding Resilience layer or a similar data driven analytic tool. ☐ Dam removal ☐ Stream bank restoration or stabilization. ☐ Restoration of floodplains to natural and beneficial function.	25	**25**
b. any other nature-based approach	20	**5**
Is the project area socially vulnerable? (Based on ADAPT VA's Social Vulnerability Index Score.)		
Very High Social Vulnerability (More than 1.5)	10	
High Social Vulnerability (1.0 to 1.5)	8	
Moderate Social Vulnerability (0.0 to 1.0)	5	
Low Social Vulnerability (-1.0 to 0.0)	0	**0**
Low Social Vulnerability (-1.0 to 0.0)	0	
Is the proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?		
Yes	5	
No	0	**0**
Is the proposed project in a low-income geographic area as defined in the DCR manual?		
Yes	10	**10**
No	0	
Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?		
Yes	5	
No	0	**0**
Does this project provide "community scale" benefits?		
Yes	30	**30**
No	0	
Total Points		**70**

Appendix C: Checklist All Categories - Social Vulnerability Index Score(s) For The Project Area

College Street Drainage Project - Phase II

Project Eligible for Consideration		
Scoring Information		
Criterion	**Point Value**	**Points Awarded**
Projects may have components of both a. and b. below; however, only one category may be chosen. The category chosen must be identified as the primary project in the application.		
a. Acquisition of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures (and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition).	30	
☐ Wetland restoration. ☐ Floodplain restoration. ☐ Construction of swales and settling ponds. ☐ Living shorelines and vegetated buffers. ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by ConserveVirginia Floodplain and Flooding Resilience layer or a similar data driven analytic tool. ☐ Dam removal ☐ Stream bank restoration or stabilization. ☐ Restoration of floodplains to natural and beneficial function.	25	**25**
b. any other nature-based approach	20	**5**
Is the project area socially vulnerable? (Based on ADAPT VA's Social Vulnerability Index Score.)		
Very High Social Vulnerability (More than 1.5)	10	
High Social Vulnerability (1.0 to 1.5)	8	
Moderate Social Vulnerability (0.0 to 1.0)	5	
Low Social Vulnerability (-1.0 to 0.0)	0	**0**
Low Social Vulnerability (-1.0 to 0.0)	0	
Is the proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?		
Yes	5	
No	0	**0**
Is the proposed project in a low-income geographic area as defined in the DCR manual?		
Yes	10	**10**
No	0	
Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?		
Yes	5	
No	0	**0**
Does this project provide "community scale" benefits?		
Yes	30	**30**
No	0	
Total Points		**70**

Budget Narrative

College Street Drainage Project Phase I and II

Town of Christiansburg

The College Street Drainage Project Phase I and Phase II engineering and construction cost estimate is $4,081,906. The Phase I estimate is provided below and is at 90% design. The Phase II estimate is also provided below and is at 60% design at the writing of this grant application. The Town of Christiansburg will manage and administer this project, which will require Town staff time for project management and inspection during project mobilization and construction. Additionally, post-construction maintenance as detailed in the maintenance plan will require Public Works time for inspection and performance of maintenance as needed. Implementation of the maintenance plan will also require equipment to perform periodic mowing and removal of any accumulated trash or debris in the completed project area. The total project estimate incorporating these costs is $4,097,246.

COLLEGE STREET DRAINAGE IMPROVEMENTS - PHASE I

October 2023 - 90% COST ESTIMATE

ITEM NO.	DESCRIPTION	UNIT PRICE	QUANTITY	UNIT	COST
	ENGINEERING COSTS				
1	AMT Surveying & Engineering Design	$230,380.00	0.6	LS	$138,228.00
2	AMT Property Acquisition Assistance	$70,495.00	1	LS	$70,495.00
	ENGINEERING COSTS SUBTOTAL				**$208,723.00**
	GENERAL CONDITIONS				
3	Mobilization and Temporary Facilities	$140,000.00	0.5	LS	$70,000.00
4	Bonds, Taxes, Permits, and Insurance	$50,000.00	0.5	LS	$25,000.00
5	As-Builts/Survey Stakeout	$30,000.00	0.5	LS	$15,000.00
6	Traffic Control Measures	$50,000.00	0.5	LS	$25,000.00
	GENERAL CONDITIONS SUBTOTAL				**$135,000.00**
	SITE PREPARATION & EROSION AND SEDIMENT CONTROL				
7	Erosion and Sediment Control Measures	$125,285.65	1	LS	$125,285.65
8	Site Clearing & Grubbing	$75,000.00	0.5	LS	$37,500.00
	SITE PREPARATION & EROSION AND SEDIMENT CONTROL SUBTOTAL				**$162,785.65**
	PHASE I				
9	30" Diameter - HDPE	$170.70	420	LF	$71,694.00
10	30" Diameter - RCP	$250.00	170	LF	$42,500.00
11	4 ft Square Conc. Manhole Structures	$8,000.00	8	ea	$64,000.00
12	6 ft Square Conc. Manhole Structures	$14,000.00	1	ea	$14,000.00
13	VDOT SWM-DR Trash Rack for 4 ft Square	$5,000.00	1	ea	$5,000.00
14	30" HDPE Flared End Section	$1,500.00	3	ea	$4,500.00
15	30" Concrete Flared End Section	$2,500.00	1	ea	$2,500.00
16	Drop Inlet Structures DI-7	$6,942.06	1	ea	$6,942.06
17	Drop Inlet Structures DI-5	$5,983.82	6	ea	$35,902.92
18	Standard flat manhole top with frame and cover	$4,000.00	1	ea	$4,000.00
19	Flexamat-Plus Erosion Control Mat	$50.00	220	SY	$11,000.00
20	VDOT Class I Riprap	$201.26	0	tons	$0.00
21	Concrete Retaining Wall	$200,436.00	1	LS	$200,436.00
22	48" Picket Fence (Brushed Bronze)	$120.00	800	LF	$96,000.00
23	Basin Excavation/Waste	$67.74	7400	CY	$501,276.00
24	24"x35" Elliptical Concrete Pipe	$200.00	192	LF	$38,400.00
25	24" Diameter - HDPE	$121.51	22	LF	$2,673.22
26	Trench Excavation/Backfill or Waste	$67.74	822	CY	$55,682.28
	PHASE I				**$1,156,506.48**
	SITE & UTILITY RESTORATION WORK				
27	Asphalt Pavement Replacements	$150.00	110	SY	$16,500.00
28	Existing Structure Relocation/Removals	$15,000.00		LS	$0.00
29	Dry Utilities Relocation	$5,000.00	1	LS	$5,000.00
30	Wet Utilities Relocation (SS)	$5,000.00	1	LS	$5,000.00
31	8" Diameter - PVC (SS)	$80.00	260	LF	$20,800.00
32	6" Diameter - PVC (SS)	$60.00	130	LF	$7,800.00
33	6" Diameter - PVC Cleanout (SS)	$1,000.00	1	LS	$1,000.00
34	4 ft Diameter Conc. Manhole Structures (SS)	$8,000.00	3	ea	$24,000.00
35	Topsoil and Permanent Stabilization	$15,000.00	0.75	LS	$11,250.00
36	Residence Pump Station for 962 College St	$5,000.00	1	LS	$5,000.00
	SITE & UTILITY RESTORATION SUBTOTAL				**$96,350.00**
	SUBTOTAL CONSTRUCTION COST				**$1,759,365.13**
	Construction Engineering & Inspection	8%	1	LS	$140,749.21
	Construction Contingency	15%	1	LS	$263,905.00
	CONSTRUCTION COST				**$2,164,019.34**
	Land Acquisition Budget (3 Parcels)	$100,000			$100,000.00
	TOTAL PROJECT COST				**$2,264,019.34**

Appendix C: Checklist All Categories - Budget Narrative

COLLEGE STREET DRAINAGE IMPROVEMENTS - PAHASE II

May 2023 - 60% COST ESTIMATE

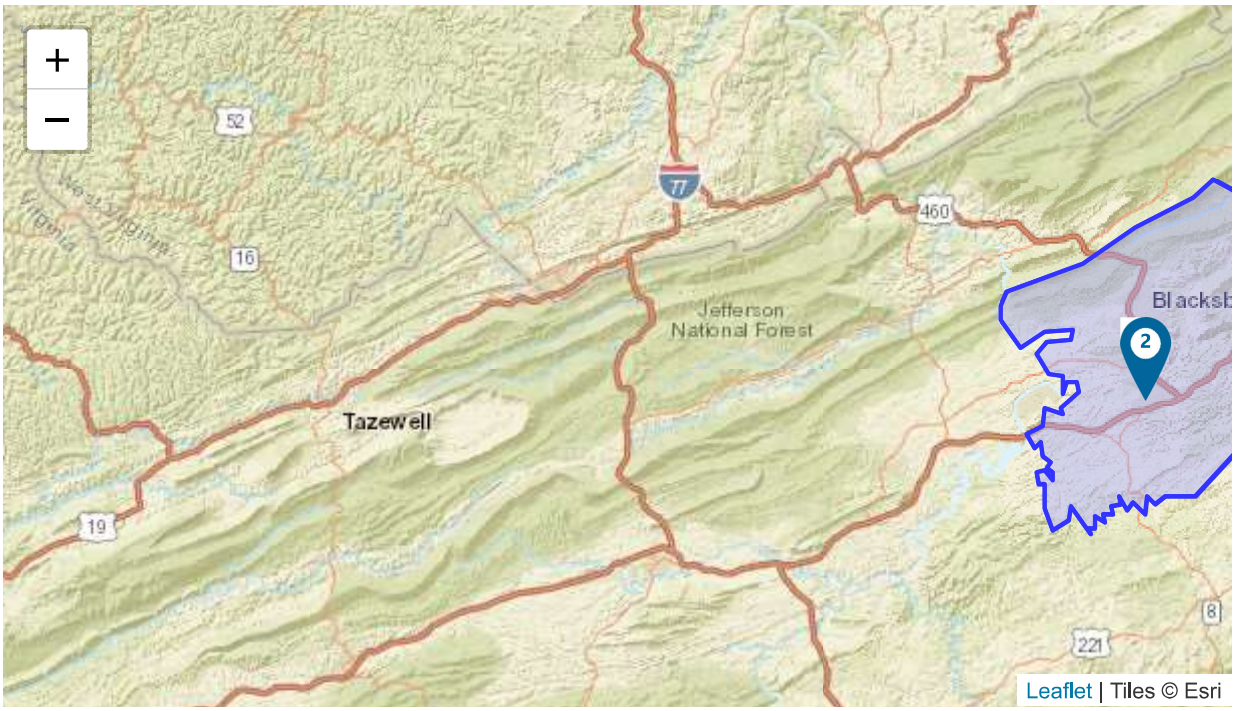
ITEM NO.	DESCRIPTION	UNIT PRICE	QUANTITY	UNIT	COST
	ENGINEERING COSTS				
1	AMT Surveying & Engineering Design	$230,380.00	0.6	LS	$138,228.00
2	AMT Property Acquisition Assistance	$70,495.00	0.7	LS	$49,346.50
	ENGINEERING COSTS SUBTOTAL				**$187,574.50**
	GENERAL CONDITIONS				
3	Mobilization and Temporary Facilities	$140,000.00	0.5	LS	$70,000.00
4	Bonds, Taxes, Permits, and Insurance	$50,000.00	0.5	LS	$25,000.00
5	As-Builts/Survey Stakeout	$30,000.00	0.5	LS	$15,000.00
6	Traffic Control Measures	$50,000.00	0.5	LS	$25,000.00
	GENERAL CONDITIONS SUBTOTAL				**$135,000.00**
	SITE PREPARATION & EROSION AND SEDIMENT CONTROL				
7	Erosion and Sediment Control Measures	$96,377.14	1	LS	$96,377.14
8	Site Clearing & Grubbing	$75,000.00	0.5	LS	$37,500.00
	SITE PREPARATION & EROSION AND SEDIMENT CONTROL SUBTOTAL				**$133,877.14**
	STORMWATER POND AND PERIPHERALS				
9	30" Diameter - HDPE	$170.70		LF	$0.00
10	4 ft Diameter Conc. Manhole Structures	$8,000.00		ea	$0.00
11	Drop Inlet Structures DI-7	$6,942.06		ea	$0.00
12	Class 1 Riprap - Outlet Protection	$201.26		tons	$0.00
13	Concrete Retaining Wall	$1,000.00		LF	$0.00
14	48" Picket Fence (Brushed Bronze)	$120.00		LF	$0.00
15	Basin Excavation/Waste	$67.74		CY	$0.00
16	Trench Excavation/Backfill or Waste	$67.74		CY	$0.00
	STORMWATER POND AND PERIPHERALS SUBTOTAL				**$0.00**
	STORMWATER SYSTEM BELOW THE POND				
17	24" Diameter - HDPE	$121.51	23	LF	$2,794.73
18	30" Diameter - HDPE	$170.70	788	LF	$134,511.60
19	36" Diameter - HDPE	$214.67	344	LF	$73,846.48
20	42" Diameter - HDPE	$370.41	102	LF	$37,781.82
21	48" Diameter - HDPE	$352.34	737	LF	$259,674.58
22	27"x43" Elliptical Concrete Pipe	$235.81		LF	$0.00
23	34"x53" Elliptical Concrete Pipe	$453.71	105	LF	$47,639.55
24	Drop Inlet Structures DI-5	$5,983.82		ea	$0.00
25	Drop Inlet Structures DI-7	$6,942.06	18	ea	$124,957.08
26	Curb Inlet Structures DI-2A, 2D	$3,000.00	2	ea	$6,000.00
27	Concrete Headwalls	$5,000.00	2	ea	$10,000.00
28	Miscellaneous Concrete Slabs	$600.00	15	CY	$9,000.00
29	Trench Excavation/Backfill or Waste	$67.74	2720.9259	CY	$184,315.52
	STORMWATER SYSTEM BELOW THE POND SUBTOTAL				**$890,521.36**
	SITE & UTILITY RESTORATION WORK				
30	Asphalt Pavement Replacements	$150.00	330	SY	$49,500.00
31	Existing Structure Relocation/Removals	$15,000.00	1	LS	$15,000.00
32	Dry Utilities Relocation	$5,000.00	1	LS	$5,000.00
33	Wet Utilities Relocation	$5,000.00		LS	$0.00
34	8" Diameter - PVC	$80.00		LF	$0.00
35	4 ft Diameter Conc. Manhole Structures	$8,000.00		ea	$0.00
36	Topsoil and Permanent Stabilization	$15,000.00	0.25	LS	$3,750.00
	SITE & UTILITY RESTORATION SUBTOTAL				**$73,250.00**
	SUBTOTAL CONSTRUCTION COST				**$1,420,223.00**
	Construction Engineering & Inspection	8%	1	LS	$113,617.84
	Construction Contingency	20%	1	LS	$284,045.00
	CONSTRUCTION COST				**$1,817,885.84**
	Land Acquisition Budget (3 Parcels)	$100,000			$0.00
	TOTAL PROJECT COST				**$1,817,885.84**

FEMA Benefit-Cost Calculator

V.6.0 (Build 20231011.1703 | Release Notes)

Benefit-Cost Analysis

Project Name: College Street Drainage Phase I and II



				Using 7% Discount Rate			Using 3% Discount Rate (For BRIC and FMA only)		
Map Marker ▲	Mitigation Title	Property Type	Hazard	Benefits (B)	Costs (C)	BCR (B/C)	Benefits (B)	Costs (C)	BCR (B/C)
1	Bioretention @ 37.1278550; -80.4133500		DFA - Riverine Flood	$ 258,953	$ 0	0.00	$ 429,744	$ 0	0.00
2	Bioretention @ College St, Christiansburg, Virginia, 24073		DFA - Riverine Flood	$ 4,315,886	$ 4,000,000	1.08	$ 7,162,400	$ 4,000,000	1.79
TOTAL (SELECTED)				**$ 4,574,839**	**$ 4,000,000**	**1.14**	**$ 7,592,144**	**$ 4,000,000**	**1.90**
TOTAL				**$ 4,574,839**	**$ 4,000,000**	**1.14**	**$ 7,592,144**	**$ 4,000,000**	**1.90**

Appendix C: Checklist All Categories - Supporting Documentation, including the Benefit-Cost Analysis tool/narrative (for projects over $2 million)

Property Configuration

Property Title:	Bioretention @ 37.1278550; -80.4133500
Property Location:	24073, Montgomery, Virginia
Property Coordinates:	37.127854985710165, -80.41334999744471
Hazard Type:	Riverine Flood
Mitigation Action Type:	Bioretention
Property Type:	Green Infrastructure
Analysis Method Type:	Professional Expected Damages

Cost Estimation

Bioretention @ 37.1278550; -80.4133500

Project Useful Life (years):	35
Project Cost:	$0
Number of Maintenance Years:	35 Use Default:Yes
Annual Maintenance Cost:	$0

Damage Analysis Parameters - Damage Frequency Assessment

Bioretention @ 37.1278550; -80.4133500

Year of Analysis was Conducted:	2023
Year Property was Built:	1970
Analysis Duration:	54 Use Default:Yes

Professional Expected Damages Before Mitigation

Bioretention @ 37.1278550; -80.4133500

	OTHER	OPTIONAL DAMAGES			VOLUNTEER COSTS		TOTAL
Recurrence Interval (years)	Damages ($)	Category 1 ($)	Category 2 ($)	Category 3 ($)	Number of Volunteers	Number of Days	Damages ($)
5	100,000	0	0	0	0	0	100,000

Annualized Damages Before Mitigation

Bioretention @ 37.1278550; -80.4133500

Annualized Recurrence Interval (years)	Damages and Losses ($)	Annualized Damages and Losses ($)
5	100,000	20,000
	Sum Damages and Losses ($)	Sum Annualized Damages and Losses ($)
	100,000	20,000

Professional Expected Damages After Mitigation

Bioretention @ 37.1278550; -80.4133500

	OTHER	OPTIONAL DAMAGES			VOLUNTEER COSTS		TOTAL
Recurrence Interval (years)	Damages ($)	Category 1 ($)	Category 2 ($)	Category 3 ($)	Number of Volunteers	Number of Days	Damages ($)
100	0	0	0	0	0	0	0

Annualized Damages After Mitigation

Bioretention @ 37.1278550; -80.4133500

Annualized Recurrence Interval (years)	Damages and Losses ($)	Annualized Damages and Losses ($)
100	0	0
	Sum Damages and Losses ($)	Sum Annualized Damages and Losses ($)
	0	0

Benefits-Costs Summary

Bioretention @ 37.1278550; -80.4133500

Total Standard Mitigation Benefits:	$258,953
Total Social Benefits:	$0
Total Mitigation Project Benefits:	$258,953
Total Mitigation Project Cost:	$0
Benefit Cost Ratio - Standard:	0
Benefit Cost Ratio - Standard + Social:	0

Appendix C: Checklist All Categories - Supporting Documentation, including the Benefit-Cost Analysis tool/narrative (for projects over $2 million)

Property Configuration

Property Title:	Bioretention @ College St, Christiansburg, Virginia, 24073
Property Location:	24073, Montgomery, Virginia
Property Coordinates:	37.127854985710165, -80.41334999744471
Hazard Type:	Riverine Flood
Mitigation Action Type:	Bioretention
Property Type:	Green Infrastructure
Analysis Method Type:	Professional Expected Damages

Cost Estimation

Bioretention @ College St, Christiansburg, Virginia, 24073

Project Useful Life (years):	35
Project Cost:	$4,000,000
Number of Maintenance Years:	35 Use Default:Yes
Annual Maintenance Cost:	$0

Damage Analysis Parameters - Damage Frequency Assessment

Bioretention @ College St, Christiansburg, Virginia, 24073

Year of Analysis was Conducted:	2023
Year Property was Built:	0
Analysis Duration:	10 Use Default:Yes

Professional Expected Damages Before Mitigation

Bioretention @ College St, Christiansburg, Virginia, 24073

	OTHER	OPTIONAL DAMAGES			VOLUNTEER COSTS		TOTAL
Recurrence Interval (years)	Damages ($)	Category 1 ($)	Category 2 ($)	Category 3 ($)	Number of Volunteers	Number of Days	Damages ($)
3	1,000,000	0	0	0	0	0	1,000,000

Annualized Damages Before Mitigation

Bioretention @ College St, Christiansburg, Virginia, 24073

Annualized Recurrence Interval (years)	Damages and Losses ($)	Annualized Damages and Losses ($)
3	1,000,000	333,333
	Sum Damages and Losses ($)	Sum Annualized Damages and Losses ($)
	1,000,000	333,333

Professional Expected Damages After Mitigation

Bioretention @ College St, Christiansburg, Virginia, 24073

	OTHER	OPTIONAL DAMAGES			VOLUNTEER COSTS		TOTAL
Recurrence Interval (years)	Damages ($)	Category 1 ($)	Category 2 ($)	Category 3 ($)	Number of Volunteers	Number of Days	Damages ($)
100	0	0	0	0	0	0	0

Annualized Damages After Mitigation

Bioretention @ College St, Christiansburg, Virginia, 24073

Annualized Recurrence Interval (years)	Damages and Losses ($)	Annualized Damages and Losses ($)
100	0	0
	Sum Damages and Losses ($)	Sum Annualized Damages and Losses ($)
	0	0

Benefits-Costs Summary

Bioretention @ College St, Christiansburg, Virginia, 24073

Total Standard Mitigation Benefits:	$4,315,886
Total Social Benefits:	$0
Total Mitigation Project Benefits:	$4,315,886
Total Mitigation Project Cost:	$4,000,000
Benefit Cost Ratio - Standard:	1.08
Benefit Cost Ratio - Standard + Social:	1.08

THE PLACE TO BE.
CHRISTIANSBURG VA
Established November 10, 1792

100 East Main Street
Christiansburg, VA 24073
p: (540) 382-6128
f: (540) 382-7338

November 8, 2023

Mr. Daryl Glover
Deputy Agency Director of Dam Safety, Flood Preparedness, and Soil and Water Conservation
Department of Conservation and Recreation
60 East Main Street, 24th Floor
Richmond, Virginia 23219

RE: Town of Christiansburg Virginia Community Flood Preparedness Fund (CFPF) Grant Request

Dear Mr. Glover:

The Town of Christiansburg is pleased to submit this grant application for project funding from the CFPF fund. The Town is seeking funding for the College Street Drainage Project Phase I and Phase II project as presented in our Town adopted Flood Resilience Plan and in the College Street Drainage Study. The Town is committed to the match as proposed ($206,865). We appreciate your consideration of our complete application for CFPF funding.

Randy Wingfield
Town Manager

TOWN OF CHRISTIANSBURG
TOWN COUNCIL
AGENDA COVER SHEET

AGENDA LOCATION:
Discussion and Action by Mayor and Council

Meeting Date:
October 24, 2023

ITEM TITLE:
Discussion and Approval of the Town of Christiansburg Flood Resilience Plan

DESCRIPTION:
The Flood Resilience Plan for the Town of Christiansburg provides an overview of the flood resilience planning efforts undertaken by the Town of Christiansburg. The Flood Resilience Plan provides opportunities for improvement to current defenses and assesses the suitability of new projects and policies for the Town. The Plan examines historical flooding in the Town and reviews current and proposed strategies for flood prevention and resilience. Current and prospective projects were reviewed, scored, and placed in a ranking matrix. Communities may apply for grant funding for projects through the Virginia Community Flood Preparedness Fund (CFPF). An approved Resilience Plan is a prerequisite for submitting a funding application to the CFPF. Approval of this plan will enable the Town to tap into an additional source of funding for projects that will help to mitigate flooding in the Town.

POTENTIAL ACTION:
Request approval of the Town of Christiansburg Flood Resilience Plan

DEPARTMENT:
Administration

PRESENTER:
Town Manager Randy Wingfield

ITEM HISTORY:
The Virginia Community Flood Preparedness Fund (CFPF) was established in the Code of Virginia during the 2020 session of the General Assembly. In December 2021, the Town received a grant award in the amount of $44,520.30 from the CFPF for the development of a Resilience Plan. This grant award required a Town match of $4,946.70. On August 10, 2022, the Town entered into a contract with A. Morton Thomas and Associates, Inc. (AMT) to develop the Town of Christiansburg Flood Resilience Plan. Town Staff has work with AMT to develop this plan and the draft Flood Resilience Plan was presented to the Water and Waste Committee on August 21, 2023. The Water and Waste Committee has reviewed the Flood Resilience Plan as attached.

INFORMATION PROVIDED:

Flood Resilience Plan

AGENDA

REGULAR MEETING OF TOWN COUNCIL
CHRISTIANSBURG TOWN HALL
100 EAST MAIN STREET
OCTOBER 24, 2023 – 7:00 P.M.

(The meeting will be in-person and streamed on YouTube Live)

The meeting will be streamed live on the Town of Christiansburg's YouTube page at www.christiansburg.org/YouTube and will remain on the Town's YouTube page once the meeting concludes.

If you do not want or cannot attend the meeting in-person, there are several contactless methods for submitting public comment. To submit public comments, please visit www.christiansburg.org/publichearings. You may also leave a voicemail with your comments at 540-382-6128, ext. 1109; mail a letter to Town Hall, ATTN: Town Council, 100 E. Main Street, Christiansburg, VA 24073; use the drop box to the left of the front doors at Town Hall to leave a letter; or email info@christiansburg.org. Regardless of the method you use, please include your full name and address with your comments. Please provide comments prior to 6:00 p.m. on Tuesday, October 24, 2023, for the comments to be distributed to Town Council before the meeting.

REGULAR MEETING

I. CALL TO ORDER

A. Moment of Reflection

B. Pledge of Allegiance

II. ADJUSTMENT OF THE AGENDA

III. PUBLIC HEARINGS

A. FY 2023-24 Budget Amendment #1

B. An Exchange of Property request by the Town of Christiansburg that an approximately 0.2665-acre (11,609 square feet) southwest portion of a certain tract or parcel of land at 1025 W. Main Street (Tax Map 556 – ((A)) – 48A; Parcel ID 020000) situate, lying and being located along W. Main Street in the Town of Christiansburg, Virginia; with an equal Exchange of Property request by Jimmy Martin that the approximately 0.2665 acres (11,609 square feet) northeast portion of a certain tract or parcel of land (Tax Map 556 – ((A)) – 47; Parcel ID 004777) situate, lying and being located along W. Main Street in the Town of Christiansburg, Virginia. The exchange is for the College Street Stormwater Project.

C. 2022 U.S. Department of Housing and Urban Development (HUD) Community Development Block Grant (CDBG) Consolidated Annual Performance and Evaluation Report (CAPER)

IV. CONSENT AGENDA

A. Approval of Minutes of September 26, 2023

B. Monthly Bill List

C. Resolution Recognizing Craig Meadows for his service as Montgomery County Administrator

D. Resolution to recognize October 28, 2023 as National First Responders Day

E. Proclamation to recognize November 1, 2023 as Extra Mile Day

F. Contract Amendment #1 with CHA Consulting, Inc. for the renewal of Water, Sewer, and Wastewater Treatment Term Services in excess of $100,000 not to exceed $500,000 per task order and not to exceed $2,500,000 per annual contract term per Virginia Public Procurement Act

G. Contract Amendment #1 with Hurt and Proffitt for the renewal of Water, Sewer, and Wastewater Treatment Term Services in excess of $100,000 not to exceed $500,000 per task order and not to exceed $2,500,000 per annual contract term per Virginia Public Procurement Act

H. Contract Amendment #1 with Hazen and Sawyer for the renewal of Water, Sewer, and Wastewater Treatment Term Services in excess of $100,000 not to exceed $500,000 per task order and not to exceed $2,500,000 per annual contract term per Virginia Public Procurement Act

I. Contract Amendment #1 with McGill Associates, PA. for the renewal of Water, Sewer, and Wastewater Treatment Term Services in excess of $100,000 not to exceed $500,000 per task order and not to exceed $2,500,000 per annual contract term per Virginia Public Procurement Act

J. Contract Amendment #1 with Whitman, Requardt & Associates, LLP, for the renewal of Water, Sewer, and Wastewater Treatment Term Services in excess of $100,000 not to exceed $500,000 per task order and not to exceed $2,500,000 per annual contract term per Virginia Public Procurement Act

K. Contract with Rummel, Klepper & Kahl, LLP (RK&K) for Professional Services for the Town's North Franklin Sidewalk In-Fill project in the amount of $232,340

V. INTRODUCTIONS AND PRESENTATIONS

A. Ginny Snead, A. Morton Thomas and Associates, Inc., to present the Town of Christiansburg Flood Resilience Plan

B. Police Chief Chris Ramsey to introduce new command staff

VI. CITIZEN COMMENTS

VII. COMMITTEE REPORTS

A. Street Committee Report – Bishop, Hockett

1. Subdivision Plat and Dedication of Easements for NRV Marketplace, LLC at 2705 Market Street, NE showing Parcels G, H, N, O, P, Q, R, S, T, U, and Revised Lot 1 (creating 10 lots)

VIII. DISCUSSION AND ACTION BY MAYOR AND COUNCIL

A. Request for street closures for the Christiansburg High School Veterans Day Parade for Friday, November 10, 2023 with street closures from 8:30 a.m. - noon to include Main Street from Park Street, N.E. to Dunkley, N.W., Roanoke Street from E. Main Street to First Street, Pepper Street, S.E. from E. Main Street to First Street, Pepper Street, N.E. from E. Main Street to Hill Street, Franklin Street from First Street to Commerce Street, N.W., Hickok Street from Commerce Street, N.W. to First Street, S.W.

B. Adoption of Town of Christiansburg Flood Resilience Plan

IX. STAFF REPORTS

A. Town Manager

B. Town Attorney

C. Other Staff

X. COUNCIL REPORTS

XI. OTHER BUSINESS

XII. ADJOURNMENT

Upcoming meetings of Council:
November 14, 2023, 7:00 p.m. – Regular Meeting
November 28, 2023, 7:00 p.m. – Regular Meeting

Appendix C: Checklist All Categories - Detailed Budget and Narrative For All Cost

Budget Narrative

College Street Drainage Project Phase I and II

Town of Christiansburg

The College Street Drainage Project Phase I and Phase II engineering and construction cost estimate is $4,081,906. The Phase I estimate is provided below and is at 90% design. The Phase II estimate is also provided below and is at 60% design at the writing of this grant application. The Town of Christiansburg will manage and administer this project, which will require Town staff time for project management and inspection during project mobilization and construction. Additionally, post-construction maintenance as detailed in the maintenance plan will require Public Works time for inspection and performance of maintenance as needed. Implementation of the maintenance plan will also require equipment to perform periodic mowing and removal of any accumulated trash or debris in the completed project area. The total project estimate incorporating these costs is $4,097,246.

COLLEGE STREET DRAINAGE IMPROVEMENTS - PHASE I

October 2023 - 90% COST ESTIMATE

ITEM NO.	DESCRIPTION	UNIT PRICE	QUANTITY	UNIT	COST
	ENGINEERING COSTS				
1	AMT Surveying & Engineering Design	$230,380.00	0.6	LS	$138,228.00
2	AMT Property Acquisition Assistance	$70,495.00	1	LS	$70,495.00
	ENGINEERING COSTS SUBTOTAL				**$208,723.00**
	GENERAL CONDITIONS				
3	Mobilization and Temporary Facilities	$140,000.00	0.5	LS	$70,000.00
4	Bonds, Taxes, Permits, and Insurance	$50,000.00	0.5	LS	$25,000.00
5	As-Builts/Survey Stakeout	$30,000.00	0.5	LS	$15,000.00
6	Traffic Control Measures	$50,000.00	0.5	LS	$25,000.00
	GENERAL CONDITIONS SUBTOTAL				**$135,000.00**
	SITE PREPARATION & EROSION AND SEDIMENT CONTROL				
7	Erosion and Sediment Control Measures	$125,285.65	1	LS	$125,285.65
8	Site Clearing & Grubbing	$75,000.00	0.5	LS	$37,500.00
	SITE PREPARATION & EROSION AND SEDIMENT CONTROL SUBTOTAL				**$162,785.65**
	PHASE I				
9	30" Diameter - HDPE	$170.70	420	LF	$71,694.00
10	30" Diameter - RCP	$250.00	170	LF	$42,500.00
11	4 ft Square Conc. Manhole Structures	$8,000.00	8	ea	$64,000.00
12	6 ft Square Conc. Manhole Structures	$14,000.00	1	ea	$14,000.00
13	VDOT SWM-DR Trash Rack for 4 ft Square	$5,000.00	1	ea	$5,000.00
14	30" HDPE Flared End Section	$1,500.00	3	ea	$4,500.00
15	30" Concrete Flared End Section	$2,500.00	1	ea	$2,500.00
16	Drop Inlet Structures DI-7	$6,942.06	1	ea	$6,942.06
17	Drop Inlet Structures DI-5	$5,983.82	6	ea	$35,902.92
18	Standard flat manhole top with frame and cover	$4,000.00	1	ea	$4,000.00
19	Flexamat-Plus Erosion Control Mat	$50.00	220	SY	$11,000.00
20	VDOT Class I Riprap	$201.26	0	tons	$0.00
21	Concrete Retaining Wall	$200,436.00	1	LS	$200,436.00
22	48" Picket Fence (Brushed Bronze)	$120.00	800	LF	$96,000.00
23	Basin Excavation/Waste	$67.74	7400	CY	$501,276.00
24	24"x35" Elliptical Concrete Pipe	$200.00	192	LF	$38,400.00
25	24" Diameter - HDPE	$121.51	22	LF	$2,673.22
26	Trench Excavation/Backfill or Waste	$67.74	822	CY	$55,682.28
	PHASE I				**$1,156,506.48**
	SITE & UTILITY RESTORATION WORK				
27	Asphalt Pavement Replacements	$150.00	110	SY	$16,500.00
28	Existing Structure Relocation/Removals	$15,000.00		LS	$0.00
29	Dry Utilities Relocation	$5,000.00	1	LS	$5,000.00
30	Wet Utilities Relocation (SS)	$5,000.00	1	LS	$5,000.00
31	8" Diameter - PVC (SS)	$80.00	260	LF	$20,800.00
32	6" Diameter - PVC (SS)	$60.00	130	LF	$7,800.00
33	6" Diameter - PVC Cleanout (SS)	$1,000.00	1	LS	$1,000.00
34	4 ft Diameter Conc. Manhole Structures (SS)	$8,000.00	3	ea	$24,000.00
35	Topsoil and Permanent Stabilization	$15,000.00	0.75	LS	$11,250.00
36	Residence Pump Station for 962 College St	$5,000.00	1	LS	$5,000.00
	SITE & UTILITY RESTORATION SUBTOTAL				**$96,350.00**
	SUBTOTAL CONSTRUCTION COST				**$1,759,365.13**
	Construction Engineering & Inspection	8%	1	LS	$140,749.21
	Construction Contingency	15%	1	LS	$263,905.00
	CONSTRUCTION COST				**$2,164,019.34**
	Land Acquisition Budget (3 Parcels)	$100,000			$100,000.00
	TOTAL PROJECT COST				**$2,264,019.34**

COLLEGE STREET DRAINAGE IMPROVEMENTS - PAHASE II

May 2023 - 60% COST ESTIMATE

ITEM NO.	DESCRIPTION	UNIT PRICE	QUANTITY	UNIT	COST
	ENGINEERING COSTS				
1	AMT Surveying & Engineering Design	$230,380.00	0.6	LS	$138,228.00
2	AMT Property Acquisition Assistance	$70,495.00	0.7	LS	$49,346.50
	ENGINEERING COSTS SUBTOTAL				**$187,574.50**
	GENERAL CONDITIONS				
3	Mobilization and Temporary Facilities	$140,000.00	0.5	LS	$70,000.00
4	Bonds, Taxes, Permits, and Insurance	$50,000.00	0.5	LS	$25,000.00
5	As-Builts/Survey Stakeout	$30,000.00	0.5	LS	$15,000.00
6	Traffic Control Measures	$50,000.00	0.5	LS	$25,000.00
	GENERAL CONDITIONS SUBTOTAL				**$135,000.00**
	SITE PREPARATION & EROSION AND SEDIMENT CONTROL				
7	Erosion and Sediment Control Measures	$96,377.14	1	LS	$96,377.14
8	Site Clearing & Grubbing	$75,000.00	0.5	LS	$37,500.00
	SITE PREPARATION & EROSION AND SEDIMENT CONTROL SUBTOTAL				**$133,877.14**
	STORMWATER POND AND PERIPHERALS				
9	30" Diameter - HDPE	$170.70		LF	$0.00
10	4 ft Diameter Conc. Manhole Structures	$8,000.00		ea	$0.00
11	Drop Inlet Structures DI-7	$6,942.06		ea	$0.00
12	Class 1 Riprap - Outlet Protection	$201.26		tons	$0.00
13	Concrete Retaining Wall	$1,000.00		LF	$0.00
14	48" Picket Fence (Brushed Bronze)	$120.00		LF	$0.00
15	Basin Excavation/Waste	$67.74		CY	$0.00
16	Trench Excavation/Backfill or Waste	$67.74		CY	$0.00
	STORMWATER POND AND PERIPHERALS SUBTOTAL				**$0.00**
	STORMWATER SYSTEM BELOW THE POND				
17	24" Diameter - HDPE	$121.51	23	LF	$2,794.73
18	30" Diameter - HDPE	$170.70	788	LF	$134,511.60
19	36" Diameter - HDPE	$214.67	344	LF	$73,846.48
20	42" Diameter - HDPE	$370.41	102	LF	$37,781.82
21	48" Diameter - HDPE	$352.34	737	LF	$259,674.58
22	27"x43" Elliptical Concrete Pipe	$235.81		LF	$0.00
23	34"x53" Elliptical Concrete Pipe	$453.71	105	LF	$47,639.55
24	Drop Inlet Structures DI-5	$5,983.82		ea	$0.00
25	Drop Inlet Structures DI-7	$6,942.06	18	ea	$124,957.08
26	Curb Inlet Structures DI-2A, 2D	$3,000.00	2	ea	$6,000.00
27	Concrete Headwalls	$5,000.00	2	ea	$10,000.00
28	Miscellaneous Concrete Slabs	$600.00	15	CY	$9,000.00
29	Trench Excavation/Backfill or Waste	$67.74	2720.9259	CY	$184,315.52
	STORMWATER SYSTEM BELOW THE POND SUBTOTAL				**$890,521.36**
	SITE & UTILITY RESTORATION WORK				
30	Asphalt Pavement Replacements	$150.00	330	SY	$49,500.00
31	Existing Structure Relocation/Removals	$15,000.00	1	LS	$15,000.00
32	Dry Utilities Relocation	$5,000.00	1	LS	$5,000.00
33	Wet Utilities Relocation	$5,000.00		LS	$0.00
34	8" Diameter - PVC	$80.00		LF	$0.00
35	4 ft Diameter Conc. Manhole Structures	$8,000.00		ea	$0.00
36	Topsoil and Permanent Stabilization	$15,000.00	0.25	LS	$3,750.00
	SITE & UTILITY RESTORATION SUBTOTAL				**$73,250.00**
	SUBTOTAL CONSTRUCTION COST				**$1,420,223.00**
	Construction Engineering & Inspection	8%	1	LS	$113,617.84
	Construction Contingency	20%	1	LS	$284,045.00
	CONSTRUCTION COST				**$1,817,885.84**
	Land Acquisition Budget (3 Parcels)	$100,000			$0.00
	TOTAL PROJECT COST				**$1,817,885.84**

Appendix D: Town of Christiansburg Flood Resilience Plan

TOWN OF CHRISTIANSBURG
TOWN COUNCIL
AGENDA COVER SHEET

AGENDA LOCATION:
Discussion and Action by Mayor and Council

Meeting Date:
October 24, 2023

ITEM TITLE:
Discussion and Approval of the Town of Christiansburg Flood Resilience Plan

DESCRIPTION:
The Flood Resilience Plan for the Town of Christiansburg provides an overview of the flood resilience planning efforts undertaken by the Town of Christiansburg. The Flood Resilience Plan provides opportunities for improvement to current defenses and assesses the suitability of new projects and policies for the Town. The Plan examines historical flooding in the Town and reviews current and proposed strategies for flood prevention and resilience. Current and prospective projects were reviewed, scored, and placed in a ranking matrix. Communities may apply for grant funding for projects through the Virginia Community Flood Preparedness Fund (CFPF). An approved Resilience Plan is a prerequisite for submitting a funding application to the CFPF. Approval of this plan will enable the Town to tap into an additional source of funding for projects that will help to mitigate flooding in the Town.

POTENTIAL ACTION:
Request approval of the Town of Christiansburg Flood Resilience Plan

DEPARTMENT:
Administration

PRESENTER:
Town Manager Randy Wingfield

ITEM HISTORY:
The Virginia Community Flood Preparedness Fund (CFPF) was established in the Code of Virginia during the 2020 session of the General Assembly. In December 2021, the Town received a grant award in the amount of $44,520.30 from the CFPF for the development of a Resilience Plan. This grant award required a Town match of $4,946.70. On August 10, 2022, the Town entered into a contract with A. Morton Thomas and Associates, Inc. (AMT) to develop the Town of Christiansburg Flood Resilience Plan. Town Staff has work with AMT to develop this plan and the draft Flood Resilience Plan was presented to the Water and Waste Committee on August 21, 2023. The Water and Waste Committee has reviewed the Flood Resilience Plan as attached.

INFORMATION PROVIDED:

Flood Resilience Plan

TOWN OF CHRISTIANSBURG

Flood Resilience Plan

October 10, 2023

Town of Christiansburg

100 E Main Street
Christiansburg, VA 24073
540.382.6128

A. Morton Thomas and Associates, Inc.

1166 Jamestown Road, Suite D
Williamsburg, VA 23185
757.345.3851
amtengineering.com

Table of Contents

Definitions

General Definitions

Gray Infrastructure – "Gray infrastructure is traditional stormwater infrastructure in the built environment such as gutters, drains, pipes, and retention basin" (EPA, 2023).

Green Infrastructure – "A strategically planned and managed network of natural lands, working landscapes, and other open spaces that conserves ecosystem values and functions and provides associated benefits to human populations" (Benedict, Allen, and McMahon, 2006). "Green infrastructure planning involves the coordination of "conservation values and actions in concert with land development and growth management" (Benedict, Allen, and McMahon, 2004). Examples include raingardens, rainwater harvesting systems, permeable pavement, and constructed wetlands.

Heat Island Effect – "Urbanized areas that experience higher temperatures than outlying areas. Structures such as buildings, roads, and other infrastructure absorb and re-emit the sun's heat more than natural landscapes such as forests and water bodies. Urban areas, where these structures are highly concentrated and greenery is limited, become "islands" of higher temperatures relative to outlying areas" (EPA, 2023-c).

Nature Based Approach/Solution – "An approach that reduces the impacts of flood and storm events through environmental processes and natural systems. A nature-based solution may provide additional benefits beyond flood control, including recreational opportunities and improved water quality. This includes a project that reduces these impacts by protecting, restoring, or emulating natural features (DCR.gov, n.d.).

Rainfall-derived infiltration and inflow – "is the increased portion of water flow in a sanitary sewer system that occurs during and after a rainfall as a source of operation problems in sanitary sewer systems. RDII is the main cause of sanitary sewer overflows" (EPA, 2023-b).

Resilience / Resiliency – Resilience is the ability of citizens and the institutions that shape our communities to identify risks, positively adapt, and build the capacity to respond to environmental stressors that impact our built infrastructure. Successful implementation of resilience efforts allows communities to rapidly regain functionality and vitality in the face of chronic stressors or severe disturbances.

Town / the Town – The Town of Christiansburg, Virginia

FEMA Definitions

The following definitions are derived from FEMA.gov if residential properties are added to the project list in the future:

Property Damage – Damage to personal property resulting from flooding. "Damage caused by falling water and wind is not considered flood damage" (FEMA.org, 2010).

Repetitive Loss Property – "Any insurable building for which two or more claims of more than $1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. A RL property may or may not be currently insured by the NFIP. Currently there are over 122,000 RL properties nationwide," (FEMA.gov, 2005).

Roadway Flooding – Flooding of "The portion of roads designed to carry traffic. Roads are paved or unpaved. Other public facilities may include bike paths, pedestrian ways, sidewalks and maintained trails" (FEMA.org, 2022).

Severe Repetitive Loss Property – "A single family property (consisting of 1 to 4 residences) that is covered under flood insurance by the NFIP and has incurred flood-related damage for which 4 or more separate claims payments have been paid under flood insurance coverage, with the amount of each claim payment exceeding $5,000 and with cumulative amount of such claims payments exceeding $20,000; or for which at least 2 separate claims payments have been made with the cumulative amount of such claims exceeding the reported value of the property"(FEMA.gov, 2005).

Matrix Definitions

The following definitions are derived from DCR's 2021 Criteria for ranking community projects for flood funding:

Acquisition of Property – "Acquisition of property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures" (DCR.gov, n.d.).

Community Scale Benefit/ Community Scale Project – "A project that provides demonstrable flood reduction benefits at the US census block level or greater" (DCR.gov, n.d.).

Impact NFIP Participation – (NFIP = Nation Flood Insurance Program) - This criterion answers the question, "Is this proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?" (DCR.gov, n.d.).

Low-income Geographic Area – "Any locality, or community within a locality, that has a median household income that is not greater than 80 percent of the local median household income, or any area in the Commonwealth designated as a qualified opportunity zone by the U.S. Secretary of the Treasury via his delegation of authority to the Internal Revenue Service. A project of any size within a low-income geographic area will be considered" (DCR.gov, n.d.).

Project Area Socially Vulnerable – (Based on ADAPT VA's Social Vulnerability Index Score.) (DCR.gov, n.d.). Alternatively, socially vulnerable can be defined as "the susceptibility of social groups to the adverse impacts of natural hazards, including disproportionate death, injury, loss, or disruption of livelihood" (FEMA, n.d).

TMDL Benefit – (TMDL = Total Maximum Daily Load) Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan? (DCR.gov, n.d.).

Acronyms

CFPF	Community Flood Preparedness Fund
CIP	Capital Improvement Plan
CMP	Corrugated Metal Pipe
DCR	Virginia Department of Conservation and Recreation
DEQ	Virginia Department of Environmental Quality
ESC	Erosion and Sediment Control
EPA	United States Environmental Protection Agency
GI	Green Infrastructure
GIS	Geographic Information System
MS4	Municipal Separate Storm Sewer System
n.d.	"No Date" (an abbreviation used for citations when a source does not contain a publication date).
RCP	Reinforced Concrete Pipe
RDII	Rainfall-derived infiltration and inflow
SWM	Stormwater Management
TMDL	Total Maximum Daily Load
VDOT	Virginia Department of Transportation
WLA	Waste Load Allocation

Executive Summary

This Flood Resilience Plan for the Town of Christiansburg (Plan) provides an overview of the flood resilience planning efforts undertaken by the Town of Christiansburg, Virginia (Town). The Plan examines historical flooding in the Town and reviews current and proposed strategies for flood prevention and resilience. Flooding in the Town poses significant threats to public safety, infrastructure, and local economy. An increase of storm events with greater rainfall intensity and duration compounds these impacts. This Plan aims to reduce vulnerabilities and promote flood resilience in the Town through policy and sound engineering practices and maintenance.

Recognition of the need to implement flood resilience in communities across the Commonwealth has increased. The increasing frequency, intensity and duration of rainfall has proven to hinder the functionality of current infrastructure and flood prevention measures within the Town. Prior to 2014, stormwater runoff regulations were limited or nonexistent. Limited past stormwater regulations, geological conditions, and more frequent rain events are all concerns for flood resilience and prevention.

Assessment of current defenses within the Town found opportunities for improvement of stormwater quantity and quality. Rehabilitation and maintenance to gray infrastructure within Town watersheds can alleviate or prevent flooding. It is anticipated that the Town's Comprehensive Plan can recommend policies and practices for promoting flood resilience will be updated in the 2023-2024 edition. Some of these policies will include increased use of green techniques and infrastructure; operation and maintenance of SWM and sewer infrastructure; and construction of new stormwater management infrastructure that helps to reduce run-off and pollution. Increased use of green techniques and green infrastructure will promote stormwater quantity and quality. The Plan also explores future projects to promote or improve the Town's flood resilience.

Current and prospective projects were reviewed, scored, and placed in a ranking matrix. Gray infrastructure project recommendations will help mitigate or prevent flooding events, create more connectedness to a greater stormwater system, and ensure that engineered solutions are maintained for functionality. In addition, green infrastructure should be utilized as often as possible to enhance gray infrastructure capabilities. Incorporating other green infrastructure techniques will assist in flood prevention and resilience.

The Town, like many other communities will continue to experience the impacts of severe weather and frequent rainfall events. This Plan provides opportunities for improvement to current defenses and assesses the suitability of new projects and policies for the Town.

Chapter 1: Introduction

Flooding caused by rainfall events combined with inadequate stormwater infrastructure can cause damage to life and property. The Town of Christiansburg (Town) is undertaking this flood resilience planning effort to gain a better understanding of flooding and related infrastructure impacts in its watersheds to better protect its citizens and their property from flooding. The goal of this plan is to promote flood resilience. Resilience is the ability of citizens and the institutions that shape our communities to identify risks, positively adapt, and build the capacity to respond to environmental stressors that impact our built infrastructure. Successful implementation of flood resilience efforts allows communities to rapidly regain functionality and vitality in the face of chronic stressors or severe disturbances such as severe or frequent rainfall events.

A flood resilience plan provides an assessment of current or potential future projects and policies that promote effective solutions and future prevention measures, tailored to geographical region, climate, infrastructure, and available resources. Well-developed flood resilience plans not only provide current and future flood reduction and prevention, but with the implementation of these strategies, can reduce the degradation of infrastructure, preserve habitat for species that live within the floodplain, and in some cases, increase the aesthetic beauty of the Town through green infrastructure and streetscape design.

Christiansburg, like many localities in the Commonwealth, is looking to flood resilience planning to aid in measures to not only mitigate current flooding and stormwater issues, but to alleviate potential future flood events due to increased rainfall frequencies and durations that are occurring in Virginia (ASCE, 2021).

Plan Development Process

This Flood Resilience Plan for the Town of Christiansburg (Plan) will first discuss regional and state efforts made towards flood resilience. This Plan will then discuss the history of the Town in relation to flooding and rainfall events, and previous resilience coverage measures set in place for reduction or prevention.

Following this chapter, the Plan will discuss the measures that the Town is currently taking to address their stormwater and flooding issues. Current flood resilience measures have been evaluated through the analysis of current Town plans, studies, and policies.

For the final chapter of this Plan, suggested green and gray infrastructure projects from Town documents will be extracted and ranked in accordance with overall flood resilience effectiveness, determined by a score card/matrix system. Recommendations of the most effective projects will be accompanied with implementation details, and other helpful resources.

Regional and State Efforts

Recognition of the need to implement flood resilience in communities has been increasing in recent years in the United States as there has been an increase in storm duration and frequency. The Commonwealth of Virginia has undertaken some specific and intentional initiatives to better prepare the state and its communities for increased rainfall frequency and other various factors of climate change. One such initiative is the Department of Conservation and Recreation (DCR) Community Flood Preparedness Fund (CFPF) that funds studies, planning efforts (including this one) and projects that are implemented to mitigate flooding and to enable more resilient communities.

Another state initiative is the Coastal Resilience Master Plan developed by the Commonwealth in 2022. This plan was developed based on a Master Planning Framework which was produced in December 2021. While this effort focused on coastal areas, both this plan and the DCR CFPF recognized the threats of flooding at a statewide level. The CFPF funds are available and utilized throughout the Commonwealth and are partially funding the development of the Town's Plan.

Most recently, the Virginia Department of Transportation (VDOT) released the VDOT Resilience Plan at the end of 2022. In addition to the VDOT Resilience Plan and the Coastal Resilience Plan development efforts, the Commonwealth also partially funded an Environmental Protection Agency (EPA) initiative to better assess storm frequency and duration across the state. This study provides specific numeric comparisons to the currently used data set (ATLAS 14) at the County level.

Christiansburg's Flood History

One of the major events that kick-started the discussion for water management planning initiatives within the Town in recent years was the flooding event that occurred in September of 2015. Phlegar and Chrisman Streets, and Reading Road were especially affected, as they are located along the Town Branch Watershed. As a result, approximately $1.5 million was budgeted towards developing improved drainage in the downtown area (AMT, 2018).

Figure 1: Historic Flooding in the Town

However, the Town Branch Watershed and its confluence with Crab Creek are not the only watersheds that influence the flooding in Christiansburg. Various watersheds in and surrounding the Town are also components that contribute to and affect the Town's flooding issues. Historically, standing water, flooding issues with public drainage systems, and overtopping of streets have been prevalent issues at various times and locations in the Town.

Even earlier, a flood event occurred in Christiansburg in May of 2009; this event was one of the worst historically for the Town's historical district of Cambria. A local tributary of Crab Creek flooded the area after consistent rain events over a series of weeks. Unfortunately, this event occurred before many of the Town's stormwater flood mitigation projects had been implemented. This flood caused damages to the Oak Tree Townhomes area, College Street, and several other surrounding areas. The rainfall intensity was estimated to be a 200-year event.

To better understand these events, the Town has undertaken several studies to assess areas of flood concern in the Town's watersheds. The map on the following page depicts the areas where these efforts have concentrated. Of note, the Town has assessed each watershed within its boundaries in recent years. These studies have led the Town to have a strong understanding of potential flood concerns within the entire community.

History of Stormwater Management in Virginia

In recent years, laws and regulations in Virginia have undergone significant changes aimed at improving the management of stormwater runoff and reducing negative environmental impacts. These updated regulations went into effect in 2014 and impose more stringent criteria for the management of stormwater after construction to better protect properties adjacent to and downstream from development. Development that occurred before 2014 had less stringent or no requirement to manage runoff from created impervious surfaces, resulting in stormwater infrastructure that is inadequate to handle significant rainfall events. These issues with older infrastructure are compounded today through the occurrence of more frequent storms with increased rainfall intensity and duration.

Virginia's 2014 regulations also have more stringent criteria for new development projects compared to older development. The primary reason for this discrepancy lies in the fact that older properties were typically built before these modern environmental concerns became a priority. Therefore, they were not subject to the same level of scrutiny regarding storm drainage systems and potential flooding.

Retrofitting existing properties to meet the new criteria or to add in additional flood mitigation can be a complex and costly process. As a result, the focus has primarily been on implementing more stringent storm drainage requirements for new developments to ensure they adhere to the latest standards and mitigate potential adverse effects on property, water quality and local ecosystems.

Specifically, Christiansburg experiences increased risk to flooding after the construction of the interstate highway system where drainage was primarily designed to remove runoff from the roadway surface as quickly as possible. At the time, there were no regulations to address the additional runoff volume and rate onto adjacent properties and downstream facilities. As such, during heavy rain events, downstream channels and systems are currently at or beyond their capacity.

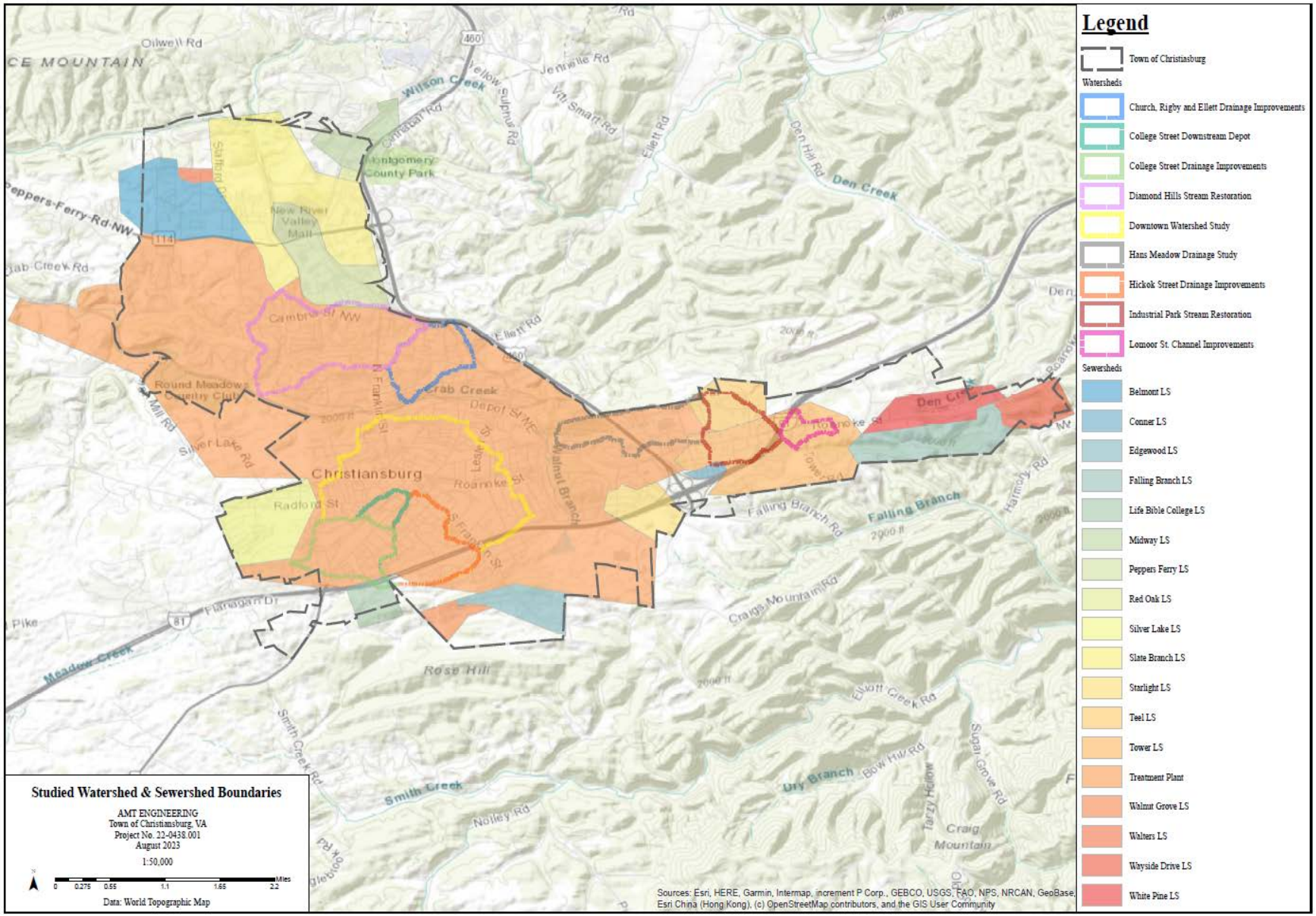


Figure 2: Studied Watershed & Sewershed Boundaries

Chapter 2: Current vs. Future Flood Prevention and Flood Resilience Efforts

Throughout the Commonwealth, including the Town of Christiansburg, Virginians have experienced the increase of storms events with greater rainfall intensity and duration. In addition, the landscape specific to Christiansburg can be characterized by its karst topography, steep slopes and prevalence of shallow soils which limits rain permeability (Town of Christiansburg, 2017). Combining these elements with heavy rains not only increases the concentration of flooding which leads to the clogging and overflowing of Town drainage infrastructure. These elements also lead to a cascading effect of other issues such as water contamination and impaired water bodies), but it can also lead to landslides and the formation or further degradation of sinkholes.

These hazards to infrastructure and human well-being have been pinpointed in areas of Christiansburg through continuous studies and improvement projects issued by the Town. Many of these projects have been associated with the greater downtown area and its associated streets and residential communities. More socially vulnerable populations living within this flood prone area are faced with the aftermath of damaged homes, sometimes on a reoccurring basis. Not all citizens can recuperate from these kinds of losses and may even be forced to move out of their homes and leave their communities.

Figure 3: Downtown Christiansburg Flooding

In recent years, the Town has increased their focus on flood reduction/prevention efforts in the form of projects and policies. Types of projects that help define the Town's flooding reduction/prevention efforts can be categorized as green infrastructure (natural-based solutions such as stream restorations, wetland installations, rainwater harvesting, etc.) and gray infrastructure (solutions such as inlets, outlets, culverts, and drainage solutions). These two types of projects are most effective when implemented in tandem with one another. Christiansburg's policies that mitigate/prevent flooding can often fall under the green

and/or gray infrastructure categories as well. These policies are framed as general goals and strategies that underline the Town's strong stance on policy goals- for both current strategies and future goals.

These current projects and policies can be found within the numerous Town documents and data files reviewed in preparation for this Plan. These documents include comprehensive plans; preliminary engineering reports; as-built monitoring reports; Erosion and Sediment Control (ESC) and Stormwater Management (SWM) plans and assessments; Stormwater Local Assistance Fund applications; drainage improvement studies; watershed studies; and all associated technical specifications, modeling, and Geographic Information System (GIS) data that come with these documents.

Current projects and policies can help to provide data for what flood prevention defenses are in use, and their effectiveness. The Town documents also provide project recommendations for future projects ("prospective projects") and suggests "goals" or policies to be expanded upon. The objective of the following section is to analyze current efforts in the form of current projects and policies, and then to compare these current defenses to future/prospective projects and future goals/policies.

Current Defenses – Studies, Projects, and Policies

Sewershed Studies

The Town's sewer system evaluation studies conducted for Arrowhead, College Street and Phlegar Street Sewersheds, and the Crab Creek Inceptor were aimed at reducing rainfall-derived infiltration and inflow (RDII) through evaluating which sewer systems had high RDII rates, and then providing rehabilitation recommendations (Town of Christiansburg, 2019). This evaluation resulted in the detection of high RDII rates for every sewer system in the study. Recommendations included manhole rehabilitation and replacement; sewer line and lateral rehabilitation; maintenance rehabilitation and on-going monitoring. Alleviating high rates of inflow can reduce the likelihood of a flood event, making these sewershed studies an important part of understanding Christiansburg's current flood resilience defenses.

Watershed Studies

Two major watershed studies conducted by the Town includes the Downtown Watershed Study (2018), and the Diamond Hills Basin Watershed Study (2013). The purpose of these studies was to analyze the current conditions of these watersheds and to provide potential outcomes of different stormwater solutions for the watersheds. The Diamond Hills Basin Watershed Study provided 2-year and 10-year storm event data that confirmed the water quantity and water quality benefits of the Diamond Hills Park Stream Restoration project, and the Diamond Hills Upper Basin Stormwater Management Facility (Balzer and Associates, 2013). The Downtown Watershed Study focused specifically on drainage and flooding concerns issues along the Town Branch Tributary that flows through Christiansburg's Downtown area. Based on review of previous Town drainage improvement studies, surveys, community meetings, and the addition of a new hydrology analysis of the watershed, 10 drainage improvement projects were recommended, prioritized, and scored.

Targeted Drainage Studies

Like the Town's watershed studies, targeted drainage Improvements projects and studies have been ramping up over the past decade to help assess specific "hotspots" where flooding occurs most often. These study areas include College Street, W. Main Street (Hickock Street), Sleepy Hollow Road, and Hans Meadow Drive. These studies have assessed current conditions, followed by recommendations derived

from projected hydrology calculations, and include design/conceptual plans with projected cost estimates. These drainage and watershed studies resulted in a variety of recommended improvements ranging from native vegetation installation, demolition of drainage infrastructure, installation of drainage infrastructure, earthwork and ESC measures, BMP installations and upgrades.

Run-Off /Pollution Studies

Identifying and recommending flooding solutions is instrumental in flood resilience planning, but further assessment of these approved projects may be needed to ensure water quality and flow functionality. Follow up studies involving approved (but not yet built) stream restorations, floodplain/overbank wetlands installations and detention ponds installations, confirm the proposed-BMP's effectiveness of keeping the local watersheds clean, which can also indicate improved stormwater overflow prevention and floodplain management. Three of the Town's drainage basins: Diamond Hills, Towne Branch (Depot Street), and Christiansburg Industrial Park were studied for their effectiveness in runoff and pollution reduction (EEE, 2013). These studies determined that these approved improvements would be effective in reducing Waste Load Allocations for the Crab Creek and New River Basins, which also indicated improved flow functionality.

Projects as a Result of the Towns Studies

As a result of the Town's plans and studies, several of the project recommendations were approved and are at various stages of design and construction. The project recommendations derived from the Hickok Street and College Street Drainage Improvement studies are still being implemented as well as several of the recommended projects from the Downtown Watershed Study. (Town of Christiansburg, n.d.). Construction for Hans Meadow Drainage Project (Phase II) and Diamond Hills Park Stream Restoration was completed in 2019, and Town Branch Stream Restoration was completed in 2018 (Town of Christiansburg, n.d.).

Figure 4: College Street Flooding

Other recently completed drainage improvements and stream restoration projects includes Church, Rigby, and Ellett Storm Drainage Improvements (completed in 2019); Blue Leaf Stream Restoration Project (2017); Brown, Church and Lucas Streets Storm Drain Improvements (2017); and North Franklin Street Drainage Improvements (2017).

Figure 5: Church Street - Drainage Issues

These projects provide a start to achieve long-lasting results that will continue to improve flooding resilience for the Town. However, other identified projects lack funding to move forward, but would further the Town's goal of increasing flood resilience if implemented.

Current Policies

Periodically, the Town of Christiansburg outlines their flooding-related policies in their Comprehensive Plan. The current 2013 version will soon be replaced by a revised edition. For brevity, below is a summary of policy themes within the 2013 Comprehensive Plan that assist in the promotion of flooding resilience, currently being implemented by the Town:

- Increased use of green techniques and infrastructure
- Water quality improvement
- Operation and maintenance of SWM and sewer infrastructure
- Execution of the MS4 plan
- Improvement or replacing of existing SWM and sewer infrastructure
- Construction of new SWM infrastructure that helps to reduce run off and pollution

These policies are designed to fully encompass the various factors that come into play regarding flooding resilience needs.

Future Projects – Studies, Projects, and Policies

Future Studies and Projects

To date, several potential projects identified in the watershed and sewershed plans have not been implemented, for various reasons. This Plan will evaluate and prioritize these potential projects to determine if they can assist the Town in its goal of increasing flood resilience.

Additionally, other projects may be considered that could provide greater flood control capabilities. Proposed mixed-use developments near Uptown Christiansburg (formerly New River Mall), Hickok Street, W. Main Street, Phlegar Street, N. Franklin Street, and College Street as proposed in the Town's Urban Development Areas document (2016) provide several opportunities to implement new and/or improved stormwater or drainage solutions for the Town.

Future Policies

Earlier in this chapter, current policies to promote the Town's flood resilience were summarized. These policies remain general to allow the easy application of flooding resilience action items. This plan will evaluate these current policies for improvement or enhancement, in addition to other policies that have not yet been pursued. For brevity, summaries of Town policies not yet explored or pursued are included in the list below:

- Landscape improvement
- Pollution reduction
- Mitigation of stormwater runoff by increasing tree canopy
- Limiting development on steep slopes (to slow down stormwater flow velocity, and decrease instances of erosion, sedimentation, and landslides)
- Increased awareness of development opportunities and restrictions on varying soil types.
- Protection of floodplains
- Creation, preservation, and maintenance of open space (including parkland)
- Design criteria using more conservative storm intensity, duration, and frequency data (IDF Curves)
- Updated subdivision guidelines encouraging best practices for stormwater collection, conveyance, and infiltration
- Consideration of karst hydrology

Chapter 3: A Plan for Flood Resilience

Methodology of Matrix/Score Card Ranking System

Based on the collection and review of Town literature (i.e., studies, plans, reports, GIS files), flood prevention and mitigation measures currently in place (current projects and policies) were identified. Potential future projects were also identified in this literature review and additional suggestions were added on by the Town Staff. The list of prospective projects and policies were then narrowed down based on optimal effectiveness, determined by the Town, and the consulting engineers assisting with this Resilience Plan.

The list of the Town's resources reviewed for determining current projects, potential projects, and other additional findings, can be found in the Appendix of this plan. Graphical representation of current resilience project coverage is demonstrated on page 9 of Chapter 1. For purposes of this resilience plan, the potential projects evaluated were based on flood and watershed studies and did not focus on sewershed based projects.

These potential projects were then ranked in accordance with a customized resilience matrix with weighted criteria, resulting in a numerical score. The matrix criteria were derived from DCR project ranking criteria that was developed by the state for the Community Flood Preparedness Fund (CFPF). The potential projects with the higher scores demonstrate a greater benefit to the Town's resilience efforts.

Some pre-existing flood prevention and mitigation projects were also evaluated using this prioritization methodology as a way for the Town to conceptualize the matrix process, its criteria, and its weighted scoring system.

Ranking Matrix Clarifications

The following caveats are to be considered when reviewing the Christiansburg Flood Resilience Ranking Matrix:

- It is important to note that the ranking of projects through this matrix scoring does not imply the order in which projects are carried out to completion. The timeline of each project depends on several factors including funding availability and project feasibility.
- Project costs for engineering and construction listed in the matrix have not been re-calculated with consideration to current-day inflation data. The matrix lists the year in which cost data was derived and is subject to change if projects are selected and implemented in the future.
- Project data displaying as "N/A" indicates that the cost to design, or remediate project is undetermined as this time.
- The following projects were not included in the matrix, as each of these involved several sub-projects, rendering the data values in the table as unquantifiable:
    - Public Works ditch work priority list
    - Public Works culvert replacement priority list
    - Other residential properties taking street water
    - Possible urban development areas designed for mixed use developments
- An additional matrix criterion to be considered for the future is the "acquisition of property" category. Acquisition can at times be the most cost-effective solution for reoccurring flooding

issues for residential properties. However, for privacy purposes, properties that specify addresses have been removed from this report.

- FEMA criteria can be added to this matrix for future grant funding consideration regarding residential properties.
    - Categories such as "Severe Repetitive Loss", "Repetitive Loss Property", "Property Damage", "Roadway Flooding", and "Potential Roadway Flooding", accompanied by a maximum point valuation can be added to this matrix, if residential properties are added to the project list in the future.
- Projects listed in the matrix that are currently marked as "*" or "**" (projects located in the floodplain and floodway, respectively) should be separately evaluated for FEMA grant funding.
- Please see the Christiansburg Floodplain/Floodway Map further along in this Chapter in the section titled "Resilience Score Card Results".
- The DCR ranking criteria can be found in Appendix A.
- Additional criteria were added to the final ranking matrix to account for estimated costs and the readiness of the project to proceed. For example, there are projects in the matrix that may score high based on the DCR criteria but do not have engineering and/or construction costs developed or may only be conceptual in design. These projects may need more development to be eligible for consideration for implementation.
- The focused list of recommended projects includes more shovel-ready projects that score highly and will also best address recurring flood issues in the Town based on the drainage studies.

Resilience Score Card Results

Detailed in the table below, are the top-ranked projects accompanied by a brief narrative and their final score. These projects represent shovel-ready projects that have been identified in previous drainage studies as the best options to alleviate recurrent flooding in the Town. An opinion of probable cost was developed for each of the recommended resilience projects based on available data. In each case, soft costs and a 30% contingency were included in the estimates as a conservative approach to budgeting. Details for each estimate can be found in the Appendix.

Potential Project	Project Description	Project Source	Points
Recommended Projects			
Chrisman / Phlegar Street Drainage Improvements: Phase II	Starting at the intersection of Phlegar Street and 3rd Street SW, this project is a series of small box culverts and open channels that convey runoff from the upper watershed to an existing triple 5'x3' box culvert under 1st Street. The channel alignment requires easements across some private properties, and may include stream stabilization measures.	Downtown Watershed Study	**75**

Chrisman / Phlegar Street Drainage Improvements: Phase I	This project collects runoff from existing 30" RCP and 48" RCP pipes under Interstate 81, and conveys the runoff in a closed drainage system along Chrisman Street, then crossing over to Phlegar Street following the alignment of the existing pipes. Recommended pipe sizes increase from 36" initially, to between 48" and 60" in diameter at 3rd Street SW.	Downtown Watershed Study	**73**
College Street Drainage Project - Phase I	Improvements at the nearby school, a reach along the opposite side of College Street, and the Detention Pond with several hundred feet of the outlet pipe downstream which will terminate upstream of the first driveway that crosses the drainage ditch. The installed pipe system below the pond will need to be installed at a flatter grade in Phase I than the final design until Phase II portion may be installed. The drainage will then re-enter the existing drainage ditch behind the residences along College Street.	College Street Drainage Study (scope revised on 06/2023)	**70**
College Street Drainage Project - Phase II	The pipe and structures previously installed below the pond will be re-installed at their originally planned deeper elevations along with the rest of the Phase II construction that extends to Depot St and also captures a large inflow from Main St. This will involve a small amount of redesign for this reach of the pipe installation immediately below the pond.	College Street Drainage Study (scope revised on 06/2023)	**70**
Hickok Street Drainage Improvements	This project conveys runoff in a proposed 10'x4' box culvert under Hickok Street SW to the intersection with Commerce Street, removing a section of drainage conveyance that goes under the existing buildings on West Main Street. Runoff is conveyed either north along Commerce Street to a connection with the existing 72" CMP or west along Hickok Street to College Street, where it connects to the College Street Drainage Improvements (Phase I).	Downtown Watershed Study	**65**

The map on the following page depicts Christiansburg Floodplain/Floodway areas, and a sampling of the top ranked projects per the ranking matrix.

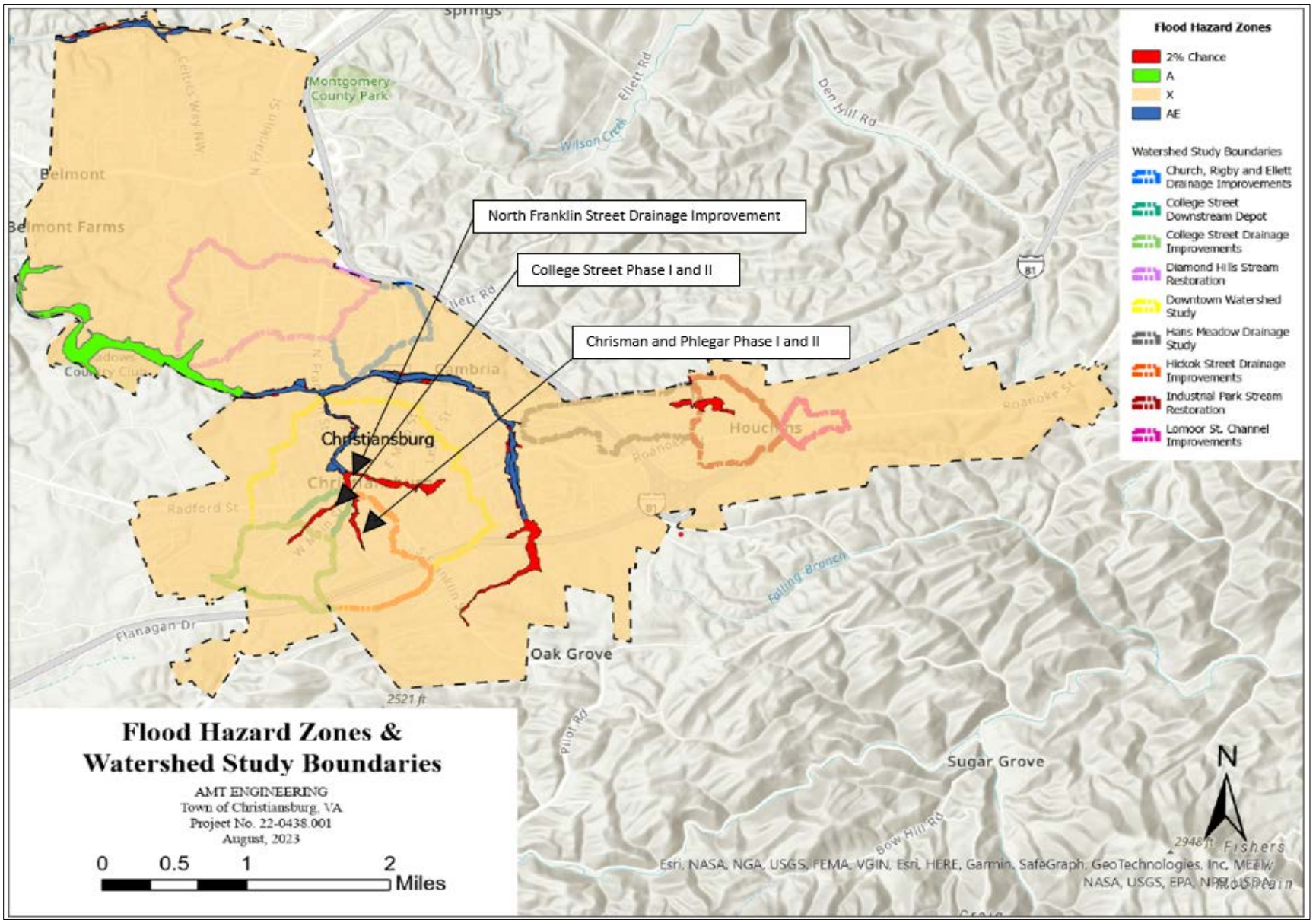


Figure 6: Christiansburg Flood Hazard Zone Map Displaying some Potential Projects and Watershed Study Boundaries

Continuation of Gray Infrastructure Implementation

The resulting gray infrastructure project recommendations from this study will help create more connectedness to a greater stormwater system, preventing or mitigating flooding events. Future new builds and retrofits alike should be designed with specifications that address increased precipitation, intensity and frequency storms, and the potential to mitigate flooding events. Additionally, maintenance protocols should be updated to ensure that these engineered solutions reliably maintain functionality. Lastly, to increase adaptive capacity, gray infrastructure should be designed in tandem with green infrastructure and nature-based solutions.

Continuation of Green Infrastructure Implementation

In addition to the project recommendations in the table above, green infrastructure should be utilized as often as possible to augment gray infrastructures capabilities if time and budgets allow. Green infrastructure is Implementing stream restorations and wetland and riparian buffer installations, and other green infrastructure techniques such as rainwater harvesting systems and pervious pavement will help to extend and reinforce the natural features that assist with flood resilience defense. Making sure our natural environmental is healthy and functional improves human well-being, creating the most immediate benefit to vulnerable communities and providing opportunities for recreation, education, and decreased heat island effect. Included with these implemented green infrastructure solutions should be updated maintenance protocols to ensure that they are functioning as designed.

RESOURCES

A. Morton Thomas and Associates. (AMT). (2018). *Town of Christiansburg Downtown Watershed Study*

American Society of Civil Engineers (ASCE). (2021) Adapting intensity-duration-frequency curves to improve climate resilience. Adapting intensity-duration-frequency curves to improve climate resilience | ASCE

Town of Christiansburg. (2017). *Town of Christiansburg 2013 Comprehensive Plan.* https://christiansburg.app.box.com/s/iqrvxh7e0kbiy6xwgyeyw5q4rvqn7f2a/file/1056208918079

Town of Christiansburg. (2019). *Town of Christiansburg, Virginia Arrowhead Sewer System Evaluation Survey.* https://christiansburg.app.box.com/s/iqrvxh7e0kbiy6xwgyeyw5q4rvqn7f2a/file/1056208918079

Town of Christiansburg. (2016). *Town of Christiansburg Interceptor Model & Preliminary Engineering Report.* https://christiansburg.app.box.com/s/iqrvxh7e0kbiy6xwgyeyw5q4rvqn7f2a/file/1056224097944

Town of Christiansburg. (2014). *Diamond Hills Park As-Built and Year 1 Monitoring.* https://christiansburg.app.box.com/s/iqrvxh7e0kbiy6xwgyeyw5q4rvqn7f2a/file/1056220870760

EEE Consulting (EEE). (2013). Christiansburg Stream Restoration and Stormwater BMP Assessment https://christiansburg.app.box.com/s/iqrvxh7e0kbiy6xwgyeyw5q4rvqn7f2a/file/1056220870760

Balzar and Associates, Inc. (2013). *Diamond Hills Basin Watershed Study.* https://christiansburg.app.box.com/s/iqrvxh7e0kbiy6xwgyeyw5q4rvqn7f2a/file/1056216341472

Town of Christiansburg, Michael Baker International. (2016). *Urban Development Areas.* https://christiansburg.app.box.com/s/iqrvxh7e0kbiy6xwgyeyw5q4rvqn7f2a/file/1056205375704

Town of Christiansburg, (n.d.). *Capital Projects* https://www.christiansburg.org/479/Capital-Project

Water Infrastructure Improvements for the Nation Act (2017)., Public Law 114-322

Benedict, M. A., W. Allen, and E.T. McMahon (2004). Advancing Strategic Conservation in the Commonwealth of Virginia: Using a Green Infrastructure Approach to Conserving and Managing the Commonwealth's Natural Areas, Working Landscapes, Open Space, and Other Critical Resources. Washington, D.C., The Conservation Fund. 2004.

Benedict, M. A. and E.T. McMahon. (2006). Green Infrastructure: Linking Landscapes and Communities. Washington, D.C., Island Press.

Green and Gray Infrastructure Research. (2023). EPA. https://www. epa.gov/water-research/green-and-gray-infrastructure-research#:~:text=Gray%20infrastructure%20is%20traditional%20stormwater,%2C%20pipes%2C%20and%20retention%20basins.

Community Flood Preparedness Fund Grants and Loans. (n.d.). https://www.dcr.virginia.gov/dam-safety-and-floodplains/dsfpm-cfpf

Social Vulnerability | National Risk Index. (n.d.). https://hazards.fema.gov/nri/social-vulnerability

Virginia Department of Conservation & Recreation. (n.d.). 2023 Grant Manual for the Virginia Community Flood Preparedness Fund. https://www.dcr.virginia.gov/dam-safety-and-floodplains/document/Round-4-2023-CFPF-Manual-DRAFT-Final.pdf

Fema.gov. (2022, March). Hurricane and Flood Mitigation Handbook for Public Facilities - Fact Sheet 1.0: Roads. www.fema.gov

Damage to Property? (2020, February). FEMA.gov. https://www.fema.gov/faq/damage-property

National Flood Insurance Program: Frequently Asked Questions - Repetitive Loss. (2005, October).www.fema.gov. https://www.fema.gov/pdf/rebuild/repetitive_loss_faqs.pdf

Sanitary Sewer Overflow Analysis and Planning (SSOAP) Toolbox. EPA. (2023-B). US EPA. https://www.epa.gov/water-research/sanitary-sewer-overflow-analysis-and-planning-ssoap-toolbox

Heat Island Effect. (2023-C). EPA. https://www.epa.gov/heatislands

Appendix

DCR Scoring Criteria

Project Eligible for Consideration		
Scoring Information		
Criterion	**Point Value**	**Points Awarded**
Projects may have components of both a. and b. below; however, only one category may be chosen. The category chosen must be identified as the primary project in the application.		
a. Acquisition of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures (and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition).	30	
☐ Wetland restoration. ☐ Floodplain restoration. ☐ Construction of swales and settling ponds. ☐ Living shorelines and vegetated buffers. ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by ConserveVirginia Floodplain and Flooding Resilience layer or a similar data driven analytic tool. ☐ Dam removal ☐ Stream bank restoration or stabilization. ☐ Restoration of floodplains to natural and beneficial function.	25	
b. any other nature-based approach	20	
Is the project area socially vulnerable? (Based on ADAPT VA's Social Vulnerability Index Score.)		
Very High Social Vulnerability (More than 1.5)	10	
High Social Vulnerability (1.0 to 1.5)	8	
Moderate Social Vulnerability (0.0 to 1.0)	5	
Low Social Vulnerability (-1.0 to 0.0)	0	
Low Social Vulnerability (-1.0 to 0.0)	0	
Is the proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?		
Yes	5	
No	0	
Is the proposed project in a low-income geographic area as defined in the DCR manual?		
Yes	10	

No	0	
Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?		
Yes	5	
No	0	
Does this project provide "community scale" benefits?		
Yes	30	
No	0	
Total Points		

Top Ranking Project Scorecards

Chrisman / Phlegar Street Drainage Improvements: Phase II

Project Eligible for Consideration		
Scoring Information		
Criterion	**Point Value**	**Points Awarded**
Projects may have components of both a. and b. below; however, only one category may be chosen. The category chosen must be identified as the primary project in the application.		
a. Acquisiion of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures (and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition).	30	
☐ Wetland restoration. ☐ Floodplain restoration. ☐ Construction of swales and settling ponds. ☐ Living shorelines and vegetated buffers. ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by ConserveVirginia Floodplain and Flooding Resilience layer or a similar data driven analytic tool. ☐ Dam removal ☐ Stream bank restoration or stabilization. ☐ Restoration of floodplains to natural and beneficial function.	25	**25**
b. any other nature-based approach	20	**5**

Is the project area socially vulnerable? (Based on ADAPT VA's Social Vulnerability Index Score.)		
Very High Social Vulnerability (More than 1.5)	10	
High Social Vulnerability (1.0 to 1.5)	8	
Moderate Social Vulnerability (0.0 to 1.0)	5	
Low Social Vulnerability (-1.0 to 0.0)	0	**0**
Low Social Vulnerability (-1.0 to 0.0)	0	
Is the proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?		
Yes	5	
No	0	**0**
Is the proposed project in a low-income geographic area as defined in the DCR manual?		
Yes	10	**10**
No	0	
Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?		
Yes	5	**5**
No	0	
Does this project provide "community scale" benefits?		
Yes	30	**30**
No	0	
Total Points		**75**

Chrisman / Phlegar Street Drainage Improvements: Phase I

Project Eligible for Consideration		
Scoring Information		
Criterion	**Point Value**	**Points Awarded**
Projects may have components of both a. and b. below; however, only one category may be chosen. The category chosen must be identified as the primary project in the application.		

a. Acquisition of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures (and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition).	30	
☐ Wetland restoration. ☐ Floodplain restoration. ☐ Construction of swales and settling ponds. ☐ Living shorelines and vegetated buffers. ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by ConserveVirginia Floodplain and Flooding Resilience layer or a similar data driven analytic tool. ☐ Dam removal ☐ Stream bank restoration or stabilization. ☐ Restoration of floodplains to natural and beneficial function.	25	**25**
b. any other nature-based approach	20	**5**
Is the project area socially vulnerable? (Based on ADAPT VA's Social Vulnerability Index Score.)		
Very High Social Vulnerability (More than 1.5)	10	
High Social Vulnerability (1.0 to 1.5)	8	
Moderate Social Vulnerability (0.0 to 1.0)	5	
Low Social Vulnerability (-1.0 to 0.0)	0	**0**
Low Social Vulnerability (-1.0 to 0.0)	0	**0**
Is the proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?		
Yes	5	
No	0	**0**
Is the proposed project in a low-income geographic area as defined in the DCR manual?		
Yes	10	**10**
No	0	
Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?		
Yes	5	**3**
No	0	
Does this project provide "community scale" benefits?		
Yes	30	**30**
No	0	

Total Points	73

College Street Drainage Project - Phase I

Project Eligible for Consideration		
Scoring Information		
Criterion	**Point Value**	**Points Awarded**
Projects may have components of both a. and b. below; however, only one category may be chosen. The category chosen must be identified as the primary project in the application.		
a. Acquisition of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures (and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition).	30	
☐ Wetland restoration. ☐ Floodplain restoration. ☐ Construction of swales and settling ponds. ☐ Living shorelines and vegetated buffers. ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by ConserveVirginia Floodplain and Flooding Resilience layer or a similar data driven analytic tool. ☐ Dam removal ☐ Stream bank restoration or stabilization. ☐ Restoration of floodplains to natural and beneficial function.	25	**25**
b. any other nature-based approach	20	**5**
Is the project area socially vulnerable? (Based on ADAPT VA's Social Vulnerability Index Score.)		
Very High Social Vulnerability (More than 1.5)	10	
High Social Vulnerability (1.0 to 1.5)	8	
Moderate Social Vulnerability (0.0 to 1.0)	5	
Low Social Vulnerability (-1.0 to 0.0)	0	**0**
Low Social Vulnerability (-1.0 to 0.0)	0	
Is the proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?		
Yes	5	
No	0	**0**
Is the proposed project in a low-income geographic area as defined in the DCR manual?		
Yes	10	**10**

No	0	
Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?		
Yes	5	
No	0	**0**
Does this project provide "community scale" benefits?		
Yes	30	**30**
No	0	
Total Points		**70**

College Street Drainage Project - Phase II

Project Eligible for Consideration		
Scoring Information		
Criterion	**Point Value**	**Points Awarded**
Projects may have components of both a. and b. below; however, only one category may be chosen. The category chosen must be identified as the primary project in the application.		
a. Acquisition of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures (and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition).	30	
☐ Wetland restoration. ☐ Floodplain restoration. ☐ Construction of swales and settling ponds. ☐ Living shorelines and vegetated buffers. ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by ConserveVirginia Floodplain and Flooding Resilience layer or a similar data driven analytic tool. ☐ Dam removal ☐ Stream bank restoration or stabilization. ☐ Restoration of floodplains to natural and beneficial function.	25	**25**
b. any other nature-based approach	20	**5**
Is the project area socially vulnerable? (Based on ADAPT VA's Social Vulnerability Index Score.)		
Very High Social Vulnerability (More than 1.5)	10	

High Social Vulnerability (1.0 to 1.5)	8	
Moderate Social Vulnerability (0.0 to 1.0)	5	
Low Social Vulnerability (-1.0 to 0.0)	0	**0**
Low Social Vulnerability (-1.0 to 0.0)	0	
Is the proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?		
Yes	5	
No	0	**0**
Is the proposed project in a low-income geographic area as defined in the DCR manual?		
Yes	10	**10**
No	0	
Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?		
Yes	5	
No	0	**0**
Does this project provide "community scale" benefits?		
Yes	30	**30**
No	0	
Total Points		**70**

Hickok Street Drainage Improvements

Project Eligible for Consideration		
Scoring Information		
Criterion	**Point Value**	**Points Awarded**
Projects may have components of both a. and b. below; however, only one category may be chosen. The category chosen must be identified as the primary project in the application.		
a. Acquisition of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures (and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition).	30	

☐ Wetland restoration. ☐ Floodplain restoration. ☐ Construction of swales and settling ponds. ☐ Living shorelines and vegetated buffers. ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by ConserveVirginia Floodplain and Flooding Resilience layer or a similar data driven analytic tool. ☐ Dam removal ☐ Stream bank restoration or stabilization. ☐ Restoration of floodplains to natural and beneficial function.	25	**25**
b. any other nature-based approach	20	
Is the project area socially vulnerable? (Based on ADAPT VA's Social Vulnerability Index Score.)		
Very High Social Vulnerability (More than 1.5)	10	
High Social Vulnerability (1.0 to 1.5)	8	
Moderate Social Vulnerability (0.0 to 1.0)	5	
Low Social Vulnerability (-1.0 to 0.0)	0	**0**
Low Social Vulnerability (-1.0 to 0.0)	0	
Is the proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?		
Yes	5	
No	0	**0**
Is the proposed project in a low-income geographic area as defined in the DCR manual?		
Yes	10	**10**
No	0	
Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?		
Yes	5	
No	0	
Does this project provide "community scale" benefits?		
Yes	30	**30**
No	0	
Total Points		**65**

Project Ranking Matrix - 10/09/2023

Project Ranking Criteria			Acquisition of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures	Nature Based Approach	Project Area Socially Vulnerable	Impact NFIP Participation	Low Income Geographic Area	TMDL Benefit? (e.g., N or P)	Community Scale Benefit		Estimated Engineering Cost	Estimated Construction Cost	Total Cost	Cost Notes (*year of cost estimate, does plan include cost?*)	**Total Points**
Categorical Weight			30	20	10	5	10	5	30						
Potential Project	**Project Description**	**Project Source**													
Recommended Projects															
College Street Drainage Project - Phase I	Improvements at the nearby school, a reach along the opposite side of College Street, and the Detention Pond with several hundred feet of the outlet pipe downstream which will terminate upstream of the first driveway that crosses the drainage ditch. The installed pipe system below the pond will need to be installed at a flatter grade in Phase I than the final design until Phase II portion may be installed. The drainage will then re-enter the existing drainage ditch behind the residences along College Street.	College Street Drainage Study (scope revised on 06/2023)	25	5	0	0	10	0	30		$155,852	$2,188,034	$2,238,034	2023	**70**
College Street Drainage Project - Phase II	The pipe and structures previously installed below the pond will be re-installed at their originally planned deeper elevations along with the rest of the Phase II construction that extends to Depot St and also captures a large inflow from Main St. This will involve a small amount of redesign for this reach of the pipe installation immediately below the pond.	College Street Drainage Study (scope revised on 06/2023)	25	5	0	0	10	0	30		$191,099	$1,457,017	$1,864,981	2023	**70**
Hickok Street Drainage Improvements	This project conveys runoff in a proposed 10'x4' box culvert under Hickok Street SW to the intersection with Commerce Street, removing a section of drainage conveyance that goes under the existing buildings on West Main Street. Runoff is conveyed either north along Commerce Street to a connection with the existing 72" CMP or west along Hickok Street to College Street, where it connects to the College Street Drainage Improvements (Phase I).	Downtown Watershed Study	25	0	0	0	10	0	30		$404,000	$2,271,722	$2,675,722 (stated as $2,700,000 in Watershed study)	2017 and later in watershed study in 2018	**65**
Chrisman / Phlegar Street Drainage Improvements: Phase I	This project collects runoff from existing 30" RCP and 48" RCP pipes under Interstate 81, and conveys the runoff in a closed drainage system along Chrisman Street, then crossing over to Phlegar Street following the alignment of the existing pipes. Recommended pipe sizes increase from 36" initially, to between 48" and 60" in diameter at 3rd Street SW.	Downtown Watershed Study	25	5	0	0	10	3	30		$378,000	$2,413,000	$2,800,000	2018	**73**
Chrisman / Phlegar Street Drainage Improvements: Phase II	Starting at the intersection of Phlegar Street and 3rd Street SW, this project is a series of small box culverts and open channels that convey runoff from the upper watershed to an existing triple 5'x3' box culvert under 1st Street. The channel alignment requires easements across some private properties, and may include stream stabilization measures.	Downtown Watershed Study	25	5	0	0	10	5	30		$187,000	$1,113,000	$1,300,000	2018	**75**
Potential Future Projects															
Gray Infrastructure															
Existing SWM Facility with Independence Boulevard Upgrade - project completed but may need further evaluation	N/A	Diamond Hills Basin Watershed Study	0	0	0	0	10	0	30		N/A	N/A	N/A	N/A	**40**
Radford Street Drainage Improvements	This project is smaller than some others in the downtown area, and addresses clogged inlets and undersized pipes along the north side of Radford Street. By increasing the pipe size from 15" to 24" and adding adequately sized throat lengths on the drainage inlets, runoff can be intercepted and conveyed into the existing 36" RCP at Lee Hy Court, then draining along Radford Street to Depot Street and into the downtown area. New sidewalks may also be considered for this area.	Downtown Watershed Study	25	0	0	0	10	0	30		$158,000	$942,000	$1,100,000	2018	**65**
Alleghany St / Canaan Rd / Epperly Drive: Drainage Improvements	This project helps address surface water and groundwater concerns from the Sunset Cemetery and Alleghany Street in areas along Canaan Road and Epperly Drive, by replacing existing 15" pipes with 24" and 30" pipes. Runoff is then conveyed into the rear yards on the south side of Epperly Drive, behind the First Church of God, with a pipe extension to an existing stormwater management basin (dry detention). During engineering design, the Town may choose to retrofit the existing basin to help proect existing drainage systems downstream and to promote improved water quality in the watershed.	Downtown Watershed Study	25	0	0	0	10	5	30		$105,000	$645,000	$750,000	2018	**70**
Stone Street Culvert Replacement at Town Branch	This project replaces an existing quadruple 48" CMP with a dual 10'x5' box culvert, providing increased capacity to convey the 2-year storm under Stone Street without overtopping onto Depot Street. 10-year and 100-year flood depths are reduced with this culvert replacement. Possible impacts of the larger pipes on the stream restoration project in Depot Park will need to be evaluated, as well as the flood reduction benefits of eliminating the abandoned bridge near Stone Street. Enhanced water quality can also be considered with this project, by developing a stream restoration project from Stone Street to North Franklin Street, creating a linear park or greenway concept	Downtown Watershed Study	30	0	5	0	10	5	30		$114,000	$526,000	$640,000	2018	**80**
Roanoke Street Drainage Improvements (near wades)	This project begins at an existing curb inlet near Wade's Foods which has a small diameter pipe draining to Craig Street. The recommendation is to eliminate runoff from Craig Street into the open channel behind 500 Roanoke Street by installing a storm drain system that conveys runoff from the Wade's Foods parking lot and Craig Street to Roanoke Street, where it ties into the existing storm drain system	Downtown Watershed Study	25	0	5	0	10	5	30		$42,000	$168,000	$210,000	2018	**75**
Sherwood Culvert Replacement	Replacement of existing storm drain culvert under Sherwood Drive which is beyond useful life and causing maintenance issues.	Town's Addition (no document source)	25	0	5	0	10	0	30		$25,000	$100,000	$125,000	2022	**70**
Glade Culvert Replacement	Replacement of existing storm drain culvert along Glade Drive which is beyond useful life and causing maintenance issues.	Town's Addition (no document source)	25	0	0	0	10	0	30		N/A	N/A	N/A	N/A	**65**
Public Works Operation Center	Public Works Operation Center is within the 100 year flood plain since it is the location of the old sewer treatment facility. Relocation is the best alternative.	Town's Addition (no document source)	30	20	5	0	10	0	30		N/A	N/A	N/A	N/A	**95**
Evans Street Drainage	Piping of road drainage through a new storm drain system to prevent drainage between and behind residences.	Town's Addition (no document source)	25	0	5	0	10	0	30		$75,000	$325,000	$400,000	2022	**70**
Overhill Drainage	Piping of road drainage through a new storm drain system to prevent drainage between and behind residences.	Town's Addition (no document source)	25	0	0	0	10	0	30		N/A	N/A	N/A	N/A	**65**
Reading Road Drainage	Research and Public outreach is required to address maintenance of drainage infrastructure and/or larger replacement projects to address capacity may be necessary.	Town's Addition (no document source)	25	0	0	0	10	0	30		N/A	N/A	N/A	N/A	**65**
Teel Street	Piping of road drainage through a new storm drain system to prevent drainage between and behind residences.	Town's Addition (no document source)	25	0	5	0	10	0	30		N/A	N/A	N/A	N/A	**70**
N Franklin Street Drainage near Conston	Roadway flooding occurs here frequently with heavy rains. The system is most likely undersized for the area it drains	Town's Addition (no document source)	25	0	0	0	10	0	30		N/A	N/A	N/A	N/A	**65**
West Main Street Drainage (near 1010 W Main, drainage from Robin Rd / Interstate)	Piping of road drainage through a new storm drain system to prevent drainage between and behind residences.	Hickock Drainage Study	25	0	0	0	10	0	30		$404,000	$2,271,722	$2,675,722	2017	**65**
Infrastructure															
Diamond Hills Basin Evaluation of Ultimate Development (including: Stream Restoration & Independence Blvd Upgrade, and Upstream SWM Facility a BMPs);	there are potential projects to come from this basin, work on various stormwater facilities and conveyance channels	Description provided by Town notes	25	0	0	0	10	5	30		N/A	N/A	N/A	N/A	**70**
Christiansburg Industrial Park Restoration and Stormwater BMP Assessment(Town is at 100% design on this and plans to go to construction in the fall…we have the costs available)	Maintenance / Upsizing of existing stormwater quantity pond and channel improvements upstream of facility.	Stream Benefits Analysis Christiansburg Industrial ParkStream Restoration	25	20	5	0	10	5	30		N/A	N/A	$700,000	N/A	**95**
Sleepy Hollow SWM BMP Modification	Maintance or removal of BMP. The embankment is not constructed properly and would need to be rebuit.	WSSI Sleepy Hollow Powerpoint	25	20	0	0	10	5	30		N/A	N/A	N/A	N/A	**90**
Kiwanas Park	Corrective work to address stream erosion along park.	Town's Addition	25	0	0	0	10	5	30		N/A	N/A	N/A	N/A	**70**
Diamond Hills SWM BMP Modification (Food Lion N Franklin St Facility)	Potential modification to address flow through pond to protect downstream channel and Blue Leaf Stream Restoration	Town's Addition (no document source)	25	0	0	0	10	5	30		N/A	N/A	N/A	N/A	**70**

Table Notes:
Project data displaying as "N/A" indicates that the cost to construct, design, or remediate project is undetermined as this time.
Project Name (* = project that is in the floodplain. ** = a project that is in the floodway)
Preferred projects are based on total points, cost considerations and shovel-ready nature of the proposed project.

Virginia Department of Conservation & Recreation

VRA Virginia Resources Authority

DCR Virginia Community Flood Preparedness Fund

Grant Program Application

November 12, 2023

Town of Christiansburg

100 E Main Street
Christiansburg, VA 24073

Contact Information

Michael Kelley, PE, Director of Engineering
(Town of Christiansburg)
Office: 540-382-6120 Ext. 1147
mkelley@christiansburg.com

THE PLACE TO BE.
CHRISTIANSBURG VA
Established November 10, 1792

100 East Main Street
Christiansburg, VA 24073
p: (540) 382-6128
f: (540) 382-7338

November 8, 2023

Mr. Daryl Glover
Deputy Agency Director of Dam Safety, Flood Preparedness, and Soil and Water Conservation
Department of Conservation and Recreation
60 East Main Street, 24th Floor
Richmond, Virginia 23219

RE: Town of Christiansburg Virginia Community Flood Preparedness Fund (CFPF) Grant Request

Dear Mr. Glover:

The Town of Christiansburg is pleased to submit this grant application for project funding from the CFPF fund. The Town is seeking funding for the College Street Drainage Project Phase I and Phase II project as presented in our Town adopted Flood Resilience Plan and in the College Street Drainage Study. The Town is committed to the match as proposed ($206,865). We appreciate your consideration of our complete application for CFPF funding.

Randy Wingfield
Town Manager

GRANT APPLICATION PROJECT NARRATIVE

TOWN OF CHRISTIANSBURG, VIRGINIA

The following narrative is provided to support the Town of Christiansburg's grant application to the DCR/VRA 2023 Community Flood Preparedness Fund (CFPF) for the 2023 Funding Round. The Town is requesting funds to support the engineering and construction of one of the Town's flood resilience projects: College Street Drainage Project - Phase I and Phase II. This project will alleviate flooding along College Street and will also contribute to the continuity of flood mitigation infrastructure and achievement of the Town's flood resilience goals, as determined by the Town of Christiansburg Flood Resilience Plan (see attached as Appendix D), approved by Town Council on October 24th, 2023.

The Town understands the CFPF funds must be utilized in accordance with the following principles:

1. Acknowledge the consequences of climate change, and base decision making on the best available science.
2. Identify and address socioeconomic inequities and work to enhance equity through adaptation and protection efforts for low-income and underserved communities.
3. Utilize community and regional scale planning to the maximum extent possible, seeking region-specific approaches tailored to the needs of individual communities.
4. Understand fiscal realities and focus on the most cost-effective solutions for the protection and adaptation of our communities, businesses, and public infrastructure. The solutions will, to the extent possible, prioritize effective natural solutions.
5. Recognize the importance of protecting and enhancing nature-based solutions in all regions, natural coastal barriers, and fish and wildlife habitat by prioritizing nature-based solutions.

The project was identified as a high priority in the Town's Flood Resilience Plan which was developed in accordance with these principles.

The following narrative includes a scope of work and budget discussion and is supported with an attachment, as noted above.

SCOPE OF WORK / NARRATIVE

The Town of Christiansburg Flood Resiliency Plan posed several potential projects that could promote flood resilience. These projects were identified based on drainage studies performed by the Town to assess recurring flooding and drainage issues within the Town. Utilizing DCR CFPF Manual scoring criterion for "Project Eligible for Consideration", potential projects were ranked alongside of construction and engineering cost data. Among these potential projects, College Street Drainage Projects – Phase I and Phase II were determined to be the most optimal for both flood resilience and cost-effectiveness. These two phases of the College Street Drainage project are connected; implementation of both phases will alleviate flooding on College Street.

Specifically, the College Street Drainage Project - Phase I and Phase II originated as project recommendations from the drainage study and report titled, Town of Christiansburg College Street

Drainage Alternatives Analysis, published in June of 2021 (linked here). This report developed and ranked project recommendations to address long-standing drainage and flooding issues along the College Street Corridor. College Street Drainage Project - Phase I and Phase II were selected by the Town as the most effective solution to the drainage issues along College Street.

The College Street Drainage Project - Phase I and Phase II were prioritized and highly ranked in drainage effectiveness per the College Street Drainage Alternatives Analysis study. Subsequently, the Town of Christiansburg Flood Resilience Plan identified this project as an effective flood resilience project. Commencing work on these projects as soon as possible will be of great benefit to the Town.

The scope of each College Street project phase is as follows:

College Street Drainage Project – Phase I

Drainage Improvements will be made at the nearby school, a reach along the opposite side of College Street, and a detention pond with several hundred feet of the outlet pipe downstream, which will terminate upstream of the first driveway that crosses the drainage ditch. The installed pipe system below the pond will be installed at a flatter grade. The drainage will then re-enter the existing drainage ditch behind the residences along College Street. Trees and landscaping will be planted to enhance the drainage capabilities of the project and to provide an aesthetic for residents.

College Street Drainage Project – Phase II

The pipe and structures previously installed below the pond in Phase I will be re-installed at their originally planned deeper elevations along with the rest of the Phase II construction that extends to Depot Street (and also captures a large inflow from Main Street). This will involve a small amount of redesign for this reach of the pipe installation immediately below the pond.

The projects include the following elements:

1. Flood control and resilience.
2. They will incorporate a nature-based approach to the maximum extent possible.
3. They will provide community scale benefit to a low-income geographic area.
4. Trees and landscaping will enhance drainage capabilities and provide an aesthetic for the project site.

BUDGET NARRATIVE

The College Street Drainage Project Phase I and Phase II engineering and construction cost estimate is $4,081,906. The Phase I estimate is provided below and is at 90% design. The Phase II estimate is also provided below and is at 60% design at the writing of this grant application. The Town of Christiansburg will manage and administer this project, which will require Town staff time for project management and inspection during project mobilization and construction. Additionally, post-construction maintenance as detailed in the maintenance plan will require Public Works time for inspection and performance of maintenance as needed. Implementation of the maintenance plan will also require equipment to perform periodic mowing and removal of any accumulated trash or debris in the completed project area. The total project estimate incorporating these costs is $4,097,246.

Applicants must have prior approval from the Department to submit applications, forms, and supporting documents by mail in lieu of the WebGrants portal.

Appendix A: Application Form for Grant and Loan Requests for All Categories

---

Virginia Department of Conservation and Recreation
Virginia Community Flood Preparedness Fund Grant Program

Name of Local Government: Town of Christiansburg, Virginia

Category Being Applied for (check one):

☐ **Capacity Building/Planning**

☒ **Project**

☐ **Study**

NFIP/DCR Community Identification Number (CID) 510101

Name of Authorized Official and Title: Randy Wingfield, Town Manager

Signature of Authorized Official: R. Wingfield

Mailing Address (1): 100 East Main Street

Mailing Address (2): _____

City: Christiansburg **State:** VA **Zip:** 24073

Telephone Number: (540) 382-6128 x1119 **Cell Phone Number:** (____) _____

Email Address: rwingfield@christiansburg.org

Contact and Title (If different from authorized official): _____

Mailing Address (1): _____

Mailing Address (2): _____

City: _____ State: _____ Zip: _____

Telephone Number: (____) _____ Cell Phone Number: (____) _____

Email Address: _____

Is the proposal in this application intended to benefit a low-income geographic area as defined in the Part 1 Definitions? Yes _X_ No ____

Categories (select applicable activities that will be included in the project and used for scoring criterion):

Capacity Building and Planning Grants

☐ Floodplain Staff Capacity.

☐ Resilience Plan Development

- ☐ Revisions to existing resilience plans and modifications to existing comprehensive and hazard mitigation plans.
- ☐ Resource assessments, planning, strategies, and development.
  - Policy management and/or development.
  - Stakeholder engagement and strategies.

☐ Other: _____

Study Grants (Check All that Apply)

☐ Studies to aid in updating floodplain ordinances to maintain compliance with the NFIP, or to incorporate higher standards that may reduce the risk of flood damage. This must include establishing processes for implementing the ordinance, including but not limited to, permitting, record retention, violations, and variances. This may include revising a floodplain ordinance when the community is getting new Flood Insurance Rate Maps (FIRMs), updating a floodplain ordinance to include floodplain setbacks, freeboard, or other

higher standards, RiskMAP public noticing requirements, or correcting issues identified in a Corrective Action Plan.

- ☐ Revising other land use ordinances to incorporate flood protection and mitigation goals, standards, and practices.
- ☐ Conducting hydrologic and hydraulic (H&H) studies of floodplains. *Changes to the base flood, as demonstrated by the H&H must be submitted to FEMA within 6 months of the data becoming available.*
- ☐ Studies and Data Collection of Statewide and Regional Significance.
- ☐ Revisions to existing resilience plans and modifications to existing comprehensive and hazard.
- ☐ Other relevant flood prevention and protection project or study.

Project Grants and Loans (Check All that Apply – Hybrid Solutions will include items from both the "Nature-Based" and "Other" categories)

Nature-based solutions

- ☒ Acquisition of property (or interests therein) and/or structures for purposes of allowing floodwater inundation, strategic retreat of existing land uses from areas vulnerable to flooding; the conservation or enhancement of natural flood resilience resources; or acquisition of structures, provided the acquired property will be protected in perpetuity from further development, and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition.
- ☐ Wetland restoration.
- ☒ Floodplain restoration.
- ☐ Construction of swales and settling ponds.
- ☐ Living shorelines and vegetated buffers.
- ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by *ConserveVirginia* Floodplain and Flooding Resilience layer or a similar data driven analytic tool, or the acquisition of developed land for future conservation.
- ☐ Dam removal.
- ☐ Stream bank restoration or stabilization.
- ☐ Restoration of floodplains to natural and beneficial function.

Other Projects

- ☐ Structural floodwalls, levees, berms, flood gates, structural conveyances.
- ☒ Storm water system upgrades.
- ☐ Medium and large-scale Low Impact Development (LID) in urban areas.

- ☐ Developing flood warning and response systems, which may include gauge installation, to notify residents of potential emergency flooding events.
- ☐ Dam restoration.
- ☐ Beneficial reuse of dredge materials for flood mitigation purposes
- ☐ Removal or relocation of structures from flood-prone areas where the land will not be returned to open space.
- ☒ Acquisition of property (or interests therein) and/or structures for purposes of allowing floodwater inundation, strategic retreat of existing land uses from areas vulnerable to flooding; the conservation or enhancement of natural flood resilience resources; or acquisition of structures, provided the acquired property will be protected in perpetuity from further development, and where the flood mitigation benefits will **not be** achieved as a part of the same project as the property acquisition.
- ☐ Other project identified in a DCR-approved Resilience Plan.

Location of Project or Activity (Include Maps): See Included Map: Appendix C: Checklist All Categories - Detailed Map of Project Area

NFIP Community Identification Number (CID#) : _____

Is Project Located in an NFIP Participating Community? ☒ Yes ☐ No

Is Project Located in a Special Flood Hazard Area? ☐ Yes ☐ No

Flood Zone(s) (If Applicable): _____

Flood Insurance Rate Map Number(s) (If Applicable): _____

Total Cost of Project: $4,097,246.00

Total Amount Requested $3,892,384.00

Amount Requested as Grant $3,892,384.00

Amount Requested as Project Loan (not including short-term loans for up-front costs) $0.00

Amount Requested as Short-Term loan for Up-Front Costs (not to exceed 20% of amount requested as Grant) $0.00

For projects, planning, capacity building, and studies in low-income geographic areas: Are you requesting that match be waived? □ Yes ☒ No

Additional Information for Loan Requests

Requested Loan Security: _____

(General Obligation, Lease, Revenue, Special Fund Revenue, and/or Moral obligation from other government entity)

Desired loan term: _____

Since the date of your latest financial statements, did the applicant issue any new debt? _____
(If yes, provide details)

Is there any pending or potential litigation by or against the applicant? _____

Attach five years of current audited financial statements (FY18-22) or refer to website if posted
(Not necessary for existing VRA borrowers)

Attach FY2024 adopted budget or refer to website

Attach current Capital Improvement Plan

Attach adopted Financial Policies

Attach a list of the ten largest employers in the Applicant's jurisdiction.

Attach a list of the ten largest taxpayers in the Applicant's jurisdiction

Appendix B: Budget Narrative Template

Applicant Name:
Community Flood Preparedness Fund &
Resilient Virginia Revolving Loan Fund
Detailed Budget Narrative
Period of Performance: January 2024 through July 2026
Submission Date: November 21 2023

Grand Total State Funding Request	$ 3,892,384
Grand Total Local Share of Project	$ 204,862
Federal Funding (if applicable)	$
Project Grand Total	$ 4,097,246
Locality Cost Match	% 5

Breakout By Cost Type	Personnel	Fringe	Travel	Equipment	Supplies	Contracts	Indirect Costs	Other Costs	Total
Federal Share (if applicable)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Local Share	$0.00	$0.00	$0.00	$0.00	$0.00	$204,095	$0.00	$2,770	$206,865
State Share	$0.00	$0.00	$0.00	$0.00	$0.00	$3,877,811	$0.00	$0.00	$3,877,811
Pre-Award/Startup	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$250.00	$250.00
Maintenance	$0.00	$0.00	$0.00	$5,000	$5,000	$0.00	$0.00	$2,320	$12,320
Total	$ 0.00	$ 0.00	$ 0.00	$ 5,000	$ 5,000	$4,081,906	$ 0.00	$5,340	$ 4,097,246

Appendix C: Checklist All Categories

(Benefit-cost analysis must be included if the proposed Project is over $2 million.)

Virginia Department of Conservation and Recreation

Community Flood Preparedness Fund Grant Program

☒ Detailed map of the project area(s) (Projects/Studies)
- See included map of project area
- See included conceptual plans containing project area

☒ FIRMette of the project area(s) (Projects/Studies)
- See included FIRMette of the project area

☒ Historic flood damage data and/or images (Projects/Studies)
- See included images of historic flood damage

☒ A link to or a copy of the current floodplain ordinance

https://library.municode.com/VA/Christiansburg/CODES/Code_of_Ordinances?nodeId=SPBLADERE_CH42ZO_ARTXVFLDIFP_S42-440OFFLDIZOMA

☒ Non-Fund financed maintenance and management plan for project extending a minimum of 10 years from project close
- See included non-Fund financed maintenance and management plan for the project

☒ A link to or a copy of the current comprehensive plan

https://www.christiansburg.org/DocumentCenter/View/6316

☒ Social vulnerability index score(s) for the project area from VFRIS SVI Layer
- See included social vulnerability index scores

☐ If applicant is not a town, city, or county, letters of support from affected localities

☐ Letter of support from impacted stakeholders

☒ Budget Narrative
- See included budget narrative

☒ Supporting Documentation, including the Benefit-Cost Analysis tool/narrative (for projects over $2 million)
- See included FEMA Benefit-Cost Analysis tool output for this project

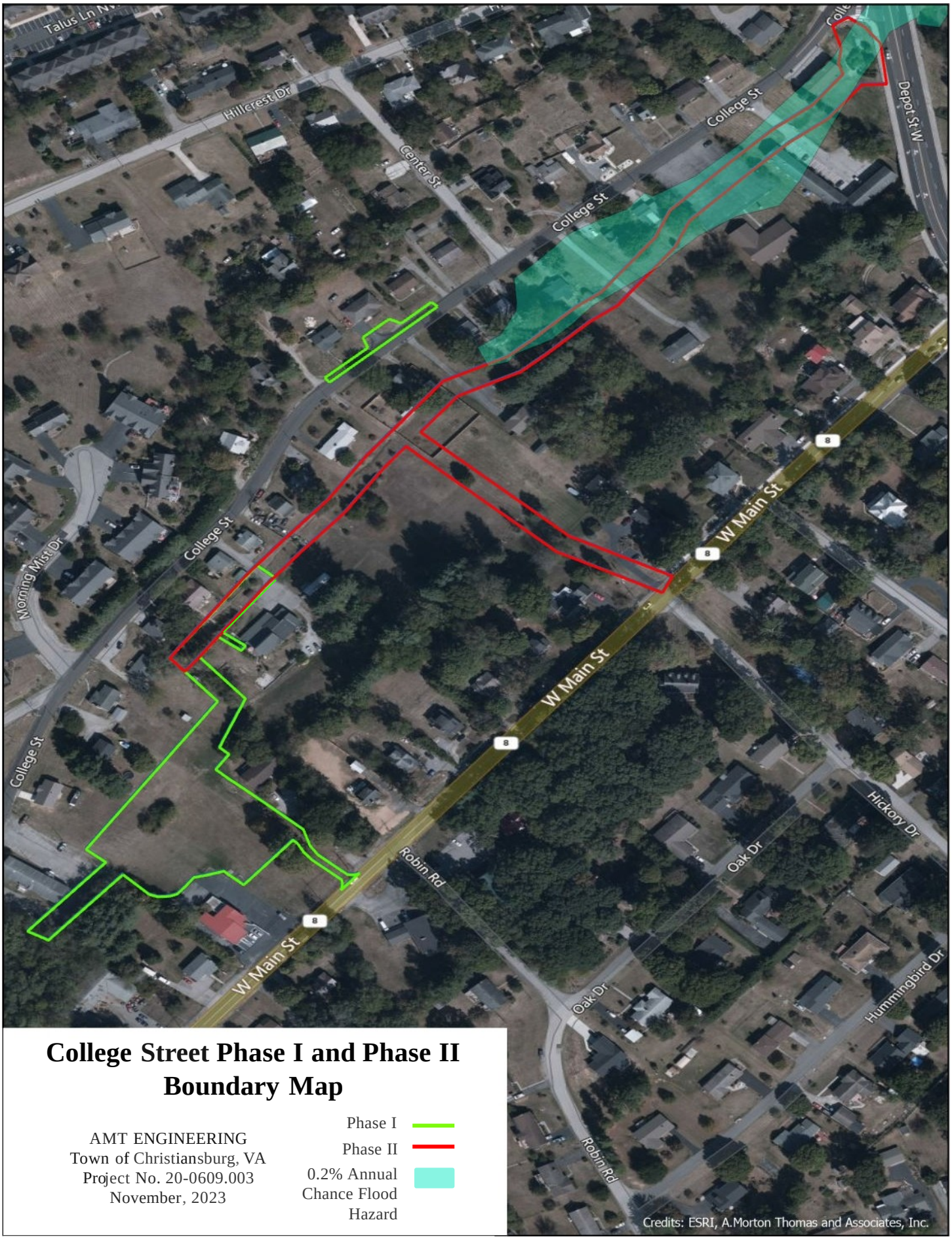
☒ Authorization to request funding from the Fund from governing body or chief executive of the local government
- See included authorization to request funding from the Fund from governing body or chief executive of the local government
- See included authorization to request funding from the Fund from governing body or chief executive of the local government - Approval of the Town of Christiansburg Flood Resilience Plan

☐ Signed pledge agreement from each contributing organization

☒ Detailed budget and narrative for all costs

- See included detailed budget and narrative for all cost

Appendix C: Checklist All Categories - Detailed Map of Project Area



College Street Phase I and Phase II Boundary Map

AMT ENGINEERING
Town of Christiansburg, VA
Project No. 20-0609.003
November, 2023

Phase I
Phase II
0.2% Annual Chance Flood Hazard

Christiansburg Middle School
Melody Dr
Wingsong Ln
Underwood St
Queensberry St
Power St
Clearview Dr
James St
Brackens St
Sullivan St
New St
Depot St. NW
EX. BMP WINDSONG HEIGHTS
Hillcrest Dr
Lee Hwy Ct
Radford St
Taylor St
Shelman St
EX. BMP MIDDLE COURT TOWNHOMES
NEW BMP FOR FUTURE DEVELOPMENT
EX. BMP CHRISTIANSBURG MIDDLE SCHOOL
EX. BMP KYLE MANOR
Buffalo Dr
Morning Mist Dr
Center St
FLOW MONITOR LOCATION 4
EX. BMP GOOD SAMARITAN HOSPICE
Moose Dr
College St
FLOW MONITOR LOCATION 3
EX. BMP DEPOT STREET
Eans Cir
Dunkley St
Hickok St
EX. BMP MUD PIKE STORAGE
FLOW MONITOR LOCATION 2
FLOW MONITOR LOCATION 1
EX. BMP COLLEGE STREET APARTMENTS
Mud Pike
W Main St
EX. BMP MUD PIKE AT MOOSE DR
FUTURE DEVELOPMENT PROJECT
South Hill Dr
Auburn Dr
Robin Rd
Hickory Dr
Grove Ln
Cherry Ln
Highview St
Oak Dr
1st ST SW
Angle Dr
Longview Dr
Chrisman St
Phlegar St
1st St
Floyd St
Hummingbird Dr
2nd St
Mitchell St
Cooper Ln
3rd St
LOWER WATERSHED (80± ACRES)
Cardinal Dr
EX. BMP SOUTH HILL PARK
Mountainway Dr
UPPER WATERSHED (198± ACRES)
Roseland Dr
4th St
Carson Dr
Roundhill Dr
I-81
Atkinson Rd

LEGEND

- PROPERTY LINE
- EXISTING EDGE OF PAVEMENT
- EXISTING SANITARY SEWER
- EXISTING WATER LINE
- EXISTING STORM SEWER
- EXISTING CREEK LINE
- EXISTING CATCH BASIN
- EXISTING FIRE HYDRANT
- EXISTING WATER VALVE
- EXISTING SANITARY MANHOLE
- EXISTING BMP
- DRAINAGE AREA BOUNDARY
- 25 YEAR FLOODPLAIN BOUNDARY
- 25 YEAR FLOOD LIMITS (ESTIMATED)

0 200' 400'
SCALE: 1"=200'

Date	D. PAPA	L. LANGLOIS	D. RISSMEYER	–
	05/21	05/21	05/21	
	Designed	Drawn	Checked	Approved

COMMONWEALTH OF VIRGINIA
DONALD J. RISSMEYER
No. 26104
PROFESSIONAL ENGINEER
NOT FOR CONSTRUCTION

Town of Christiansburg – College Street
Existing Conditions
Conceptual Design Plans
Town of Christiansburg, VA

A. MORTON THOMAS AND ASSOCIATES, INC.
CONSULTING ENGINEERS

AMT Project No.
20-0609.001

Drawing Name
C1-1

Sheet 1 of 5

X:\RICHMOND\20-0609.001 - TOWN OF CHRISTIANSBURG COLLEGE STREET\05-CAD\20609.001-EXIST.DWG, 4/22/2021 10:05 AM, DPAPA

OPTIMIZE EXISTING BMP IN PHASE 3

OPTIMIZE EXISTING BMP

CLEAN AND REPAIR EXISTING STORM DRAIN SYSTEM (1,090± L.F.)

EXISTING BMP TO REMAIN

OPTIMIZE EXISTING BMP IN PHASE 3

EXISTING BMP TO REMAIN

Q25 FLOOD LIMITS

CLEAN AND REPAIR EXISTING CMP NEAR THE MASONIC LODGE (380± L.F.)

EXISTING BMP TO REMAIN

BMPS TO BE OPTIMIZED

Christiansburg Middle School

Melody Dr

Wingsong Ln

Underwood St

Quesenberry St

Clearview Dr

Radford St

Hillcrest Dr

Lee Hwy Ct

Center St

Buffalo Dr

Morning Mist Dr

Moose Dr

College St

Depot St NW

W Main St

Mud Pike Dr

South Hill Dr

Auburn Dr

Robin Rd

Hickory Dr

Grove Ln

Cherry Ln

Oak Dr

LEGEND

- PROPERTY LINE
- EXISTING EDGE OF PAVEMENT
- EXISTING SANITARY SEWER
- EXISTING WATER LINE
- EXISTING STORM SEWER
- EXISTING CREEK LINE
- EXISTING CATCH BASIN
- EXISTING FIRE HYDRANT
- EXISTING WATER VALVE
- EXISTING SANITARY MANHOLE
- EXISTING BMP
- PROPOSED STORM SEWER

0 62.5' 125'
SCALE: 1"=125'

	D. PAPA	L. LANGLOIS	D. RISSMEYER	–
Designed				
Drawn				
Checked				
Approved				
Date	05/21	05/21	05/21	

COMMONWEALTH OF VIRGINIA
DONALD J. RISSMEYER
No. 26104
PROFESSIONAL ENGINEER

Town of Christiansburg – College Street
Alternative 1
Conceptual Design Plans
Town of Christiansburg, VA

A. MORTON THOMAS AND ASSOCIATES, INC.
CONSULTING ENGINEERS

AMT Project No.
20-0609.001

Drawing Name
C1-2

Sheet 2 of 5

X:\RICHMOND\20-0609.001 - TOWN OF CHRISTIANSBURG COLLEGE STREET\05-CAD\20609.001-ALT-1.DWG, 4/22/2021 2:50 PM, DPAPA

Christiansburg Middle School
Melody Dr
Wingsong Ln
Underwood St
Quesenberry St
Clearview Dr
Radford St
Hillcrest Dr
Lee Hwy Ct
Buffalo Dr
Morning Mist Dr
Center St
Moose Dr
College St
Depot St NW
W Main St
Mud Pike Dr
South Hill Dr
Auburn Dr
Robin Rd
Hickory Dr
Grove Ln
Cherry Ln
Oak Dr
DI-2
DI-3
DI-4
DI-5
DI-7
DI-7 RISER
704 L.F. 24" HDPE
308 L.F. 30" HDPE
172 L.F. 30" HDPE
339 L.F. 24" HDPE
RELOCATE SHED
HEADWALL
HEADWALL
PROPOSED BMP FOR STORMWATER DETENTION
EXIST. DI

LEGEND

- PROPERTY LINE
- EXISTING EDGE OF PAVEMENT
- EXISTING SANITARY SEWER
- EXISTING WATER LINE
- EXISTING STORM SEWER
- EXISTING CREEK LINE
- EXISTING CATCH BASIN
- EXISTING FIRE HYDRANT
- EXISTING WATER VALVE
- EXISTING SANITARY MANHOLE
- EXISTING BMP
- PROPOSED STORM SEWER
- PROPOSED DI-7
- PROPOSED STORM SEWER ALIGNMENT

0 62.5' 125'
SCALE: 1"=125'

Date	Designed	Drawn	Checked	Approved
05/21	D. PAPA	L. LANGLOIS	D. RISSMEYER	–

COMMONWEALTH OF VIRGINIA
DONALD J. RISSMEYER
No. 26104
PROFESSIONAL ENGINEER
NOT FOR CONSTRUCTION

Town of Christiansburg – College Street
Alternative 2A
Conceptual Design Plans
Town of Christiansburg, VA

A. Morton Thomas and Associates, Inc.
Consulting Engineers

AMT Project No.
20-0609.001

Drawing Name
C1-3

Sheet 3 of 5

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Christiansburg Middle School
Melody Dr
Wingsong Ln
Underwood St
Quesenberry St
Clearview Dr
Radford St
Hillcrest Dr
Lee Hwy Ct
Center St
Buffalo Dr
Morning Mist Dr
Moose Dr
College St
Depot St NW
W Main St
Mud Pike Dr
South Hill Dr
Auburn Dr
Robin Rd
Hickory Dr
Grove Ln
Cherry Ln
Oak Dr

DI-1
DI-2
DI-3
DI-4
DI-7

654 L.F. 36" HDPE
267 L.F. 36" RCP
308 L.F. 36" HDPE
172 L.F. 36" HDPE
358 L.F. DUAL 30" HDPE
339 L.F. 24" HDPE
RELOCATE SHED

LEGEND

- PROPERTY LINE
- EXISTING EDGE OF PAVEMENT
- EXISTING SANITARY SEWER
- EXISTING WATER LINE
- EXISTING STORM SEWER
- EXISTING CREEK LINE
- EXISTING CATCH BASIN
- EXISTING FIRE HYDRANT
- EXISTING WATER VALVE
- EXISTING SANITARY MANHOLE
- EXISTING BMP
- PROPOSED STORM SEWER
- PROPOSED DI-7
- PROPOSED STORM SEWER ALIGNMENT

0 62.5' 125'
SCALE: 1"=125'

Date	Designed	Drawn	Checked	Approved
05/21	D. PAPA	L. LANGLOIS	D. RISSMEYER	–

COMMONWEALTH OF VIRGINIA
DONALD J. RISSMEYER
No. 26104
PROFESSIONAL ENGINEER

Town of Christiansburg – College Street
Alternative 2B
Conceptual Design Plans
Town of Christiansburg, VA

A. Morton Thomas and Associates, Inc.
Consulting Engineers

AMT Project No.
20-0609.001

Drawing Name
C1-4

Sheet 4 of 5

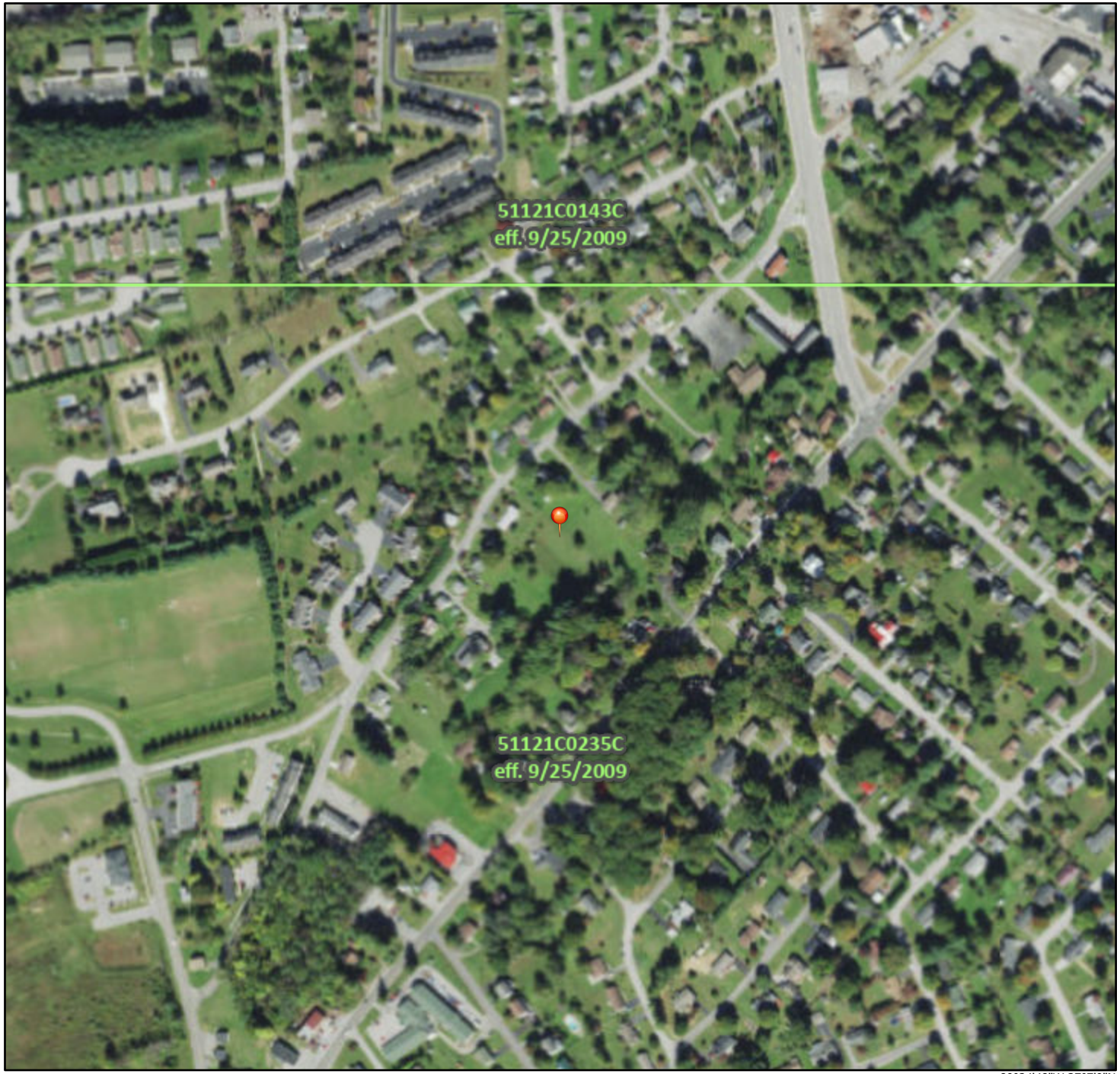
X:\RICHMOND\20-0609.001 - TOWN OF CHRISTIANSBURG COLLEGE STREET\05-CAD\20609.001-ALT-3NEW.DWG, 4/22/2021 2:05 PM, DPAPA


EXPAND EXISTING BMP TO PROVIDE MORE DETENTION
RAIN GARDEN TO ELIMINATE PONDING
ADD 2' BERM TO PROVIDE MORE DETENTION AND PROTECT COLLEGE ST
192 L.F. 27"x43" ELIP
277 L.F. 48" HDPE
187 L.F. 48" HDPE
383 L.F. 48" HDPE
Christiansburg Middle School
College St
W Main St
Depot St NW
Hillcrest Dr
Mud Pike Dr
LEGEND
PROPERTY LINE
EXISTING EDGE OF PAVEMENT
EXISTING SANITARY SEWER
EXISTING WATER LINE
EXISTING STORM SEWER
EXISTING CREEK LINE
EXISTING CATCH BASIN
EXISTING FIRE HYDRANT
EXISTING WATER VALVE
EXISTING SANITARY MANHOLE
EXISTING BMP
PROPOSED STORM SEWER
SCALE: 1"=200'
Designed D. PAPA 05/21
Drawn L. LANGLOIS 05/21
Checked D. RISSMEYER 05/21
Approved
COMMONWEALTH OF VIRGINIA
DONALD J. RISSMEYER
Lic. No. 26104
PROFESSIONAL ENGINEER
Town of Christiansburg – College Street
Alternative 3
Conceptual Design Plans
Town of Christiansburg, VA
AMT
A. MORTON THOMAS AND ASSOCIATES, INC.
CONSULTING ENGINEERS
AMT Project No. 20-0609.001
Drawing Name C1-5
Sheet 5 of 5
X:\RICHMOND\20-0609.001 - TOWN OF CHRISTIANSBURG COLLEGE STREET\05-CAD\200609.001-ALT-4.DWG, 4/22/2021 11:00 AM, DPAPA

National Flood Hazard Layer FIRMette

FEMA

80°25'25"W 37°7'38"N



80°24'48"W 37°7'9"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/8/2023 at 9:19 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

May 2020 College St. Flooding

Appendix C: Checklist All Categories - Non-Fund financed maintenance and management plan for project extending a minimum of 10 years from project close

Maintenance and Management Plan

College Street Drainage Project Phase I and II

Town of Christiansburg

The College Street Drainage Project Phase I and Phase II project will create a new pond and landscaping that will be the responsibility of the Town's Department of Public Works to maintain. The Town has an existing maintenance program (linked here) for its facilities and assets and this site will be added to the inventory. The area will require minimal maintenance other than periodic mowing of the BMP to remove unwanted vegetation. Inspections of the BMP including trees and vegetation will be performed by Public Works to ensure continued functionality. Periodic trash and debris removal will also be required.

Appendix C: Checklist All Categories - Social Vulnerability Index Score(s) For The Project Area

College Street Drainage Project - Phase I

Project Eligible for Consideration		
Scoring Information		
Criterion	**Point Value**	**Points Awarded**
Projects may have components of both a. and b. below; however, only one category may be chosen. The category chosen must be identified as the primary project in the application.		
a. Acquisition of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures (and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition).	30	
☐ Wetland restoration. ☐ Floodplain restoration. ☐ Construction of swales and settling ponds. ☐ Living shorelines and vegetated buffers. ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by ConserveVirginia Floodplain and Flooding Resilience layer or a similar data driven analytic tool. ☐ Dam removal ☐ Stream bank restoration or stabilization. ☐ Restoration of floodplains to natural and beneficial function.	25	**25**
b. any other nature-based approach	20	**5**
Is the project area socially vulnerable? (Based on ADAPT VA's Social Vulnerability Index Score.)		
Very High Social Vulnerability (More than 1.5)	10	
High Social Vulnerability (1.0 to 1.5)	8	
Moderate Social Vulnerability (0.0 to 1.0)	5	
Low Social Vulnerability (-1.0 to 0.0)	0	**0**
Low Social Vulnerability (-1.0 to 0.0)	0	
Is the proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?		
Yes	5	
No	0	**0**
Is the proposed project in a low-income geographic area as defined in the DCR manual?		
Yes	10	**10**
No	0	
Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?		
Yes	5	
No	0	**0**
Does this project provide "community scale" benefits?		
Yes	30	**30**
No	0	
Total Points		**70**

Appendix C: Checklist All Categories - Social Vulnerability Index Score(s) For The Project Area

College Street Drainage Project - Phase II

Project Eligible for Consideration		
Scoring Information		
Criterion	**Point Value**	**Points Awarded**
Projects may have components of both a. and b. below; however, only one category may be chosen. The category chosen must be identified as the primary project in the application.		
a. Acquisition of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures (and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition).	30	
☐ Wetland restoration. ☐ Floodplain restoration. ☐ Construction of swales and settling ponds. ☐ Living shorelines and vegetated buffers. ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by ConserveVirginia Floodplain and Flooding Resilience layer or a similar data driven analytic tool. ☐ Dam removal ☐ Stream bank restoration or stabilization. ☐ Restoration of floodplains to natural and beneficial function.	25	**25**
b. any other nature-based approach	20	**5**
Is the project area socially vulnerable? (Based on ADAPT VA's Social Vulnerability Index Score.)		
Very High Social Vulnerability (More than 1.5)	10	
High Social Vulnerability (1.0 to 1.5)	8	
Moderate Social Vulnerability (0.0 to 1.0)	5	
Low Social Vulnerability (-1.0 to 0.0)	0	**0**
Low Social Vulnerability (-1.0 to 0.0)	0	
Is the proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?		
Yes	5	
No	0	**0**
Is the proposed project in a low-income geographic area as defined in the DCR manual?		
Yes	10	**10**
No	0	
Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?		
Yes	5	
No	0	**0**
Does this project provide "community scale" benefits?		
Yes	30	**30**
No	0	
Total Points		**70**

Budget Narrative

College Street Drainage Project Phase I and II

Town of Christiansburg

The College Street Drainage Project Phase I and Phase II engineering and construction cost estimate is $4,081,906. The Phase I estimate is provided below and is at 90% design. The Phase II estimate is also provided below and is at 60% design at the writing of this grant application. The Town of Christiansburg will manage and administer this project, which will require Town staff time for project management and inspection during project mobilization and construction. Additionally, post-construction maintenance as detailed in the maintenance plan will require Public Works time for inspection and performance of maintenance as needed. Implementation of the maintenance plan will also require equipment to perform periodic mowing and removal of any accumulated trash or debris in the completed project area. The total project estimate incorporating these costs is $4,097,246.

COLLEGE STREET DRAINAGE IMPROVEMENTS - PHASE I

October 2023 - 90% COST ESTIMATE

ITEM NO.	DESCRIPTION	UNIT PRICE	QUANTITY	UNIT	COST
	ENGINEERING COSTS				
1	AMT Surveying & Engineering Design	$230,380.00	0.6	LS	$138,228.00
2	AMT Property Acquisition Assistance	$70,495.00	1	LS	$70,495.00
	ENGINEERING COSTS SUBTOTAL				**$208,723.00**
	GENERAL CONDITIONS				
3	Mobilization and Temporary Facilities	$140,000.00	0.5	LS	$70,000.00
4	Bonds, Taxes, Permits, and Insurance	$50,000.00	0.5	LS	$25,000.00
5	As-Builts/Survey Stakeout	$30,000.00	0.5	LS	$15,000.00
6	Traffic Control Measures	$50,000.00	0.5	LS	$25,000.00
	GENERAL CONDITIONS SUBTOTAL				**$135,000.00**
	SITE PREPARATION & EROSION AND SEDIMENT CONTROL				
7	Erosion and Sediment Control Measures	$125,285.65	1	LS	$125,285.65
8	Site Clearing & Grubbing	$75,000.00	0.5	LS	$37,500.00
	SITE PREPARATION & EROSION AND SEDIMENT CONTROL SUBTOTAL				**$162,785.65**
	PHASE I				
9	30" Diameter - HDPE	$170.70	420	LF	$71,694.00
10	30" Diameter - RCP	$250.00	170	LF	$42,500.00
11	4 ft Square Conc. Manhole Structures	$8,000.00	8	ea	$64,000.00
12	6 ft Square Conc. Manhole Structures	$14,000.00	1	ea	$14,000.00
13	VDOT SWM-DR Trash Rack for 4 ft Square	$5,000.00	1	ea	$5,000.00
14	30" HDPE Flared End Section	$1,500.00	3	ea	$4,500.00
15	30" Concrete Flared End Section	$2,500.00	1	ea	$2,500.00
16	Drop Inlet Structures DI-7	$6,942.06	1	ea	$6,942.06
17	Drop Inlet Structures DI-5	$5,983.82	6	ea	$35,902.92
18	Standard flat manhole top with frame and cover	$4,000.00	1	ea	$4,000.00
19	Flexamat-Plus Erosion Control Mat	$50.00	220	SY	$11,000.00
20	VDOT Class I Riprap	$201.26	0	tons	$0.00
21	Concrete Retaining Wall	$200,436.00	1	LS	$200,436.00
22	48" Picket Fence (Brushed Bronze)	$120.00	800	LF	$96,000.00
23	Basin Excavation/Waste	$67.74	7400	CY	$501,276.00
24	24"x35" Elliptical Concrete Pipe	$200.00	192	LF	$38,400.00
25	24" Diameter - HDPE	$121.51	22	LF	$2,673.22
26	Trench Excavation/Backfill or Waste	$67.74	822	CY	$55,682.28
	PHASE I				**$1,156,506.48**
	SITE & UTILITY RESTORATION WORK				
27	Asphalt Pavement Replacements	$150.00	110	SY	$16,500.00
28	Existing Structure Relocation/Removals	$15,000.00		LS	$0.00
29	Dry Utilities Relocation	$5,000.00	1	LS	$5,000.00
30	Wet Utilities Relocation (SS)	$5,000.00	1	LS	$5,000.00
31	8" Diameter - PVC (SS)	$80.00	260	LF	$20,800.00
32	6" Diameter - PVC (SS)	$60.00	130	LF	$7,800.00
33	6" Diameter - PVC Cleanout (SS)	$1,000.00	1	LS	$1,000.00
34	4 ft Diameter Conc. Manhole Structures (SS)	$8,000.00	3	ea	$24,000.00
35	Topsoil and Permanent Stabilization	$15,000.00	0.75	LS	$11,250.00
36	Residence Pump Station for 962 College St	$5,000.00	1	LS	$5,000.00
	SITE & UTILITY RESTORATION SUBTOTAL				**$96,350.00**
	SUBTOTAL CONSTRUCTION COST				**$1,759,365.13**
	Construction Engineering & Inspection	8%	1	LS	$140,749.21
	Construction Contingency	15%	1	LS	$263,905.00
	CONSTRUCTION COST				**$2,164,019.34**
	Land Acquisition Budget (3 Parcels)	$100,000			$100,000.00
	TOTAL PROJECT COST				**$2,264,019.34**

Appendix C: Checklist All Categories - Budget Narrative

COLLEGE STREET DRAINAGE IMPROVEMENTS - PAHASE II

May 2023 - 60% COST ESTIMATE

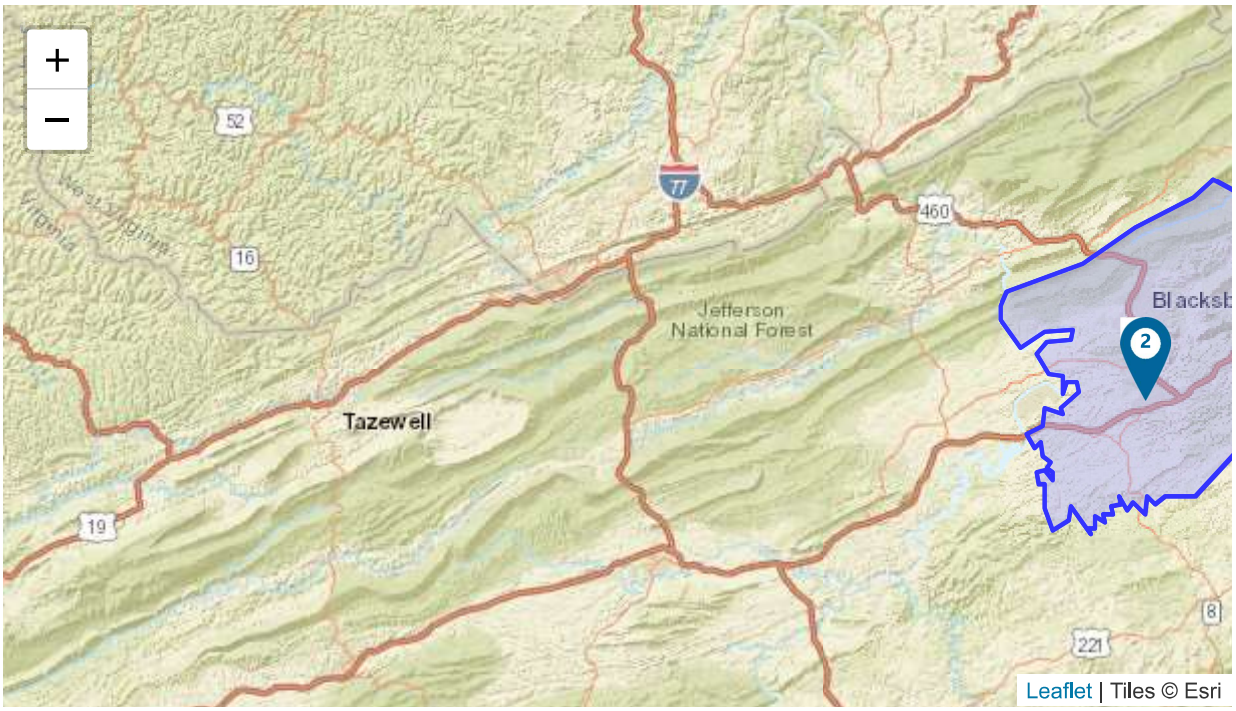
ITEM NO.	DESCRIPTION	UNIT PRICE	QUANTITY	UNIT	COST
	ENGINEERING COSTS				
1	AMT Surveying & Engineering Design	$230,380.00	0.6	LS	$138,228.00
2	AMT Property Acquisition Assistance	$70,495.00	0.7	LS	$49,346.50
	ENGINEERING COSTS SUBTOTAL				**$187,574.50**
	GENERAL CONDITIONS				
3	Mobilization and Temporary Facilities	$140,000.00	0.5	LS	$70,000.00
4	Bonds, Taxes, Permits, and Insurance	$50,000.00	0.5	LS	$25,000.00
5	As-Builts/Survey Stakeout	$30,000.00	0.5	LS	$15,000.00
6	Traffic Control Measures	$50,000.00	0.5	LS	$25,000.00
	GENERAL CONDITIONS SUBTOTAL				**$135,000.00**
	SITE PREPARATION & EROSION AND SEDIMENT CONTROL				
7	Erosion and Sediment Control Measures	$96,377.14	1	LS	$96,377.14
8	Site Clearing & Grubbing	$75,000.00	0.5	LS	$37,500.00
	SITE PREPARATION & EROSION AND SEDIMENT CONTROL SUBTOTAL				**$133,877.14**
	STORMWATER POND AND PERIPHERALS				
9	30" Diameter - HDPE	$170.70		LF	$0.00
10	4 ft Diameter Conc. Manhole Structures	$8,000.00		ea	$0.00
11	Drop Inlet Structures DI-7	$6,942.06		ea	$0.00
12	Class 1 Riprap - Outlet Protection	$201.26		tons	$0.00
13	Concrete Retaining Wall	$1,000.00		LF	$0.00
14	48" Picket Fence (Brushed Bronze)	$120.00		LF	$0.00
15	Basin Excavation/Waste	$67.74		CY	$0.00
16	Trench Excavation/Backfill or Waste	$67.74		CY	$0.00
	STORMWATER POND AND PERIPHERALS SUBTOTAL				**$0.00**
	STORMWATER SYSTEM BELOW THE POND				
17	24" Diameter - HDPE	$121.51	23	LF	$2,794.73
18	30" Diameter - HDPE	$170.70	788	LF	$134,511.60
19	36" Diameter - HDPE	$214.67	344	LF	$73,846.48
20	42" Diameter - HDPE	$370.41	102	LF	$37,781.82
21	48" Diameter - HDPE	$352.34	737	LF	$259,674.58
22	27"x43" Elliptical Concrete Pipe	$235.81		LF	$0.00
23	34"x53" Elliptical Concrete Pipe	$453.71	105	LF	$47,639.55
24	Drop Inlet Structures DI-5	$5,983.82		ea	$0.00
25	Drop Inlet Structures DI-7	$6,942.06	18	ea	$124,957.08
26	Curb Inlet Structures DI-2A, 2D	$3,000.00	2	ea	$6,000.00
27	Concrete Headwalls	$5,000.00	2	ea	$10,000.00
28	Miscellaneous Concrete Slabs	$600.00	15	CY	$9,000.00
29	Trench Excavation/Backfill or Waste	$67.74	2720.9259	CY	$184,315.52
	STORMWATER SYSTEM BELOW THE POND SUBTOTAL				**$890,521.36**
	SITE & UTILITY RESTORATION WORK				
30	Asphalt Pavement Replacements	$150.00	330	SY	$49,500.00
31	Existing Structure Relocation/Removals	$15,000.00	1	LS	$15,000.00
32	Dry Utilities Relocation	$5,000.00	1	LS	$5,000.00
33	Wet Utilities Relocation	$5,000.00		LS	$0.00
34	8" Diameter - PVC	$80.00		LF	$0.00
35	4 ft Diameter Conc. Manhole Structures	$8,000.00		ea	$0.00
36	Topsoil and Permanent Stabilization	$15,000.00	0.25	LS	$3,750.00
	SITE & UTILITY RESTORATION SUBTOTAL				**$73,250.00**
	SUBTOTAL CONSTRUCTION COST				**$1,420,223.00**
	Construction Engineering & Inspection	8%	1	LS	$113,617.84
	Construction Contingency	20%	1	LS	$284,045.00
	CONSTRUCTION COST				**$1,817,885.84**
	Land Acquisition Budget (3 Parcels)	$100,000			$0.00
	TOTAL PROJECT COST				**$1,817,885.84**

FEMA Benefit-Cost Calculator

V.6.0 (Build 20231011.1703 | Release Notes)

Benefit-Cost Analysis

Project Name: College Street Drainage Phase I and II



				Using 7% Discount Rate			Using 3% Discount Rate (For BRIC and FMA only)		
Map Marker ▲	Mitigation Title	Property Type	Hazard	Benefits (B)	Costs (C)	BCR (B/C)	Benefits (B)	Costs (C)	BCR (B/C)
1	Bioretention @ 37.1278550; -80.4133500		DFA - Riverine Flood	$ 258,953	$ 0	0.00	$ 429,744	$ 0	0.00
2	Bioretention @ College St, Christiansburg, Virginia, 24073		DFA - Riverine Flood	$ 4,315,886	$ 4,000,000	1.08	$ 7,162,400	$ 4,000,000	1.79
TOTAL (SELECTED)				**$ 4,574,839**	**$ 4,000,000**	**1.14**	**$ 7,592,144**	**$ 4,000,000**	**1.90**
TOTAL				**$ 4,574,839**	**$ 4,000,000**	**1.14**	**$ 7,592,144**	**$ 4,000,000**	**1.90**

Appendix C: Checklist All Categories - Supporting Documentation, including the Benefit-Cost Analysis tool/narrative (for projects over $2 million)

Property Configuration

Property Title:	Bioretention @ 37.1278550; -80.4133500
Property Location:	24073, Montgomery, Virginia
Property Coordinates:	37.127854985710165, -80.41334999744471
Hazard Type:	Riverine Flood
Mitigation Action Type:	Bioretention
Property Type:	Green Infrastructure
Analysis Method Type:	Professional Expected Damages

Cost Estimation

Bioretention @ 37.1278550; -80.4133500

Project Useful Life (years):	35
Project Cost:	$0
Number of Maintenance Years:	35 Use Default:Yes
Annual Maintenance Cost:	$0

Damage Analysis Parameters - Damage Frequency Assessment

Bioretention @ 37.1278550; -80.4133500

Year of Analysis was Conducted:	2023
Year Property was Built:	1970
Analysis Duration:	54 Use Default:Yes

Professional Expected Damages Before Mitigation

Bioretention @ 37.1278550; -80.4133500

	OTHER	OPTIONAL DAMAGES			VOLUNTEER COSTS		TOTAL
Recurrence Interval (years)	Damages ($)	Category 1 ($)	Category 2 ($)	Category 3 ($)	Number of Volunteers	Number of Days	Damages ($)
5	100,000	0	0	0	0	0	100,000

Annualized Damages Before Mitigation

Bioretention @ 37.1278550; -80.4133500

Annualized Recurrence Interval (years)	Damages and Losses ($)	Annualized Damages and Losses ($)
5	100,000	20,000
	Sum Damages and Losses ($)	Sum Annualized Damages and Losses ($)
	100,000	20,000

Professional Expected Damages After Mitigation

Bioretention @ 37.1278550; -80.4133500

	OTHER	OPTIONAL DAMAGES			VOLUNTEER COSTS		TOTAL
Recurrence Interval (years)	Damages ($)	Category 1 ($)	Category 2 ($)	Category 3 ($)	Number of Volunteers	Number of Days	Damages ($)
100	0	0	0	0	0	0	0

Annualized Damages After Mitigation

Bioretention @ 37.1278550; -80.4133500

Annualized Recurrence Interval (years)	Damages and Losses ($)	Annualized Damages and Losses ($)
100	0	0
	Sum Damages and Losses ($)	Sum Annualized Damages and Losses ($)
	0	0

Benefits-Costs Summary

Bioretention @ 37.1278550; -80.4133500

Total Standard Mitigation Benefits:	$258,953
Total Social Benefits:	$0
Total Mitigation Project Benefits:	$258,953
Total Mitigation Project Cost:	$0
Benefit Cost Ratio - Standard:	0
Benefit Cost Ratio - Standard + Social:	0

Appendix C: Checklist All Categories - Supporting Documentation, including the Benefit-Cost Analysis tool/narrative (for projects over $2 million)

Property Configuration

Property Title:	Bioretention @ College St, Christiansburg, Virginia, 24073
Property Location:	24073, Montgomery, Virginia
Property Coordinates:	37.127854985710165, -80.41334999744471
Hazard Type:	Riverine Flood
Mitigation Action Type:	Bioretention
Property Type:	Green Infrastructure
Analysis Method Type:	Professional Expected Damages

Cost Estimation

Bioretention @ College St, Christiansburg, Virginia, 24073

Project Useful Life (years):	35
Project Cost:	$4,000,000
Number of Maintenance Years:	35 Use Default:Yes
Annual Maintenance Cost:	$0

Damage Analysis Parameters - Damage Frequency Assessment

Bioretention @ College St, Christiansburg, Virginia, 24073

Year of Analysis was Conducted:	2023
Year Property was Built:	0
Analysis Duration:	10 Use Default:Yes

Professional Expected Damages Before Mitigation

Bioretention @ College St, Christiansburg, Virginia, 24073

	OTHER	OPTIONAL DAMAGES			VOLUNTEER COSTS		TOTAL
Recurrence Interval (years)	Damages ($)	Category 1 ($)	Category 2 ($)	Category 3 ($)	Number of Volunteers	Number of Days	Damages ($)
3	1,000,000	0	0	0	0	0	1,000,000

Annualized Damages Before Mitigation

Bioretention @ College St, Christiansburg, Virginia, 24073

Annualized Recurrence Interval (years)	Damages and Losses ($)	Annualized Damages and Losses ($)
3	1,000,000	333,333
	Sum Damages and Losses ($)	Sum Annualized Damages and Losses ($)
	1,000,000	333,333

Professional Expected Damages After Mitigation

Bioretention @ College St, Christiansburg, Virginia, 24073

	OTHER	OPTIONAL DAMAGES			VOLUNTEER COSTS		TOTAL
Recurrence Interval (years)	Damages ($)	Category 1 ($)	Category 2 ($)	Category 3 ($)	Number of Volunteers	Number of Days	Damages ($)
100	0	0	0	0	0	0	0

Annualized Damages After Mitigation

Bioretention @ College St, Christiansburg, Virginia, 24073

Annualized Recurrence Interval (years)	Damages and Losses ($)	Annualized Damages and Losses ($)
100	0	0
	Sum Damages and Losses ($)	Sum Annualized Damages and Losses ($)
	0	0

Benefits-Costs Summary

Bioretention @ College St, Christiansburg, Virginia, 24073

Total Standard Mitigation Benefits:	$4,315,886
Total Social Benefits:	$0
Total Mitigation Project Benefits:	$4,315,886
Total Mitigation Project Cost:	$4,000,000
Benefit Cost Ratio - Standard:	1.08
Benefit Cost Ratio - Standard + Social:	1.08

THE PLACE TO BE.
CHRISTIANSBURG VA
Established November 10, 1792

100 East Main Street
Christiansburg, VA 24073
p: (540) 382-6128
f: (540) 382-7338

November 8, 2023

Mr. Daryl Glover
Deputy Agency Director of Dam Safety, Flood Preparedness, and Soil and Water Conservation
Department of Conservation and Recreation
60 East Main Street, 24th Floor
Richmond, Virginia 23219

RE: Town of Christiansburg Virginia Community Flood Preparedness Fund (CFPF) Grant Request

Dear Mr. Glover:

The Town of Christiansburg is pleased to submit this grant application for project funding from the CFPF fund. The Town is seeking funding for the College Street Drainage Project Phase I and Phase II project as presented in our Town adopted Flood Resilience Plan and in the College Street Drainage Study. The Town is committed to the match as proposed ($206,865). We appreciate your consideration of our complete application for CFPF funding.

Randy Wingfield
Town Manager

TOWN OF CHRISTIANSBURG
TOWN COUNCIL
AGENDA COVER SHEET

AGENDA LOCATION:
Discussion and Action by Mayor and Council

Meeting Date:
October 24, 2023

ITEM TITLE:
Discussion and Approval of the Town of Christiansburg Flood Resilience Plan

DESCRIPTION:
The Flood Resilience Plan for the Town of Christiansburg provides an overview of the flood resilience planning efforts undertaken by the Town of Christiansburg. The Flood Resilience Plan provides opportunities for improvement to current defenses and assesses the suitability of new projects and policies for the Town. The Plan examines historical flooding in the Town and reviews current and proposed strategies for flood prevention and resilience. Current and prospective projects were reviewed, scored, and placed in a ranking matrix. Communities may apply for grant funding for projects through the Virginia Community Flood Preparedness Fund (CFPF). An approved Resilience Plan is a prerequisite for submitting a funding application to the CFPF. Approval of this plan will enable the Town to tap into an additional source of funding for projects that will help to mitigate flooding in the Town.

POTENTIAL ACTION:
Request approval of the Town of Christiansburg Flood Resilience Plan

DEPARTMENT:
Administration

PRESENTER:
Town Manager Randy Wingfield

ITEM HISTORY:
The Virginia Community Flood Preparedness Fund (CFPF) was established in the Code of Virginia during the 2020 session of the General Assembly. In December 2021, the Town received a grant award in the amount of $44,520.30 from the CFPF for the development of a Resilience Plan. This grant award required a Town match of $4,946.70. On August 10, 2022, the Town entered into a contract with A. Morton Thomas and Associates, Inc. (AMT) to develop the Town of Christiansburg Flood Resilience Plan. Town Staff has work with AMT to develop this plan and the draft Flood Resilience Plan was presented to the Water and Waste Committee on August 21, 2023. The Water and Waste Committee has reviewed the Flood Resilience Plan as attached.

INFORMATION PROVIDED:

Flood Resilience Plan

AGENDA

REGULAR MEETING OF TOWN COUNCIL
CHRISTIANSBURG TOWN HALL
100 EAST MAIN STREET
OCTOBER 24, 2023 – 7:00 P.M.

(The meeting will be in-person and streamed on YouTube Live)

The meeting will be streamed live on the Town of Christiansburg's YouTube page at www.christiansburg.org/YouTube and will remain on the Town's YouTube page once the meeting concludes.

If you do not want or cannot attend the meeting in-person, there are several contactless methods for submitting public comment. To submit public comments, please visit www.christiansburg.org/publichearings. You may also leave a voicemail with your comments at 540-382-6128, ext. 1109; mail a letter to Town Hall, ATTN: Town Council, 100 E. Main Street, Christiansburg, VA 24073; use the drop box to the left of the front doors at Town Hall to leave a letter; or email info@christiansburg.org. Regardless of the method you use, please include your full name and address with your comments. Please provide comments prior to 6:00 p.m. on Tuesday, October 24, 2023, for the comments to be distributed to Town Council before the meeting.

REGULAR MEETING

I. CALL TO ORDER

A. Moment of Reflection

B. Pledge of Allegiance

II. ADJUSTMENT OF THE AGENDA

III. PUBLIC HEARINGS

A. FY 2023-24 Budget Amendment #1

B. An Exchange of Property request by the Town of Christiansburg that an approximately 0.2665-acre (11,609 square feet) southwest portion of a certain tract or parcel of land at 1025 W. Main Street (Tax Map 556 – ((A)) – 48A; Parcel ID 020000) situate, lying and being located along W. Main Street in the Town of Christiansburg, Virginia; with an equal Exchange of Property request by Jimmy Martin that the approximately 0.2665 acres (11,609 square feet) northeast portion of a certain tract or parcel of land (Tax Map 556 – ((A)) – 47; Parcel ID 004777) situate, lying and being located along W. Main Street in the Town of Christiansburg, Virginia. The exchange is for the College Street Stormwater Project.

C. 2022 U.S. Department of Housing and Urban Development (HUD) Community Development Block Grant (CDBG) Consolidated Annual Performance and Evaluation Report (CAPER)

IV. CONSENT AGENDA

A. Approval of Minutes of September 26, 2023

B. Monthly Bill List

C. Resolution Recognizing Craig Meadows for his service as Montgomery County Administrator

D. Resolution to recognize October 28, 2023 as National First Responders Day

E. Proclamation to recognize November 1, 2023 as Extra Mile Day

F. Contract Amendment #1 with CHA Consulting, Inc. for the renewal of Water, Sewer, and Wastewater Treatment Term Services in excess of $100,000 not to exceed $500,000 per task order and not to exceed $2,500,000 per annual contract term per Virginia Public Procurement Act

G. Contract Amendment #1 with Hurt and Proffitt for the renewal of Water, Sewer, and Wastewater Treatment Term Services in excess of $100,000 not to exceed $500,000 per task order and not to exceed $2,500,000 per annual contract term per Virginia Public Procurement Act

H. Contract Amendment #1 with Hazen and Sawyer for the renewal of Water, Sewer, and Wastewater Treatment Term Services in excess of $100,000 not to exceed $500,000 per task order and not to exceed $2,500,000 per annual contract term per Virginia Public Procurement Act

I. Contract Amendment #1 with McGill Associates, PA. for the renewal of Water, Sewer, and Wastewater Treatment Term Services in excess of $100,000 not to exceed $500,000 per task order and not to exceed $2,500,000 per annual contract term per Virginia Public Procurement Act

J. Contract Amendment #1 with Whitman, Requardt & Associates, LLP, for the renewal of Water, Sewer, and Wastewater Treatment Term Services in excess of $100,000 not to exceed $500,000 per task order and not to exceed $2,500,000 per annual contract term per Virginia Public Procurement Act

K. Contract with Rummel, Klepper & Kahl, LLP (RK&K) for Professional Services for the Town's North Franklin Sidewalk In-Fill project in the amount of $232,340

V. INTRODUCTIONS AND PRESENTATIONS

A. Ginny Snead, A. Morton Thomas and Associates, Inc., to present the Town of Christiansburg Flood Resilience Plan

B. Police Chief Chris Ramsey to introduce new command staff

VI. CITIZEN COMMENTS

VII. COMMITTEE REPORTS

A. Street Committee Report – Bishop, Hockett

1. Subdivision Plat and Dedication of Easements for NRV Marketplace, LLC at 2705 Market Street, NE showing Parcels G, H, N, O, P, Q, R, S, T, U, and Revised Lot 1 (creating 10 lots)

VIII. DISCUSSION AND ACTION BY MAYOR AND COUNCIL

A. Request for street closures for the Christiansburg High School Veterans Day Parade for Friday, November 10, 2023 with street closures from 8:30 a.m. - noon to include Main Street from Park Street, N.E. to Dunkley, N.W., Roanoke Street from E. Main Street to First Street, Pepper Street, S.E. from E. Main Street to First Street, Pepper Street, N.E. from E. Main Street to Hill Street, Franklin Street from First Street to Commerce Street, N.W., Hickok Street from Commerce Street, N.W. to First Street, S.W.

B. Adoption of Town of Christiansburg Flood Resilience Plan

IX. STAFF REPORTS

A. Town Manager

B. Town Attorney

C. Other Staff

X. COUNCIL REPORTS

XI. OTHER BUSINESS

XII. ADJOURNMENT

Upcoming meetings of Council:
November 14, 2023, 7:00 p.m. – Regular Meeting
November 28, 2023, 7:00 p.m. – Regular Meeting

Appendix C: Checklist All Categories - Detailed Budget and Narrative For All Cost

Budget Narrative

College Street Drainage Project Phase I and II

Town of Christiansburg

The College Street Drainage Project Phase I and Phase II engineering and construction cost estimate is $4,081,906. The Phase I estimate is provided below and is at 90% design. The Phase II estimate is also provided below and is at 60% design at the writing of this grant application. The Town of Christiansburg will manage and administer this project, which will require Town staff time for project management and inspection during project mobilization and construction. Additionally, post-construction maintenance as detailed in the maintenance plan will require Public Works time for inspection and performance of maintenance as needed. Implementation of the maintenance plan will also require equipment to perform periodic mowing and removal of any accumulated trash or debris in the completed project area. The total project estimate incorporating these costs is $4,097,246.

COLLEGE STREET DRAINAGE IMPROVEMENTS - PHASE I

October 2023 - 90% COST ESTIMATE

ITEM NO.	DESCRIPTION	UNIT PRICE	QUANTITY	UNIT	COST
	ENGINEERING COSTS				
1	AMT Surveying & Engineering Design	$230,380.00	0.6	LS	$138,228.00
2	AMT Property Acquisition Assistance	$70,495.00	1	LS	$70,495.00
	ENGINEERING COSTS SUBTOTAL				**$208,723.00**
	GENERAL CONDITIONS				
3	Mobilization and Temporary Facilities	$140,000.00	0.5	LS	$70,000.00
4	Bonds, Taxes, Permits, and Insurance	$50,000.00	0.5	LS	$25,000.00
5	As-Builts/Survey Stakeout	$30,000.00	0.5	LS	$15,000.00
6	Traffic Control Measures	$50,000.00	0.5	LS	$25,000.00
	GENERAL CONDITIONS SUBTOTAL				**$135,000.00**
	SITE PREPARATION & EROSION AND SEDIMENT CONTROL				
7	Erosion and Sediment Control Measures	$125,285.65	1	LS	$125,285.65
8	Site Clearing & Grubbing	$75,000.00	0.5	LS	$37,500.00
	SITE PREPARATION & EROSION AND SEDIMENT CONTROL SUBTOTAL				**$162,785.65**
	PHASE I				
9	30" Diameter - HDPE	$170.70	420	LF	$71,694.00
10	30" Diameter - RCP	$250.00	170	LF	$42,500.00
11	4 ft Square Conc. Manhole Structures	$8,000.00	8	ea	$64,000.00
12	6 ft Square Conc. Manhole Structures	$14,000.00	1	ea	$14,000.00
13	VDOT SWM-DR Trash Rack for 4 ft Square	$5,000.00	1	ea	$5,000.00
14	30" HDPE Flared End Section	$1,500.00	3	ea	$4,500.00
15	30" Concrete Flared End Section	$2,500.00	1	ea	$2,500.00
16	Drop Inlet Structures DI-7	$6,942.06	1	ea	$6,942.06
17	Drop Inlet Structures DI-5	$5,983.82	6	ea	$35,902.92
18	Standard flat manhole top with frame and cover	$4,000.00	1	ea	$4,000.00
19	Flexamat-Plus Erosion Control Mat	$50.00	220	SY	$11,000.00
20	VDOT Class I Riprap	$201.26	0	tons	$0.00
21	Concrete Retaining Wall	$200,436.00	1	LS	$200,436.00
22	48" Picket Fence (Brushed Bronze)	$120.00	800	LF	$96,000.00
23	Basin Excavation/Waste	$67.74	7400	CY	$501,276.00
24	24"x35" Elliptical Concrete Pipe	$200.00	192	LF	$38,400.00
25	24" Diameter - HDPE	$121.51	22	LF	$2,673.22
26	Trench Excavation/Backfill or Waste	$67.74	822	CY	$55,682.28
	PHASE I				**$1,156,506.48**
	SITE & UTILITY RESTORATION WORK				
27	Asphalt Pavement Replacements	$150.00	110	SY	$16,500.00
28	Existing Structure Relocation/Removals	$15,000.00		LS	$0.00
29	Dry Utilities Relocation	$5,000.00	1	LS	$5,000.00
30	Wet Utilities Relocation (SS)	$5,000.00	1	LS	$5,000.00
31	8" Diameter - PVC (SS)	$80.00	260	LF	$20,800.00
32	6" Diameter - PVC (SS)	$60.00	130	LF	$7,800.00
33	6" Diameter - PVC Cleanout (SS)	$1,000.00	1	LS	$1,000.00
34	4 ft Diameter Conc. Manhole Structures (SS)	$8,000.00	3	ea	$24,000.00
35	Topsoil and Permanent Stabilization	$15,000.00	0.75	LS	$11,250.00
36	Residence Pump Station for 962 College St	$5,000.00	1	LS	$5,000.00
	SITE & UTILITY RESTORATION SUBTOTAL				**$96,350.00**
	SUBTOTAL CONSTRUCTION COST				**$1,759,365.13**
	Construction Engineering & Inspection	8%	1	LS	$140,749.21
	Construction Contingency	15%	1	LS	$263,905.00
	CONSTRUCTION COST				**$2,164,019.34**
	Land Acquisition Budget (3 Parcels)	$100,000			$100,000.00
	TOTAL PROJECT COST				**$2,264,019.34**

COLLEGE STREET DRAINAGE IMPROVEMENTS - PAHASE II

May 2023 - 60% COST ESTIMATE

ITEM NO.	DESCRIPTION	UNIT PRICE	QUANTITY	UNIT	COST
	ENGINEERING COSTS				
1	AMT Surveying & Engineering Design	$230,380.00	0.6	LS	$138,228.00
2	AMT Property Acquisition Assistance	$70,495.00	0.7	LS	$49,346.50
	ENGINEERING COSTS SUBTOTAL				**$187,574.50**
	GENERAL CONDITIONS				
3	Mobilization and Temporary Facilities	$140,000.00	0.5	LS	$70,000.00
4	Bonds, Taxes, Permits, and Insurance	$50,000.00	0.5	LS	$25,000.00
5	As-Builts/Survey Stakeout	$30,000.00	0.5	LS	$15,000.00
6	Traffic Control Measures	$50,000.00	0.5	LS	$25,000.00
	GENERAL CONDITIONS SUBTOTAL				**$135,000.00**
	SITE PREPARATION & EROSION AND SEDIMENT CONTROL				
7	Erosion and Sediment Control Measures	$96,377.14	1	LS	$96,377.14
8	Site Clearing & Grubbing	$75,000.00	0.5	LS	$37,500.00
	SITE PREPARATION & EROSION AND SEDIMENT CONTROL SUBTOTAL				**$133,877.14**
	STORMWATER POND AND PERIPHERALS				
9	30" Diameter - HDPE	$170.70		LF	$0.00
10	4 ft Diameter Conc. Manhole Structures	$8,000.00		ea	$0.00
11	Drop Inlet Structures DI-7	$6,942.06		ea	$0.00
12	Class 1 Riprap - Outlet Protection	$201.26		tons	$0.00
13	Concrete Retaining Wall	$1,000.00		LF	$0.00
14	48" Picket Fence (Brushed Bronze)	$120.00		LF	$0.00
15	Basin Excavation/Waste	$67.74		CY	$0.00
16	Trench Excavation/Backfill or Waste	$67.74		CY	$0.00
	STORMWATER POND AND PERIPHERALS SUBTOTAL				**$0.00**
	STORMWATER SYSTEM BELOW THE POND				
17	24" Diameter - HDPE	$121.51	23	LF	$2,794.73
18	30" Diameter - HDPE	$170.70	788	LF	$134,511.60
19	36" Diameter - HDPE	$214.67	344	LF	$73,846.48
20	42" Diameter - HDPE	$370.41	102	LF	$37,781.82
21	48" Diameter - HDPE	$352.34	737	LF	$259,674.58
22	27"x43" Elliptical Concrete Pipe	$235.81		LF	$0.00
23	34"x53" Elliptical Concrete Pipe	$453.71	105	LF	$47,639.55
24	Drop Inlet Structures DI-5	$5,983.82		ea	$0.00
25	Drop Inlet Structures DI-7	$6,942.06	18	ea	$124,957.08
26	Curb Inlet Structures DI-2A, 2D	$3,000.00	2	ea	$6,000.00
27	Concrete Headwalls	$5,000.00	2	ea	$10,000.00
28	Miscellaneous Concrete Slabs	$600.00	15	CY	$9,000.00
29	Trench Excavation/Backfill or Waste	$67.74	2720.9259	CY	$184,315.52
	STORMWATER SYSTEM BELOW THE POND SUBTOTAL				**$890,521.36**
	SITE & UTILITY RESTORATION WORK				
30	Asphalt Pavement Replacements	$150.00	330	SY	$49,500.00
31	Existing Structure Relocation/Removals	$15,000.00	1	LS	$15,000.00
32	Dry Utilities Relocation	$5,000.00	1	LS	$5,000.00
33	Wet Utilities Relocation	$5,000.00		LS	$0.00
34	8" Diameter - PVC	$80.00		LF	$0.00
35	4 ft Diameter Conc. Manhole Structures	$8,000.00		ea	$0.00
36	Topsoil and Permanent Stabilization	$15,000.00	0.25	LS	$3,750.00
	SITE & UTILITY RESTORATION SUBTOTAL				**$73,250.00**
	SUBTOTAL CONSTRUCTION COST				**$1,420,223.00**
	Construction Engineering & Inspection	8%	1	LS	$113,617.84
	Construction Contingency	20%	1	LS	$284,045.00
	CONSTRUCTION COST				**$1,817,885.84**
	Land Acquisition Budget (3 Parcels)	$100,000			$0.00
	TOTAL PROJECT COST				**$1,817,885.84**

Appendix D: Town of Christiansburg Flood Resilience Plan

TOWN OF CHRISTIANSBURG
TOWN COUNCIL
AGENDA COVER SHEET

AGENDA LOCATION:
Discussion and Action by Mayor and Council

Meeting Date:
October 24, 2023

ITEM TITLE:
Discussion and Approval of the Town of Christiansburg Flood Resilience Plan

DESCRIPTION:
The Flood Resilience Plan for the Town of Christiansburg provides an overview of the flood resilience planning efforts undertaken by the Town of Christiansburg. The Flood Resilience Plan provides opportunities for improvement to current defenses and assesses the suitability of new projects and policies for the Town. The Plan examines historical flooding in the Town and reviews current and proposed strategies for flood prevention and resilience. Current and prospective projects were reviewed, scored, and placed in a ranking matrix. Communities may apply for grant funding for projects through the Virginia Community Flood Preparedness Fund (CFPF). An approved Resilience Plan is a prerequisite for submitting a funding application to the CFPF. Approval of this plan will enable the Town to tap into an additional source of funding for projects that will help to mitigate flooding in the Town.

POTENTIAL ACTION:
Request approval of the Town of Christiansburg Flood Resilience Plan

DEPARTMENT:
Administration

PRESENTER:
Town Manager Randy Wingfield

ITEM HISTORY:
The Virginia Community Flood Preparedness Fund (CFPF) was established in the Code of Virginia during the 2020 session of the General Assembly. In December 2021, the Town received a grant award in the amount of $44,520.30 from the CFPF for the development of a Resilience Plan. This grant award required a Town match of $4,946.70. On August 10, 2022, the Town entered into a contract with A. Morton Thomas and Associates, Inc. (AMT) to develop the Town of Christiansburg Flood Resilience Plan. Town Staff has work with AMT to develop this plan and the draft Flood Resilience Plan was presented to the Water and Waste Committee on August 21, 2023. The Water and Waste Committee has reviewed the Flood Resilience Plan as attached.

INFORMATION PROVIDED:

Flood Resilience Plan

TOWN OF CHRISTIANSBURG

Flood Resilience Plan

October 10, 2023

Town of Christiansburg

100 E Main Street
Christiansburg, VA 24073
540.382.6128

A. Morton Thomas and Associates, Inc.

1166 Jamestown Road, Suite D
Williamsburg, VA 23185
757.345.3851
amtengineering.com

Table of Contents

Definitions

General Definitions

Gray Infrastructure – "Gray infrastructure is traditional stormwater infrastructure in the built environment such as gutters, drains, pipes, and retention basin" (EPA, 2023).

Green Infrastructure – "A strategically planned and managed network of natural lands, working landscapes, and other open spaces that conserves ecosystem values and functions and provides associated benefits to human populations" (Benedict, Allen, and McMahon, 2006). "Green infrastructure planning involves the coordination of "conservation values and actions in concert with land development and growth management" (Benedict, Allen, and McMahon, 2004). Examples include raingardens, rainwater harvesting systems, permeable pavement, and constructed wetlands.

Heat Island Effect – "Urbanized areas that experience higher temperatures than outlying areas. Structures such as buildings, roads, and other infrastructure absorb and re-emit the sun's heat more than natural landscapes such as forests and water bodies. Urban areas, where these structures are highly concentrated and greenery is limited, become "islands" of higher temperatures relative to outlying areas" (EPA, 2023-c).

Nature Based Approach/Solution – "An approach that reduces the impacts of flood and storm events through environmental processes and natural systems. A nature-based solution may provide additional benefits beyond flood control, including recreational opportunities and improved water quality. This includes a project that reduces these impacts by protecting, restoring, or emulating natural features (DCR.gov, n.d.).

Rainfall-derived infiltration and inflow – "is the increased portion of water flow in a sanitary sewer system that occurs during and after a rainfall as a source of operation problems in sanitary sewer systems. RDII is the main cause of sanitary sewer overflows" (EPA, 2023-b).

Resilience / Resiliency – Resilience is the ability of citizens and the institutions that shape our communities to identify risks, positively adapt, and build the capacity to respond to environmental stressors that impact our built infrastructure. Successful implementation of resilience efforts allows communities to rapidly regain functionality and vitality in the face of chronic stressors or severe disturbances.

Town / the Town – The Town of Christiansburg, Virginia

FEMA Definitions

The following definitions are derived from FEMA.gov if residential properties are added to the project list in the future:

Property Damage – Damage to personal property resulting from flooding. "Damage caused by falling water and wind is not considered flood damage" (FEMA.org, 2010).

Repetitive Loss Property – "Any insurable building for which two or more claims of more than $1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. A RL property may or may not be currently insured by the NFIP. Currently there are over 122,000 RL properties nationwide," (FEMA.gov, 2005).

Roadway Flooding – Flooding of "The portion of roads designed to carry traffic. Roads are paved or unpaved. Other public facilities may include bike paths, pedestrian ways, sidewalks and maintained trails" (FEMA.org, 2022).

Severe Repetitive Loss Property – "A single family property (consisting of 1 to 4 residences) that is covered under flood insurance by the NFIP and has incurred flood-related damage for which 4 or more separate claims payments have been paid under flood insurance coverage, with the amount of each claim payment exceeding $5,000 and with cumulative amount of such claims payments exceeding $20,000; or for which at least 2 separate claims payments have been made with the cumulative amount of such claims exceeding the reported value of the property"(FEMA.gov, 2005).

Matrix Definitions

The following definitions are derived from DCR's 2021 Criteria for ranking community projects for flood funding:

Acquisition of Property – "Acquisition of property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures" (DCR.gov, n.d.).

Community Scale Benefit/ Community Scale Project – "A project that provides demonstrable flood reduction benefits at the US census block level or greater" (DCR.gov, n.d.).

Impact NFIP Participation – (NFIP = Nation Flood Insurance Program) - This criterion answers the question, "Is this proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?" (DCR.gov, n.d.).

Low-income Geographic Area – "Any locality, or community within a locality, that has a median household income that is not greater than 80 percent of the local median household income, or any area in the Commonwealth designated as a qualified opportunity zone by the U.S. Secretary of the Treasury via his delegation of authority to the Internal Revenue Service. A project of any size within a low-income geographic area will be considered" (DCR.gov, n.d.).

Project Area Socially Vulnerable – (Based on ADAPT VA's Social Vulnerability Index Score.) (DCR.gov, n.d.). Alternatively, socially vulnerable can be defined as "the susceptibility of social groups to the adverse impacts of natural hazards, including disproportionate death, injury, loss, or disruption of livelihood" (FEMA, n.d).

TMDL Benefit – (TMDL = Total Maximum Daily Load) Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan? (DCR.gov, n.d.).

Acronyms

CFPF	Community Flood Preparedness Fund
CIP	Capital Improvement Plan
CMP	Corrugated Metal Pipe
DCR	Virginia Department of Conservation and Recreation
DEQ	Virginia Department of Environmental Quality
ESC	Erosion and Sediment Control
EPA	United States Environmental Protection Agency
GI	Green Infrastructure
GIS	Geographic Information System
MS4	Municipal Separate Storm Sewer System
n.d.	"No Date" (an abbreviation used for citations when a source does not contain a publication date).
RCP	Reinforced Concrete Pipe
RDII	Rainfall-derived infiltration and inflow
SWM	Stormwater Management
TMDL	Total Maximum Daily Load
VDOT	Virginia Department of Transportation
WLA	Waste Load Allocation

Executive Summary

This Flood Resilience Plan for the Town of Christiansburg (Plan) provides an overview of the flood resilience planning efforts undertaken by the Town of Christiansburg, Virginia (Town). The Plan examines historical flooding in the Town and reviews current and proposed strategies for flood prevention and resilience. Flooding in the Town poses significant threats to public safety, infrastructure, and local economy. An increase of storm events with greater rainfall intensity and duration compounds these impacts. This Plan aims to reduce vulnerabilities and promote flood resilience in the Town through policy and sound engineering practices and maintenance.

Recognition of the need to implement flood resilience in communities across the Commonwealth has increased. The increasing frequency, intensity and duration of rainfall has proven to hinder the functionality of current infrastructure and flood prevention measures within the Town. Prior to 2014, stormwater runoff regulations were limited or nonexistent. Limited past stormwater regulations, geological conditions, and more frequent rain events are all concerns for flood resilience and prevention.

Assessment of current defenses within the Town found opportunities for improvement of stormwater quantity and quality. Rehabilitation and maintenance to gray infrastructure within Town watersheds can alleviate or prevent flooding. It is anticipated that the Town's Comprehensive Plan can recommend policies and practices for promoting flood resilience will be updated in the 2023-2024 edition. Some of these policies will include increased use of green techniques and infrastructure; operation and maintenance of SWM and sewer infrastructure; and construction of new stormwater management infrastructure that helps to reduce run-off and pollution. Increased use of green techniques and green infrastructure will promote stormwater quantity and quality. The Plan also explores future projects to promote or improve the Town's flood resilience.

Current and prospective projects were reviewed, scored, and placed in a ranking matrix. Gray infrastructure project recommendations will help mitigate or prevent flooding events, create more connectedness to a greater stormwater system, and ensure that engineered solutions are maintained for functionality. In addition, green infrastructure should be utilized as often as possible to enhance gray infrastructure capabilities. Incorporating other green infrastructure techniques will assist in flood prevention and resilience.

The Town, like many other communities will continue to experience the impacts of severe weather and frequent rainfall events. This Plan provides opportunities for improvement to current defenses and assesses the suitability of new projects and policies for the Town.

Chapter 1: Introduction

Flooding caused by rainfall events combined with inadequate stormwater infrastructure can cause damage to life and property. The Town of Christiansburg (Town) is undertaking this flood resilience planning effort to gain a better understanding of flooding and related infrastructure impacts in its watersheds to better protect its citizens and their property from flooding. The goal of this plan is to promote flood resilience. Resilience is the ability of citizens and the institutions that shape our communities to identify risks, positively adapt, and build the capacity to respond to environmental stressors that impact our built infrastructure. Successful implementation of flood resilience efforts allows communities to rapidly regain functionality and vitality in the face of chronic stressors or severe disturbances such as severe or frequent rainfall events.

A flood resilience plan provides an assessment of current or potential future projects and policies that promote effective solutions and future prevention measures, tailored to geographical region, climate, infrastructure, and available resources. Well-developed flood resilience plans not only provide current and future flood reduction and prevention, but with the implementation of these strategies, can reduce the degradation of infrastructure, preserve habitat for species that live within the floodplain, and in some cases, increase the aesthetic beauty of the Town through green infrastructure and streetscape design.

Christiansburg, like many localities in the Commonwealth, is looking to flood resilience planning to aid in measures to not only mitigate current flooding and stormwater issues, but to alleviate potential future flood events due to increased rainfall frequencies and durations that are occurring in Virginia (ASCE, 2021).

Plan Development Process

This Flood Resilience Plan for the Town of Christiansburg (Plan) will first discuss regional and state efforts made towards flood resilience. This Plan will then discuss the history of the Town in relation to flooding and rainfall events, and previous resilience coverage measures set in place for reduction or prevention.

Following this chapter, the Plan will discuss the measures that the Town is currently taking to address their stormwater and flooding issues. Current flood resilience measures have been evaluated through the analysis of current Town plans, studies, and policies.

For the final chapter of this Plan, suggested green and gray infrastructure projects from Town documents will be extracted and ranked in accordance with overall flood resilience effectiveness, determined by a score card/matrix system. Recommendations of the most effective projects will be accompanied with implementation details, and other helpful resources.

Regional and State Efforts

Recognition of the need to implement flood resilience in communities has been increasing in recent years in the United States as there has been an increase in storm duration and frequency. The Commonwealth of Virginia has undertaken some specific and intentional initiatives to better prepare the state and its communities for increased rainfall frequency and other various factors of climate change. One such initiative is the Department of Conservation and Recreation (DCR) Community Flood Preparedness Fund (CFPF) that funds studies, planning efforts (including this one) and projects that are implemented to mitigate flooding and to enable more resilient communities.

Another state initiative is the Coastal Resilience Master Plan developed by the Commonwealth in 2022. This plan was developed based on a Master Planning Framework which was produced in December 2021. While this effort focused on coastal areas, both this plan and the DCR CFPF recognized the threats of flooding at a statewide level. The CFPF funds are available and utilized throughout the Commonwealth and are partially funding the development of the Town's Plan.

Most recently, the Virginia Department of Transportation (VDOT) released the VDOT Resilience Plan at the end of 2022. In addition to the VDOT Resilience Plan and the Coastal Resilience Plan development efforts, the Commonwealth also partially funded an Environmental Protection Agency (EPA) initiative to better assess storm frequency and duration across the state. This study provides specific numeric comparisons to the currently used data set (ATLAS 14) at the County level.

Christiansburg's Flood History

One of the major events that kick-started the discussion for water management planning initiatives within the Town in recent years was the flooding event that occurred in September of 2015. Phlegar and Chrisman Streets, and Reading Road were especially affected, as they are located along the Town Branch Watershed. As a result, approximately $1.5 million was budgeted towards developing improved drainage in the downtown area (AMT, 2018).

Figure 1: Historic Flooding in the Town

However, the Town Branch Watershed and its confluence with Crab Creek are not the only watersheds that influence the flooding in Christiansburg. Various watersheds in and surrounding the Town are also components that contribute to and affect the Town's flooding issues. Historically, standing water, flooding issues with public drainage systems, and overtopping of streets have been prevalent issues at various times and locations in the Town.

Even earlier, a flood event occurred in Christiansburg in May of 2009; this event was one of the worst historically for the Town's historical district of Cambria. A local tributary of Crab Creek flooded the area after consistent rain events over a series of weeks. Unfortunately, this event occurred before many of the Town's stormwater flood mitigation projects had been implemented. This flood caused damages to the Oak Tree Townhomes area, College Street, and several other surrounding areas. The rainfall intensity was estimated to be a 200-year event.

To better understand these events, the Town has undertaken several studies to assess areas of flood concern in the Town's watersheds. The map on the following page depicts the areas where these efforts have concentrated. Of note, the Town has assessed each watershed within its boundaries in recent years. These studies have led the Town to have a strong understanding of potential flood concerns within the entire community.

History of Stormwater Management in Virginia

In recent years, laws and regulations in Virginia have undergone significant changes aimed at improving the management of stormwater runoff and reducing negative environmental impacts. These updated regulations went into effect in 2014 and impose more stringent criteria for the management of stormwater after construction to better protect properties adjacent to and downstream from development. Development that occurred before 2014 had less stringent or no requirement to manage runoff from created impervious surfaces, resulting in stormwater infrastructure that is inadequate to handle significant rainfall events. These issues with older infrastructure are compounded today through the occurrence of more frequent storms with increased rainfall intensity and duration.

Virginia's 2014 regulations also have more stringent criteria for new development projects compared to older development. The primary reason for this discrepancy lies in the fact that older properties were typically built before these modern environmental concerns became a priority. Therefore, they were not subject to the same level of scrutiny regarding storm drainage systems and potential flooding.

Retrofitting existing properties to meet the new criteria or to add in additional flood mitigation can be a complex and costly process. As a result, the focus has primarily been on implementing more stringent storm drainage requirements for new developments to ensure they adhere to the latest standards and mitigate potential adverse effects on property, water quality and local ecosystems.

Specifically, Christiansburg experiences increased risk to flooding after the construction of the interstate highway system where drainage was primarily designed to remove runoff from the roadway surface as quickly as possible. At the time, there were no regulations to address the additional runoff volume and rate onto adjacent properties and downstream facilities. As such, during heavy rain events, downstream channels and systems are currently at or beyond their capacity.

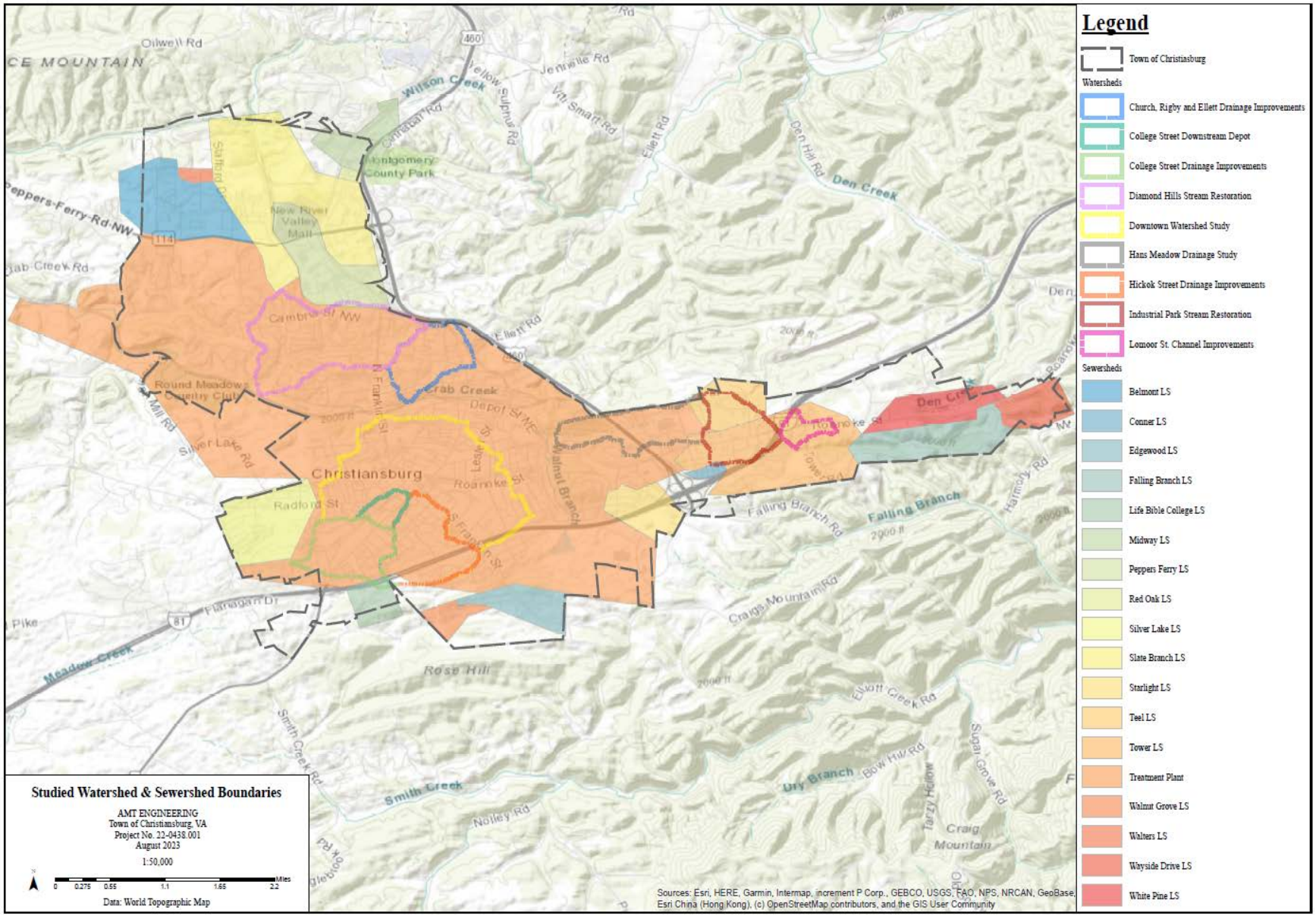


Figure 2: Studied Watershed & Sewershed Boundaries

Chapter 2: Current vs. Future Flood Prevention and Flood Resilience Efforts

Throughout the Commonwealth, including the Town of Christiansburg, Virginians have experienced the increase of storms events with greater rainfall intensity and duration. In addition, the landscape specific to Christiansburg can be characterized by its karst topography, steep slopes and prevalence of shallow soils which limits rain permeability (Town of Christiansburg, 2017). Combining these elements with heavy rains not only increases the concentration of flooding which leads to the clogging and overflowing of Town drainage infrastructure. These elements also lead to a cascading effect of other issues such as water contamination and impaired water bodies), but it can also lead to landslides and the formation or further degradation of sinkholes.

These hazards to infrastructure and human well-being have been pinpointed in areas of Christiansburg through continuous studies and improvement projects issued by the Town. Many of these projects have been associated with the greater downtown area and its associated streets and residential communities. More socially vulnerable populations living within this flood prone area are faced with the aftermath of damaged homes, sometimes on a reoccurring basis. Not all citizens can recuperate from these kinds of losses and may even be forced to move out of their homes and leave their communities.

Figure 3: Downtown Christiansburg Flooding

In recent years, the Town has increased their focus on flood reduction/prevention efforts in the form of projects and policies. Types of projects that help define the Town's flooding reduction/prevention efforts can be categorized as green infrastructure (natural-based solutions such as stream restorations, wetland installations, rainwater harvesting, etc.) and gray infrastructure (solutions such as inlets, outlets, culverts, and drainage solutions). These two types of projects are most effective when implemented in tandem with one another. Christiansburg's policies that mitigate/prevent flooding can often fall under the green

and/or gray infrastructure categories as well. These policies are framed as general goals and strategies that underline the Town's strong stance on policy goals- for both current strategies and future goals.

These current projects and policies can be found within the numerous Town documents and data files reviewed in preparation for this Plan. These documents include comprehensive plans; preliminary engineering reports; as-built monitoring reports; Erosion and Sediment Control (ESC) and Stormwater Management (SWM) plans and assessments; Stormwater Local Assistance Fund applications; drainage improvement studies; watershed studies; and all associated technical specifications, modeling, and Geographic Information System (GIS) data that come with these documents.

Current projects and policies can help to provide data for what flood prevention defenses are in use, and their effectiveness. The Town documents also provide project recommendations for future projects ("prospective projects") and suggests "goals" or policies to be expanded upon. The objective of the following section is to analyze current efforts in the form of current projects and policies, and then to compare these current defenses to future/prospective projects and future goals/policies.

Current Defenses – Studies, Projects, and Policies

Sewershed Studies

The Town's sewer system evaluation studies conducted for Arrowhead, College Street and Phlegar Street Sewersheds, and the Crab Creek Inceptor were aimed at reducing rainfall-derived infiltration and inflow (RDII) through evaluating which sewer systems had high RDII rates, and then providing rehabilitation recommendations (Town of Christiansburg, 2019). This evaluation resulted in the detection of high RDII rates for every sewer system in the study. Recommendations included manhole rehabilitation and replacement; sewer line and lateral rehabilitation; maintenance rehabilitation and on-going monitoring. Alleviating high rates of inflow can reduce the likelihood of a flood event, making these sewershed studies an important part of understanding Christiansburg's current flood resilience defenses.

Watershed Studies

Two major watershed studies conducted by the Town includes the Downtown Watershed Study (2018), and the Diamond Hills Basin Watershed Study (2013). The purpose of these studies was to analyze the current conditions of these watersheds and to provide potential outcomes of different stormwater solutions for the watersheds. The Diamond Hills Basin Watershed Study provided 2-year and 10-year storm event data that confirmed the water quantity and water quality benefits of the Diamond Hills Park Stream Restoration project, and the Diamond Hills Upper Basin Stormwater Management Facility (Balzer and Associates, 2013). The Downtown Watershed Study focused specifically on drainage and flooding concerns issues along the Town Branch Tributary that flows through Christiansburg's Downtown area. Based on review of previous Town drainage improvement studies, surveys, community meetings, and the addition of a new hydrology analysis of the watershed, 10 drainage improvement projects were recommended, prioritized, and scored.

Targeted Drainage Studies

Like the Town's watershed studies, targeted drainage Improvements projects and studies have been ramping up over the past decade to help assess specific "hotspots" where flooding occurs most often. These study areas include College Street, W. Main Street (Hickock Street), Sleepy Hollow Road, and Hans Meadow Drive. These studies have assessed current conditions, followed by recommendations derived

from projected hydrology calculations, and include design/conceptual plans with projected cost estimates. These drainage and watershed studies resulted in a variety of recommended improvements ranging from native vegetation installation, demolition of drainage infrastructure, installation of drainage infrastructure, earthwork and ESC measures, BMP installations and upgrades.

Run-Off /Pollution Studies

Identifying and recommending flooding solutions is instrumental in flood resilience planning, but further assessment of these approved projects may be needed to ensure water quality and flow functionality. Follow up studies involving approved (but not yet built) stream restorations, floodplain/overbank wetlands installations and detention ponds installations, confirm the proposed-BMP's effectiveness of keeping the local watersheds clean, which can also indicate improved stormwater overflow prevention and floodplain management. Three of the Town's drainage basins: Diamond Hills, Towne Branch (Depot Street), and Christiansburg Industrial Park were studied for their effectiveness in runoff and pollution reduction (EEE, 2013). These studies determined that these approved improvements would be effective in reducing Waste Load Allocations for the Crab Creek and New River Basins, which also indicated improved flow functionality.

Projects as a Result of the Towns Studies

As a result of the Town's plans and studies, several of the project recommendations were approved and are at various stages of design and construction. The project recommendations derived from the Hickok Street and College Street Drainage Improvement studies are still being implemented as well as several of the recommended projects from the Downtown Watershed Study. (Town of Christiansburg, n.d.). Construction for Hans Meadow Drainage Project (Phase II) and Diamond Hills Park Stream Restoration was completed in 2019, and Town Branch Stream Restoration was completed in 2018 (Town of Christiansburg, n.d.).

Figure 4: College Street Flooding

Other recently completed drainage improvements and stream restoration projects includes Church, Rigby, and Ellett Storm Drainage Improvements (completed in 2019); Blue Leaf Stream Restoration Project (2017); Brown, Church and Lucas Streets Storm Drain Improvements (2017); and North Franklin Street Drainage Improvements (2017).

Figure 5: Church Street - Drainage Issues

These projects provide a start to achieve long-lasting results that will continue to improve flooding resilience for the Town. However, other identified projects lack funding to move forward, but would further the Town's goal of increasing flood resilience if implemented.

Current Policies

Periodically, the Town of Christiansburg outlines their flooding-related policies in their Comprehensive Plan. The current 2013 version will soon be replaced by a revised edition. For brevity, below is a summary of policy themes within the 2013 Comprehensive Plan that assist in the promotion of flooding resilience, currently being implemented by the Town:

- Increased use of green techniques and infrastructure
- Water quality improvement
- Operation and maintenance of SWM and sewer infrastructure
- Execution of the MS4 plan
- Improvement or replacing of existing SWM and sewer infrastructure
- Construction of new SWM infrastructure that helps to reduce run off and pollution

These policies are designed to fully encompass the various factors that come into play regarding flooding resilience needs.

Future Projects – Studies, Projects, and Policies

Future Studies and Projects

To date, several potential projects identified in the watershed and sewershed plans have not been implemented, for various reasons. This Plan will evaluate and prioritize these potential projects to determine if they can assist the Town in its goal of increasing flood resilience.

Additionally, other projects may be considered that could provide greater flood control capabilities. Proposed mixed-use developments near Uptown Christiansburg (formerly New River Mall), Hickok Street, W. Main Street, Phlegar Street, N. Franklin Street, and College Street as proposed in the Town's Urban Development Areas document (2016) provide several opportunities to implement new and/or improved stormwater or drainage solutions for the Town.

Future Policies

Earlier in this chapter, current policies to promote the Town's flood resilience were summarized. These policies remain general to allow the easy application of flooding resilience action items. This plan will evaluate these current policies for improvement or enhancement, in addition to other policies that have not yet been pursued. For brevity, summaries of Town policies not yet explored or pursued are included in the list below:

- Landscape improvement
- Pollution reduction
- Mitigation of stormwater runoff by increasing tree canopy
- Limiting development on steep slopes (to slow down stormwater flow velocity, and decrease instances of erosion, sedimentation, and landslides)
- Increased awareness of development opportunities and restrictions on varying soil types.
- Protection of floodplains
- Creation, preservation, and maintenance of open space (including parkland)
- Design criteria using more conservative storm intensity, duration, and frequency data (IDF Curves)
- Updated subdivision guidelines encouraging best practices for stormwater collection, conveyance, and infiltration
- Consideration of karst hydrology

Chapter 3: A Plan for Flood Resilience

Methodology of Matrix/Score Card Ranking System

Based on the collection and review of Town literature (i.e., studies, plans, reports, GIS files), flood prevention and mitigation measures currently in place (current projects and policies) were identified. Potential future projects were also identified in this literature review and additional suggestions were added on by the Town Staff. The list of prospective projects and policies were then narrowed down based on optimal effectiveness, determined by the Town, and the consulting engineers assisting with this Resilience Plan.

The list of the Town's resources reviewed for determining current projects, potential projects, and other additional findings, can be found in the Appendix of this plan. Graphical representation of current resilience project coverage is demonstrated on page 9 of Chapter 1. For purposes of this resilience plan, the potential projects evaluated were based on flood and watershed studies and did not focus on sewershed based projects.

These potential projects were then ranked in accordance with a customized resilience matrix with weighted criteria, resulting in a numerical score. The matrix criteria were derived from DCR project ranking criteria that was developed by the state for the Community Flood Preparedness Fund (CFPF). The potential projects with the higher scores demonstrate a greater benefit to the Town's resilience efforts.

Some pre-existing flood prevention and mitigation projects were also evaluated using this prioritization methodology as a way for the Town to conceptualize the matrix process, its criteria, and its weighted scoring system.

Ranking Matrix Clarifications

The following caveats are to be considered when reviewing the Christiansburg Flood Resilience Ranking Matrix:

- It is important to note that the ranking of projects through this matrix scoring does not imply the order in which projects are carried out to completion. The timeline of each project depends on several factors including funding availability and project feasibility.
- Project costs for engineering and construction listed in the matrix have not been re-calculated with consideration to current-day inflation data. The matrix lists the year in which cost data was derived and is subject to change if projects are selected and implemented in the future.
- Project data displaying as "N/A" indicates that the cost to design, or remediate project is undetermined as this time.
- The following projects were not included in the matrix, as each of these involved several sub-projects, rendering the data values in the table as unquantifiable:
    - Public Works ditch work priority list
    - Public Works culvert replacement priority list
    - Other residential properties taking street water
    - Possible urban development areas designed for mixed use developments
- An additional matrix criterion to be considered for the future is the "acquisition of property" category. Acquisition can at times be the most cost-effective solution for reoccurring flooding

issues for residential properties. However, for privacy purposes, properties that specify addresses have been removed from this report.

- FEMA criteria can be added to this matrix for future grant funding consideration regarding residential properties.
    - Categories such as "Severe Repetitive Loss", "Repetitive Loss Property", "Property Damage", "Roadway Flooding", and "Potential Roadway Flooding", accompanied by a maximum point valuation can be added to this matrix, if residential properties are added to the project list in the future.
- Projects listed in the matrix that are currently marked as "*" or "**" (projects located in the floodplain and floodway, respectively) should be separately evaluated for FEMA grant funding.
- Please see the Christiansburg Floodplain/Floodway Map further along in this Chapter in the section titled "Resilience Score Card Results".
- The DCR ranking criteria can be found in Appendix A.
- Additional criteria were added to the final ranking matrix to account for estimated costs and the readiness of the project to proceed. For example, there are projects in the matrix that may score high based on the DCR criteria but do not have engineering and/or construction costs developed or may only be conceptual in design. These projects may need more development to be eligible for consideration for implementation.
- The focused list of recommended projects includes more shovel-ready projects that score highly and will also best address recurring flood issues in the Town based on the drainage studies.

Resilience Score Card Results

Detailed in the table below, are the top-ranked projects accompanied by a brief narrative and their final score. These projects represent shovel-ready projects that have been identified in previous drainage studies as the best options to alleviate recurrent flooding in the Town. An opinion of probable cost was developed for each of the recommended resilience projects based on available data. In each case, soft costs and a 30% contingency were included in the estimates as a conservative approach to budgeting. Details for each estimate can be found in the Appendix.

Potential Project	Project Description	Project Source	Points
Recommended Projects			
Chrisman / Phlegar Street Drainage Improvements: Phase II	Starting at the intersection of Phlegar Street and 3rd Street SW, this project is a series of small box culverts and open channels that convey runoff from the upper watershed to an existing triple 5'x3' box culvert under 1st Street. The channel alignment requires easements across some private properties, and may include stream stabilization measures.	Downtown Watershed Study	**75**

Chrisman / Phlegar Street Drainage Improvements: Phase I	This project collects runoff from existing 30" RCP and 48" RCP pipes under Interstate 81, and conveys the runoff in a closed drainage system along Chrisman Street, then crossing over to Phlegar Street following the alignment of the existing pipes. Recommended pipe sizes increase from 36" initially, to between 48" and 60" in diameter at 3rd Street SW.	Downtown Watershed Study	**73**
College Street Drainage Project - Phase I	Improvements at the nearby school, a reach along the opposite side of College Street, and the Detention Pond with several hundred feet of the outlet pipe downstream which will terminate upstream of the first driveway that crosses the drainage ditch. The installed pipe system below the pond will need to be installed at a flatter grade in Phase I than the final design until Phase II portion may be installed. The drainage will then re-enter the existing drainage ditch behind the residences along College Street.	College Street Drainage Study (scope revised on 06/2023)	**70**
College Street Drainage Project - Phase II	The pipe and structures previously installed below the pond will be re-installed at their originally planned deeper elevations along with the rest of the Phase II construction that extends to Depot St and also captures a large inflow from Main St. This will involve a small amount of redesign for this reach of the pipe installation immediately below the pond.	College Street Drainage Study (scope revised on 06/2023)	**70**
Hickok Street Drainage Improvements	This project conveys runoff in a proposed 10'x4' box culvert under Hickok Street SW to the intersection with Commerce Street, removing a section of drainage conveyance that goes under the existing buildings on West Main Street. Runoff is conveyed either north along Commerce Street to a connection with the existing 72" CMP or west along Hickok Street to College Street, where it connects to the College Street Drainage Improvements (Phase I).	Downtown Watershed Study	**65**

The map on the following page depicts Christiansburg Floodplain/Floodway areas, and a sampling of the top ranked projects per the ranking matrix.

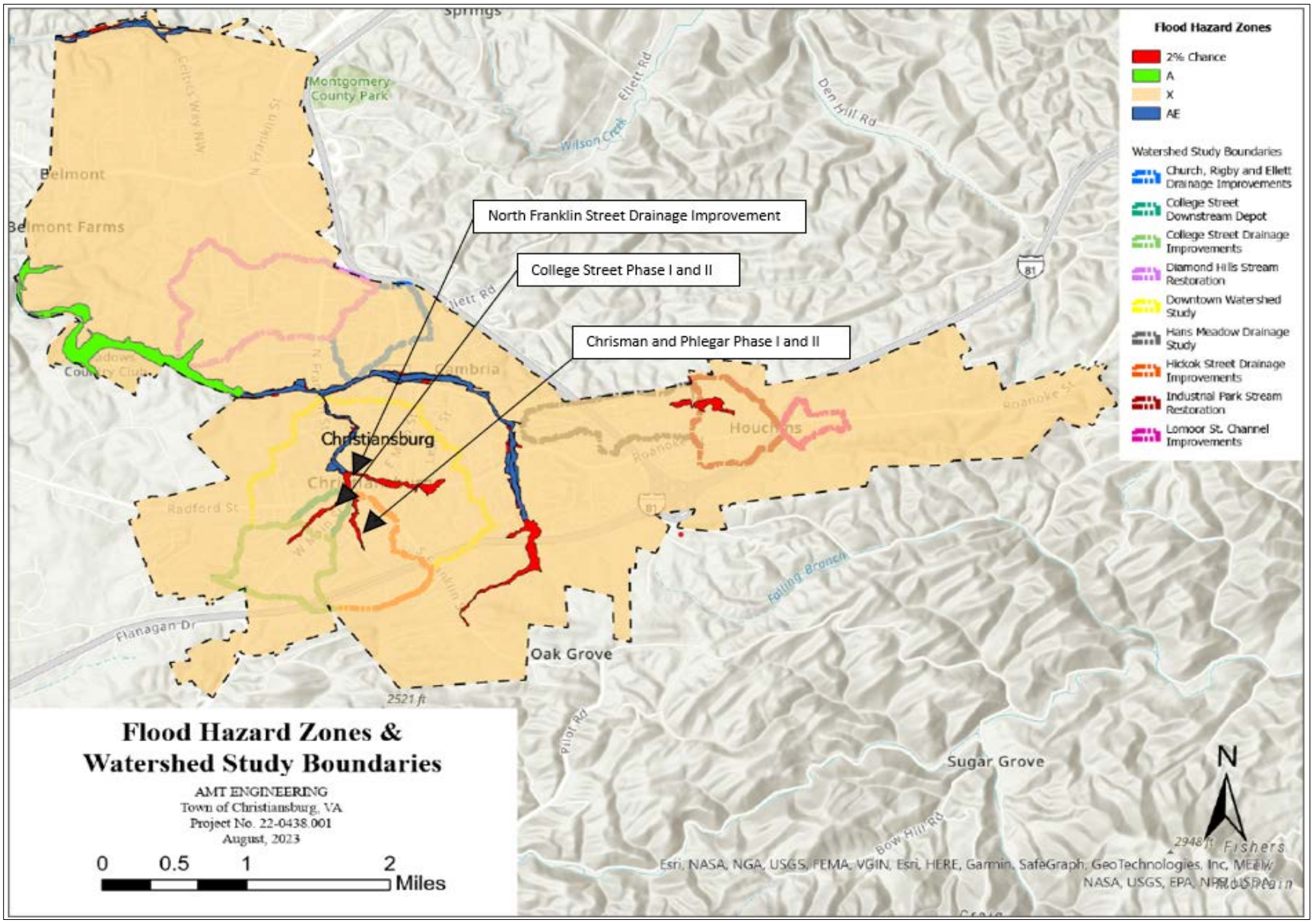


Figure 6: Christiansburg Flood Hazard Zone Map Displaying some Potential Projects and Watershed Study Boundaries

Continuation of Gray Infrastructure Implementation

The resulting gray infrastructure project recommendations from this study will help create more connectedness to a greater stormwater system, preventing or mitigating flooding events. Future new builds and retrofits alike should be designed with specifications that address increased precipitation, intensity and frequency storms, and the potential to mitigate flooding events. Additionally, maintenance protocols should be updated to ensure that these engineered solutions reliably maintain functionality. Lastly, to increase adaptive capacity, gray infrastructure should be designed in tandem with green infrastructure and nature-based solutions.

Continuation of Green Infrastructure Implementation

In addition to the project recommendations in the table above, green infrastructure should be utilized as often as possible to augment gray infrastructures capabilities if time and budgets allow. Green infrastructure is Implementing stream restorations and wetland and riparian buffer installations, and other green infrastructure techniques such as rainwater harvesting systems and pervious pavement will help to extend and reinforce the natural features that assist with flood resilience defense. Making sure our natural environmental is healthy and functional improves human well-being, creating the most immediate benefit to vulnerable communities and providing opportunities for recreation, education, and decreased heat island effect. Included with these implemented green infrastructure solutions should be updated maintenance protocols to ensure that they are functioning as designed.

RESOURCES

A. Morton Thomas and Associates. (AMT). (2018). *Town of Christiansburg Downtown Watershed Study*

American Society of Civil Engineers (ASCE). (2021) Adapting intensity-duration-frequency curves to improve climate resilience. Adapting intensity-duration-frequency curves to improve climate resilience | ASCE

Town of Christiansburg. (2017). *Town of Christiansburg 2013 Comprehensive Plan.* https://christiansburg.app.box.com/s/iqrvxh7e0kbiy6xwgyeyw5q4rvqn7f2a/file/1056208918079

Town of Christiansburg. (2019). *Town of Christiansburg, Virginia Arrowhead Sewer System Evaluation Survey.* https://christiansburg.app.box.com/s/iqrvxh7e0kbiy6xwgyeyw5q4rvqn7f2a/file/1056208918079

Town of Christiansburg. (2016). *Town of Christiansburg Interceptor Model & Preliminary Engineering Report.* https://christiansburg.app.box.com/s/iqrvxh7e0kbiy6xwgyeyw5q4rvqn7f2a/file/1056224097944

Town of Christiansburg. (2014). *Diamond Hills Park As-Built and Year 1 Monitoring.* https://christiansburg.app.box.com/s/iqrvxh7e0kbiy6xwgyeyw5q4rvqn7f2a/file/1056220870760

EEE Consulting (EEE). (2013). Christiansburg Stream Restoration and Stormwater BMP Assessment https://christiansburg.app.box.com/s/iqrvxh7e0kbiy6xwgyeyw5q4rvqn7f2a/file/1056220870760

Balzar and Associates, Inc. (2013). *Diamond Hills Basin Watershed Study.* https://christiansburg.app.box.com/s/iqrvxh7e0kbiy6xwgyeyw5q4rvqn7f2a/file/1056216341472

Town of Christiansburg, Michael Baker International. (2016). *Urban Development Areas.* https://christiansburg.app.box.com/s/iqrvxh7e0kbiy6xwgyeyw5q4rvqn7f2a/file/1056205375704

Town of Christiansburg, (n.d.). *Capital Projects* https://www.christiansburg.org/479/Capital-Project

Water Infrastructure Improvements for the Nation Act (2017)., Public Law 114-322

Benedict, M. A., W. Allen, and E.T. McMahon (2004). Advancing Strategic Conservation in the Commonwealth of Virginia: Using a Green Infrastructure Approach to Conserving and Managing the Commonwealth's Natural Areas, Working Landscapes, Open Space, and Other Critical Resources. Washington, D.C., The Conservation Fund. 2004.

Benedict, M. A. and E.T. McMahon. (2006). Green Infrastructure: Linking Landscapes and Communities. Washington, D.C., Island Press.

Green and Gray Infrastructure Research. (2023). EPA. https://www. epa.gov/water-research/green-and-gray-infrastructure-research#:~:text=Gray%20infrastructure%20is%20traditional%20stormwater,%2C%20pipes%2C%20and%20retention%20basins.

Community Flood Preparedness Fund Grants and Loans. (n.d.). https://www.dcr.virginia.gov/dam-safety-and-floodplains/dsfpm-cfpf

Social Vulnerability | National Risk Index. (n.d.). https://hazards.fema.gov/nri/social-vulnerability

Virginia Department of Conservation & Recreation. (n.d.). 2023 Grant Manual for the Virginia Community Flood Preparedness Fund. https://www.dcr.virginia.gov/dam-safety-and-floodplains/document/Round-4-2023-CFPF-Manual-DRAFT-Final.pdf

Fema.gov. (2022, March). Hurricane and Flood Mitigation Handbook for Public Facilities - Fact Sheet 1.0: Roads. www.fema.gov

Damage to Property? (2020, February). FEMA.gov. https://www.fema.gov/faq/damage-property

National Flood Insurance Program: Frequently Asked Questions - Repetitive Loss. (2005, October).www.fema.gov. https://www.fema.gov/pdf/rebuild/repetitive_loss_faqs.pdf

Sanitary Sewer Overflow Analysis and Planning (SSOAP) Toolbox. EPA. (2023-B). US EPA. https://www.epa.gov/water-research/sanitary-sewer-overflow-analysis-and-planning-ssoap-toolbox

Heat Island Effect. (2023-C). EPA. https://www.epa.gov/heatislands

Appendix

DCR Scoring Criteria

Project Eligible for Consideration		
Scoring Information		
Criterion	**Point Value**	**Points Awarded**
Projects may have components of both a. and b. below; however, only one category may be chosen. The category chosen must be identified as the primary project in the application.		
a. Acquisition of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures (and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition).	30	
☐ Wetland restoration. ☐ Floodplain restoration. ☐ Construction of swales and settling ponds. ☐ Living shorelines and vegetated buffers. ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by ConserveVirginia Floodplain and Flooding Resilience layer or a similar data driven analytic tool. ☐ Dam removal ☐ Stream bank restoration or stabilization. ☐ Restoration of floodplains to natural and beneficial function.	25	
b. any other nature-based approach	20	
Is the project area socially vulnerable? (Based on ADAPT VA's Social Vulnerability Index Score.)		
Very High Social Vulnerability (More than 1.5)	10	
High Social Vulnerability (1.0 to 1.5)	8	
Moderate Social Vulnerability (0.0 to 1.0)	5	
Low Social Vulnerability (-1.0 to 0.0)	0	
Low Social Vulnerability (-1.0 to 0.0)	0	
Is the proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?		
Yes	5	
No	0	
Is the proposed project in a low-income geographic area as defined in the DCR manual?		
Yes	10	

No	0	
Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?		
Yes	5	
No	0	
Does this project provide "community scale" benefits?		
Yes	30	
No	0	
Total Points		

Top Ranking Project Scorecards

Chrisman / Phlegar Street Drainage Improvements: Phase II

Project Eligible for Consideration		
Scoring Information		
Criterion	**Point Value**	**Points Awarded**
Projects may have components of both a. and b. below; however, only one category may be chosen. The category chosen must be identified as the primary project in the application.		
a. Acquisiion of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures (and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition).	30	
☐ Wetland restoration. ☐ Floodplain restoration. ☐ Construction of swales and settling ponds. ☐ Living shorelines and vegetated buffers. ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by ConserveVirginia Floodplain and Flooding Resilience layer or a similar data driven analytic tool. ☐ Dam removal ☐ Stream bank restoration or stabilization. ☐ Restoration of floodplains to natural and beneficial function.	25	**25**
b. any other nature-based approach	20	**5**

Is the project area socially vulnerable? (Based on ADAPT VA's Social Vulnerability Index Score.)		
Very High Social Vulnerability (More than 1.5)	10	
High Social Vulnerability (1.0 to 1.5)	8	
Moderate Social Vulnerability (0.0 to 1.0)	5	
Low Social Vulnerability (-1.0 to 0.0)	0	**0**
Low Social Vulnerability (-1.0 to 0.0)	0	
Is the proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?		
Yes	5	
No	0	**0**
Is the proposed project in a low-income geographic area as defined in the DCR manual?		
Yes	10	**10**
No	0	
Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?		
Yes	5	**5**
No	0	
Does this project provide "community scale" benefits?		
Yes	30	**30**
No	0	
Total Points		**75**

Chrisman / Phlegar Street Drainage Improvements: Phase I

Project Eligible for Consideration		
Scoring Information		
Criterion	**Point Value**	**Points Awarded**
Projects may have components of both a. and b. below; however, only one category may be chosen. The category chosen must be identified as the primary project in the application.		

a. Acquisition of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures (and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition).	30	
☐ Wetland restoration. ☐ Floodplain restoration. ☐ Construction of swales and settling ponds. ☐ Living shorelines and vegetated buffers. ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by ConserveVirginia Floodplain and Flooding Resilience layer or a similar data driven analytic tool. ☐ Dam removal ☐ Stream bank restoration or stabilization. ☐ Restoration of floodplains to natural and beneficial function.	25	**25**
b. any other nature-based approach	20	**5**
Is the project area socially vulnerable? (Based on ADAPT VA's Social Vulnerability Index Score.)		
Very High Social Vulnerability (More than 1.5)	10	
High Social Vulnerability (1.0 to 1.5)	8	
Moderate Social Vulnerability (0.0 to 1.0)	5	
Low Social Vulnerability (-1.0 to 0.0)	0	**0**
Low Social Vulnerability (-1.0 to 0.0)	0	**0**
Is the proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?		
Yes	5	
No	0	**0**
Is the proposed project in a low-income geographic area as defined in the DCR manual?		
Yes	10	**10**
No	0	
Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?		
Yes	5	**3**
No	0	
Does this project provide "community scale" benefits?		
Yes	30	**30**
No	0	

Total Points	73

College Street Drainage Project - Phase I

Project Eligible for Consideration		
Scoring Information		
Criterion	**Point Value**	**Points Awarded**
Projects may have components of both a. and b. below; however, only one category may be chosen. The category chosen must be identified as the primary project in the application.		
a. Acquisition of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures (and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition).	30	
☐ Wetland restoration. ☐ Floodplain restoration. ☐ Construction of swales and settling ponds. ☐ Living shorelines and vegetated buffers. ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by ConserveVirginia Floodplain and Flooding Resilience layer or a similar data driven analytic tool. ☐ Dam removal ☐ Stream bank restoration or stabilization. ☐ Restoration of floodplains to natural and beneficial function.	25	**25**
b. any other nature-based approach	20	**5**
Is the project area socially vulnerable? (Based on ADAPT VA's Social Vulnerability Index Score.)		
Very High Social Vulnerability (More than 1.5)	10	
High Social Vulnerability (1.0 to 1.5)	8	
Moderate Social Vulnerability (0.0 to 1.0)	5	
Low Social Vulnerability (-1.0 to 0.0)	0	**0**
Low Social Vulnerability (-1.0 to 0.0)	0	
Is the proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?		
Yes	5	
No	0	**0**
Is the proposed project in a low-income geographic area as defined in the DCR manual?		
Yes	10	**10**

No	0	
Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?		
Yes	5	
No	0	**0**
Does this project provide "community scale" benefits?		
Yes	30	**30**
No	0	
Total Points		**70**

College Street Drainage Project - Phase II

Project Eligible for Consideration		
Scoring Information		
Criterion	**Point Value**	**Points Awarded**
Projects may have components of both a. and b. below; however, only one category may be chosen. The category chosen must be identified as the primary project in the application.		
a. Acquisition of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures (and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition).	30	
☐ Wetland restoration. ☐ Floodplain restoration. ☐ Construction of swales and settling ponds. ☐ Living shorelines and vegetated buffers. ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by ConserveVirginia Floodplain and Flooding Resilience layer or a similar data driven analytic tool. ☐ Dam removal ☐ Stream bank restoration or stabilization. ☐ Restoration of floodplains to natural and beneficial function.	25	**25**
b. any other nature-based approach	20	**5**
Is the project area socially vulnerable? (Based on ADAPT VA's Social Vulnerability Index Score.)		
Very High Social Vulnerability (More than 1.5)	10	

High Social Vulnerability (1.0 to 1.5)	8	
Moderate Social Vulnerability (0.0 to 1.0)	5	
Low Social Vulnerability (-1.0 to 0.0)	0	**0**
Low Social Vulnerability (-1.0 to 0.0)	0	
Is the proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?		
Yes	5	
No	0	**0**
Is the proposed project in a low-income geographic area as defined in the DCR manual?		
Yes	10	**10**
No	0	
Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?		
Yes	5	
No	0	**0**
Does this project provide "community scale" benefits?		
Yes	30	**30**
No	0	
Total Points		**70**

Hickok Street Drainage Improvements

Project Eligible for Consideration		
Scoring Information		
Criterion	**Point Value**	**Points Awarded**
Projects may have components of both a. and b. below; however, only one category may be chosen. The category chosen must be identified as the primary project in the application.		
a. Acquisition of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures (and where the flood mitigation benefits will be achieved as a part of the same project as the property acquisition).	30	

☐ Wetland restoration. ☐ Floodplain restoration. ☐ Construction of swales and settling ponds. ☐ Living shorelines and vegetated buffers. ☐ Permanent conservation of undeveloped lands identified as having flood resilience value by ConserveVirginia Floodplain and Flooding Resilience layer or a similar data driven analytic tool. ☐ Dam removal ☐ Stream bank restoration or stabilization. ☐ Restoration of floodplains to natural and beneficial function.	25	**25**
b. any other nature-based approach	20	
Is the project area socially vulnerable? (Based on ADAPT VA's Social Vulnerability Index Score.)		
Very High Social Vulnerability (More than 1.5)	10	
High Social Vulnerability (1.0 to 1.5)	8	
Moderate Social Vulnerability (0.0 to 1.0)	5	
Low Social Vulnerability (-1.0 to 0.0)	0	**0**
Low Social Vulnerability (-1.0 to 0.0)	0	
Is the proposed project part of an effort to join or remedy the community's probation or suspension from the NFIP?		
Yes	5	
No	0	**0**
Is the proposed project in a low-income geographic area as defined in the DCR manual?		
Yes	10	**10**
No	0	
Projects eligible for funding may also reduce nutrient and sediment pollution to local waters and the Chesapeake Bay and assist the Commonwealth in achieving local and/or Chesapeake Bay TMDLs. Does the proposed project include implementation of one or more best management practices with a nitrogen, phosphorus, or sediment reduction efficiency established by the Virginia Department of Environmental Quality or the Chesapeake Bay Program Partnership in support of the Chesapeake Bay TMDL Phase III Watershed Implementation Plan?		
Yes	5	
No	0	
Does this project provide "community scale" benefits?		
Yes	30	**30**
No	0	
Total Points		**65**

Project Ranking Matrix - 10/09/2023

Project Ranking Criteria			Acquisition of developed property consistent with an overall comprehensive local or regional plan for purposes of allowing inundation, retreat, or acquisition of structures	Nature Based Approach	Project Area Socially Vulnerable	Impact NFIP Participation	Low Income Geographic Area	TMDL Benefit? (e.g., N or P)	Community Scale Benefit		Estimated Engineering Cost	Estimated Construction Cost	Total Cost	Cost Notes (*year of cost estimate, does plan include cost?*)	**Total Points**
Categorical Weight			30	20	10	5	10	5	30						
Potential Project	**Project Description**	**Project Source**													
Recommended Projects															
College Street Drainage Project - Phase I	Improvements at the nearby school, a reach along the opposite side of College Street, and the Detention Pond with several hundred feet of the outlet pipe downstream which will terminate upstream of the first driveway that crosses the drainage ditch. The installed pipe system below the pond will need to be installed at a flatter grade in Phase I than the final design until Phase II portion may be installed. The drainage will then re-enter the existing drainage ditch behind the residences along College Street.	College Street Drainage Study (scope revised on 06/2023)	25	5	0	0	10	0	30		$155,852	$2,188,034	$2,238,034	2023	**70**
College Street Drainage Project - Phase II	The pipe and structures previously installed below the pond will be re-installed at their originally planned deeper elevations along with the rest of the Phase II construction that extends to Depot St and also captures a large inflow from Main St. This will involve a small amount of redesign for this reach of the pipe installation immediately below the pond.	College Street Drainage Study (scope revised on 06/2023)	25	5	0	0	10	0	30		$191,099	$1,457,017	$1,864,981	2023	**70**
Hickok Street Drainage Improvements	This project conveys runoff in a proposed 10'x4' box culvert under Hickok Street SW to the intersection with Commerce Street, removing a section of drainage conveyance that goes under the existing buildings on West Main Street. Runoff is conveyed either north along Commerce Street to a connection with the existing 72" CMP or west along Hickok Street to College Street, where it connects to the College Street Drainage Improvements (Phase I).	Downtown Watershed Study	25	0	0	0	10	0	30		$404,000	$2,271,722	$2,675,722 (stated as $2,700,000 in Watershed study)	2017 and later in watershed study in 2018	**65**
Chrisman / Phlegar Street Drainage Improvements: Phase I	This project collects runoff from existing 30" RCP and 48" RCP pipes under Interstate 81, and conveys the runoff in a closed drainage system along Chrisman Street, then crossing over to Phlegar Street following the alignment of the existing pipes. Recommended pipe sizes increase from 36" initially, to between 48" and 60" in diameter at 3rd Street SW.	Downtown Watershed Study	25	5	0	0	10	3	30		$378,000	$2,413,000	$2,800,000	2018	**73**
Chrisman / Phlegar Street Drainage Improvements: Phase II	Starting at the intersection of Phlegar Street and 3rd Street SW, this project is a series of small box culverts and open channels that convey runoff from the upper watershed to an existing triple 5'x3' box culvert under 1st Street. The channel alignment requires easements across some private properties, and may include stream stabilization measures.	Downtown Watershed Study	25	5	0	0	10	5	30		$187,000	$1,113,000	$1,300,000	2018	**75**
Potential Future Projects															
Gray Infrastructure															
Existing SWM Facility with Independence Boulevard Upgrade - project completed but may need further evaluation	N/A	Diamond Hills Basin Watershed Study	0	0	0	0	10	0	30		N/A	N/A	N/A	N/A	**40**
Radford Street Drainage Improvements	This project is smaller than some others in the downtown area, and addresses clogged inlets and undersized pipes along the north side of Radford Street. By increasing the pipe size from 15" to 24" and adding adequately sized throat lengths on the drainage inlets, runoff can be intercepted and conveyed into the existing 36" RCP at Lee Hy Court, then draining along Radford Street to Depot Street and into the downtown area. New sidewalks may also be considered for this area.	Downtown Watershed Study	25	0	0	0	10	0	30		$158,000	$942,000	$1,100,000	2018	**65**
Alleghany St / Canaan Rd / Epperly Drive: Drainage Improvements	This project helps address surface water and groundwater concerns from the Sunset Cemetery and Alleghany Street in areas along Canaan Road and Epperly Drive, by replacing existing 15" pipes with 24" and 30" pipes. Runoff is then conveyed into the rear yards on the south side of Epperly Drive, behind the First Church of God, with a pipe extension to an existing stormwater management basin (dry detention). During engineering design, the Town may choose to retrofit the existing basin to help proect existing drainage systems downstream and to promote improved water quality in the watershed.	Downtown Watershed Study	25	0	0	0	10	5	30		$105,000	$645,000	$750,000	2018	**70**
Stone Street Culvert Replacement at Town Branch	This project replaces an existing quadruple 48" CMP with a dual 10'x5' box culvert, providing increased capacity to convey the 2-year storm under Stone Street without overtopping onto Depot Street. 10-year and 100-year flood depths are reduced with this culvert replacement. Possible impacts of the larger pipes on the stream restoration project in Depot Park will need to be evaluated, as well as the flood reduction benefits of eliminating the abandoned bridge near Stone Street. Enhanced water quality can also be considered with this project, by developing a stream restoration project from Stone Street to North Franklin Street, creating a linear park or greenway concept	Downtown Watershed Study	30	0	5	0	10	5	30		$114,000	$526,000	$640,000	2018	**80**
Roanoke Street Drainage Improvements (near wades)	This project begins at an existing curb inlet near Wade's Foods which has a small diameter pipe draining to Craig Street. The recommendation is to eliminate runoff from Craig Street into the open channel behind 500 Roanoke Street by installing a storm drain system that conveys runoff from the Wade's Foods parking lot and Craig Street to Roanoke Street, where it ties into the existing storm drain system	Downtown Watershed Study	25	0	5	0	10	5	30		$42,000	$168,000	$210,000	2018	**75**
Sherwood Culvert Replacement	Replacement of existing storm drain culvert under Sherwood Drive which is beyond useful life and causing maintenance issues.	Town's Addition (no document source)	25	0	5	0	10	0	30		$25,000	$100,000	$125,000	2022	**70**
Glade Culvert Replacement	Replacement of existing storm drain culvert along Glade Drive which is beyond useful life and causing maintenance issues.	Town's Addition (no document source)	25	0	0	0	10	0	30		N/A	N/A	N/A	N/A	**65**
Public Works Operation Center	Public Works Operation Center is within the 100 year flood plain since it is the location of the old sewer treatment facility. Relocation is the best alternative.	Town's Addition (no document source)	30	20	5	0	10	0	30		N/A	N/A	N/A	N/A	**95**
Evans Street Drainage	Piping of road drainage through a new storm drain system to prevent drainage between and behind residences.	Town's Addition (no document source)	25	0	5	0	10	0	30		$75,000	$325,000	$400,000	2022	**70**
Overhill Drainage	Piping of road drainage through a new storm drain system to prevent drainage between and behind residences.	Town's Addition (no document source)	25	0	0	0	10	0	30		N/A	N/A	N/A	N/A	**65**
Reading Road Drainage	Research and Public outreach is required to address maintenance of drainage infrastructure and/or larger replacement projects to address capacity may be necessary.	Town's Addition (no document source)	25	0	0	0	10	0	30		N/A	N/A	N/A	N/A	**65**
Teel Street	Piping of road drainage through a new storm drain system to prevent drainage between and behind residences.	Town's Addition (no document source)	25	0	5	0	10	0	30		N/A	N/A	N/A	N/A	**70**
N Franklin Street Drainage near Conston	Roadway flooding occurs here frequently with heavy rains. The system is most likely undersized for the area it drains	Town's Addition (no document source)	25	0	0	0	10	0	30		N/A	N/A	N/A	N/A	**65**
West Main Street Drainage (near 1010 W Main, drainage from Robin Rd / Interstate)	Piping of road drainage through a new storm drain system to prevent drainage between and behind residences.	Hickock Drainage Study	25	0	0	0	10	0	30		$404,000	$2,271,722	$2,675,722	2017	**65**
Infrastructure															
Diamond Hills Basin Evaluation of Ultimate Development (including: Stream Restoration & Independence Blvd Upgrade, and Upstream SWM Facility a BMPs);	there are potential projects to come from this basin, work on various stormwater facilities and conveyance channels	Description provided by Town notes	25	0	0	0	10	5	30		N/A	N/A	N/A	N/A	**70**
Christiansburg Industrial Park Restoration and Stormwater BMP Assessment(Town is at 100% design on this and plans to go to construction in the fall…we have the costs available)	Maintenance / Upsizing of existing stormwater quantity pond and channel improvements upstream of facility.	Stream Benefits Analysis Christiansburg Industrial ParkStream Restoration	25	20	5	0	10	5	30		N/A	N/A	$700,000	N/A	**95**
Sleepy Hollow SWM BMP Modification	Maintance or removal of BMP. The embankment is not constructed properly and would need to be rebuit.	WSSI Sleepy Hollow Powerpoint	25	20	0	0	10	5	30		N/A	N/A	N/A	N/A	**90**
Kiwanas Park	Corrective work to address stream erosion along park.	Town's Addition	25	0	0	0	10	5	30		N/A	N/A	N/A	N/A	**70**
Diamond Hills SWM BMP Modification (Food Lion N Franklin St Facility)	Potential modification to address flow through pond to protect downstream channel and Blue Leaf Stream Restoration	Town's Addition (no document source)	25	0	0	0	10	5	30		N/A	N/A	N/A	N/A	**70**

Table Notes:
Project data displaying as "N/A" indicates that the cost to construct, design, or remediate project is undetermined as this time.
Project Name (* = project that is in the floodplain. ** = a project that is in the floodway)
Preferred projects are based on total points, cost considerations and shovel-ready nature of the proposed project.