2. Scope of Work

flood risks and potential flood mitigation projects to pursue through alternate funding sources in the future. more flood mitigation projects for FEMA HMGP funding, the study will provide an understanding of current develop HMGP applications for those projects. While this study will primarily focus on developing one or accordance with FEMA guidelines. This analysis will be used to assess eligibility for HMGP funding and to the conceptual (30%) design phase. At this point, our team will complete a Benefit Cost Analysis (BCA) in mitigation projects. Following an alternatives analysis, viable projects will be selected by the Town to progress tributaries that contribute to flooding in Richmond in order to inform identification and prioritization of flood role in the Richmond Scoping Study is to complete a hydraulic study for the Winooski River and key We understand the importance of supporting Vermont communities in their flood recovery efforts. Our team's

municipal level and high-resolution topographic and bathymetric data collection to inform hydraulic modeling of the Winooski River provide geospatial data collection and processing to support high-resolution two-dimensional hydraulic during project identification, conceptual design, and benefit cost analysis tasks, and Whiteout Solutions will modeling to support this effort. SEAM Solutions will provide BCA and FEMA HMGP guidance support improving flood resiliency. We have included partner firms with expertise in flood hazard planning at the wastewater, water quality, and stream restoration projects with direct and indirect benefits related to Resources Management team has decades of experience working with towns to develop stormwater, village importance of community involvement during the project identification and scoping process. Stone's Water We are familiar with Vermont's flood history, the interdisciplinary nature of flood mitigation projects, and the

the full application stage if the project budget, timeline, and availability of viable projects within the and approach, but we will coordinate with the Town to adjust the number of projects selected to progress to grant Vermont additional deadline extensions, the Stone team anticipates maintaining the same scope of work have a high potential to reduce flood damages, are cost-effective, have community support, or already have the Town's RFP and our familiarity with FEMA's HMGP guidelines. This approach prioritizes projects that with the Town to develop an acceptable timeline. Our proposed approach, presented below, is informed by Management's (VEM) current FEMA HMGP deadline. Should that extension be denied, our team will work community allow completed conceptual or preliminary design work and are seeking implementation funding. Should FEMA proposed timeline, which assumes that a six-month extension request is granted to Vermont Emergency Stone staff, along with our partnering firms, have the capacity to complete the following scope of work in the

2.1. Task 1: Project Kick-Off Meeting

engineering will have been completed prior to this meeting. Stone will record meeting minutes and share scoping study goals, scope, and timeline. Stone staff will be available in person at this kickoff meeting to attend a project kickoff meeting with the Town Manager, project stakeholders, and the public to introduce the Stone recognizes the importance of clear communication with project partners from the start. Our team will answer questions about the project and listen to concerns and project ideas from the public, but no

challenges, and milestones to the Town throughout each task. will work with the Town to solicit input from residents living along Snipe Island and Jones Mill brooks at a hydraulic study, alternatives analysis, and conceptual design process. Concurrently to the kickoff meeting, we them with meeting attendees. Ideas and concerns raised in this first meeting will be considered throughout the minimum via a targeted email or other communication. Our team will continue to share project updates,

Task 1: Project Kickoff

- Public kickoff meeting attendance and meeting minutes
- Communication with residents along tributaries to introduce project and solicit input
- Open communication and coordination with the Town through each task

Task 2: Existing Data and Desktop Review

high-water mark data collected during the July 2023 and July 2024 flood events will also be reviewed at this data sources mentioned during the project kickoff will be included in this initial review. Aerial imagery and experience to establish a strong understanding of current conditions and risks related to flooding. Studies and rate maps, and engineering projects throughout the Winooski River watershed, and will leverage that stormwater master plans, river corridor plans, effective and preliminary modeling for FEMA flood insurance estimates, and conceptual design development. Our team is familiar with local hazard mitigation plans, field data collection, hydrologic and hydraulic modeling, project identification and alternatives analysis, cost Stone will begin the project with a desktop review of existing data and relevant records. This review will guide

and assessment tools available through FEMA, such as the Risk MAP products (https://www.fema.gov/flood restoration, planting, and easements. The Stone team will also review and take into consideration planning types of projects identified in the FFI tool include dam removal, buffer planting, bank stabilization, floodplain selection criteria (i.e., eligible for FEMA funding, within the project area, or cost-effective). Examples of the sediment transport, nutrient uptake, and habitat uplift. Within the context of this scoping study, the FFI tool floodplain connectivity can restore natural stream and floodplain processes related to flood water storage, recommending potential projects for restoring stream and floodplain connectivity along that reach. Enhanced application for identifying river reaches with little lateral, vertical, or longitudinal connectivity and developed the TRPT tool following Tropical Storm Irene and funded it through the FEMA HMGP. The FFI and engineering staff are well-versed in applying these tools to project screening and scoping. VT rans Stone's team of data scientists and modelers led the web-based application development phase for both tools, and the Transportation Resilience Planning Tool (TRPT) (https://roadfloodresilience.vermont.gov/#/map). project area using the Functioning Floodplains Initiative (FFI) Explorer Tool (https://fli.stone-env.net/home) screening tools for initial project identification. Specifically, we propose to complete a detailed review of the <u>maps/tools-resources/risk-map/products),</u> which are non-regulatory materials that supplement regulatory can be used to identify reaches that are both poorly connected to their adjacent floodplain, and meet project Explorer Tool is designed to build on river corridor planning in Vermont by providing a web-based In addition to the materials and documents mentioned above, Stone staff will use current web-based project

and conceptual designs. Summaries of relevant information from these reviews will be included in the Work completed in this step will set the groundwork for subsequent hydraulic studies, alternatives analysis, Scoping Study Final Report and/or visually in project maps and figures.

Task 2: Existing Data and Desktop Review

Relevant summaries, figures, maps, and background data incorporated into scoping study narratives

2.3. Task 3: Hydraulic Study – Winooski River

components of this study will include: The Stone team will complete a hydraulic study for the Winooski River through Richmond. The main

- Aerial topographic and bathymetric survey
- River corridor assessment and field data collection
- Winooski River hydraulic model development
- Hydraulic study report

projects included in the alternatives analysis. The model will be used to evaluate current conditions and potential future benefits of flood mitigation

2.3.1. Aerial Topographic and Bathymetric Survey

including vegetation, bathymetry elevation, water surface, road surface, buildings, bridges, and ground. made available to the Town for future modeling and design efforts. Vermont State Plane coordinated and vertical datum NAVD88, unless otherwise noted. These datasets will be Deliverables will include elevation contours, Digital Surface Models and Digital Terrain Models projected in Solutions will process the data into useable geospatial formats. Key environmental features will be identified, timeframe than traditional total station surveying. After the data collection process is complete, Whiteout depth-which is influenced by water clarity. The aerial survey will be completed over two days, a much shorter topobathymetric sensor can collect elevation data up to 15 meters below the water surface-2.5 times the Secchi accuracy with ground control. The 532-nanometer wavelength photon or green laser used in the could be downsized as needed. The LiDAR system produces 200+ points per square meet and 3cm of vertical 89, an area of approximately 42 acres. Following the kickoff meeting and discussions with the Town, this area the water surface) data along the main stem of the Winooski River from Jonesville to downstream of Interstate mounted to an Unmanned Aerial Vehicle to collect topographic and bathymetric (streambed elevation below high-precision LiDAR collection systems and data processes. Their team will use a topobathymetric system dimensional hydraulic model of the Winooski River through Richmond. Whiteout Solutions specializes in Stone has partnered with Whiteout Solutions to obtain high-resolution elevation data to develop a two-

2.3.2. River Survey and Supplemental Field Data Collection

flood mitigation projects. This field data will be used to refine the hydraulic model and inform subsequent size and type, bank conditions, culvert and bridge dimensions and conditions, and location data for potential to collect supplemental field data as needed. During this walk, we will collect data on stream bed sediment alternatives analysis. To complement the aerial topographic and bathymetric survey, Stone staff will complete a river corridor walk

2.3.3. Hydraulic Model Development

goals. Our scientists, modelers, and engineers are well-versed in hydraulic model development dimensional approach can be used in simpler reaches, balancing computational requirements with project model provides flexibility to model high-priority or complex areas in two dimensions, while a one-(USACE) Hydrologic Engineering Center's River Analysis System (HEC-RAS). A coupled 1D/2D hydraulic that a coupled 1D/2D hydraulic model will be developed using the United States Army Corps of Engineers The Stone team will complete hydrologic analyses and hydraulic modeling for the project extent. We propose

visits and/or aerial imagery. Boundary conditions will be set at the upstream and downstream extent of the parameters assigned to the main channel and each overbank based on professional judgment based on-site topobathymetric survey data, field data, and publicly available geospatial data layers. Model roughness mitigation measures that would benefit Richmond. The model geometry will be developed from the aerial extent may be adjusted in coordination with the Town and will be set to ensure that the model boundary and overbank roughness parameters, and boundary conditions. The model extent ranges from upstream of channel and floodplain geometry, bridges and other infrastructure, peak discharges (or streamflow), channel model and junctions with tributaries. conditions do not influence model results in areas of interest and are sufficiently reasonable to evaluate flood Jonesville to approximately one mile downstream of where Interstate 89 crosses the Winooski River. This The hydraulic model will be used to simulate flooding under existing conditions. Model inputs will include

the Winooski to select the most appropriate peak flows for the model simulations. to peak flow estimates calculated using USGS StreamStats and effective peak flows from the FEMA FIS for similar peak flow estimates for the hydraulic model extent through Richmond. These values will be compared Distribution flood frequency analysis technique. We will then perform the gage transfer technique to develop flow for the 2-, 5-, 10-, 25-, 50-, and 100-year recurrence interval flood events, using the Log-Pearson Type III gages along the Winooski River. We will process data from the selected gage(s) and develop estimates of peak utilizing gage transfer and statistical analysis techniques. Our team will perform a review of USGS stream determine the most appropriate flood flow values to model. Stone will develop hydrology for the site by The model will be used to simulate peak discharges, or flood flows. A hydrologic analysis will be completed

in accordance with Stone's standard hydraulic model review procedures to ensure accuracy of inputs and flood inundation maps and estimates of water velocity, shear stress, and stream power. The model will be reviewed High-water mark data from the July 2023 flood is available through the United States Geologic Survey (USGS) Flood Event Viewer. This data will be used to validate the model. Model results will include flood

2.3.4. Hydraulic Study Report – Winooski River

reductions associated with specific flood mitigation projects. A map of flood inundation extent and potential flood inundation and impacts associated with different peak flows and to simulate potential flood included as an appendix to the Scoping Study Report. longitudinal profile of the Winooski River depicting flood levels will be provided. The hydraulic report will be validation, and model results. The report will include a summary of how the model may be used to assess Stone will prepare a hydraulic study report summarizing field data collection, model inputs, model

be completed to address the Town's comments prior to the alternatives analysis interim meeting described in Stone will share a final draft of the report with the Town for comment and review. One round of revisions will

Task 3: Existing Data and Desktop Review

- aerial topographic and bathymetric survey Digital Surface Model (DSM), Digital Terrain Model (DTM), and elevation contours developed from the
- ✓ Coupled 1D/2D Winooski River Hydraulic Model
- alternatives analysis interim meeting. Hydraulic Study Report included as an appendix to the Scoping Study Report and presented at the

2.4. Huntington River Task 4: Hydraulic Study – Jones Mill Brook, Snipe Island Brook

tributaries. The main components of the Winooski River Tributaries Hydraulics Study include: flood impacts in Richmond with a focus on town-owned infrastructure, roadways, and residences along the the hydraulic studies on the three tributaries will align with the overall flood mitigation goals of reducing model to gain a better understanding of water depths and velocity contributing to flood hazards. The scale of tributaries, including incorporating their confluences with the Winooski in the Winooski River hydraulic associated with flood events present a hazard to infrastructure and homes along tributaries to the Winooski. Brook, Snipe Island Brook, and the Huntington River. Stone will complete a hydraulic study for these three The Town has identified three tributaries to examine further as part of this effort. These include Jones Mill In addition to flooding along the main stem of the Winooski, increases in water depth and stream velocities

- Supplemental field data collection and survey
- One-dimensional hydraulic model development
- Hydraulic study report

2.4.1. Supplemental Field Data Collection and Survey

anticipate that data collection will focus on the most vulnerable reaches of these tributaries. information learned during the project kickoff meeting, existing data review, and desktop analysis. We flood mitigation projects. Field data collection locations and extents will be informed and refined based on Field notes will be recorded using electronic or paper field forms. Location data will be recorded for potential each tributary. Field data collection will be completed using a survey-grade GPS Base Station and Rover. geospatial and geomorphic data. Our proposed scope includes one day of field work for two Stone staff along Stone staff will collect limited topographic, bathymetric, and stream geomorphic data to supplement existing

2.4.2. Hydraulic Model Development

available via state records. Model roughness parameters assigned to the main channel and each overbank are geometry will be developed using terrestrial LiDAR data available through the Vermont Center for ensure that the model boundary conditions do not influence model results in areas of interest. The model with the Winooski River, and the Huntington River hydraulic analysis will extend far enough upstream to upstream and downstream extent of the model. based on professional judgment from site visits and aerial imagery. Boundary conditions will be set at the Geographic Information (VCGI), supplemental survey data, field data, and bridge and culvert dimension data Snipe Island Brook and Jones Mill Brook will be studied from the Richmond town line to their confluence River. Based on information from the project site visit and RFP Question and Answers, it is assumed that the Town and are anticipated to extend upstream from the confluence of each tributary with the Winooski roughness parameters, and boundary conditions. The model extents will be determined in coordination with floodplain geometry, bridges and other infrastructure, peak discharges (or streamflow), channel and overbank here assume that a recent effective model is not available from FEMA. Model inputs will include channel and conditions. In some cases, this can reduce time spent on model development. The scope and budget presented FEMA models used to develop FIRMs will be used as a starting point and modified to reflect current The hydraulic models will be used to simulate flooding under existing conditions. If available, effective The Stone team will complete hydrologic analyses and hydraulic modeling for each of the three tributaries.

2.3.3. If available, high-water mark data from the July 2023 flood is available through the USGS Flood Event determine the most appropriate flood flow values to model following the same methods described in section The model will be used to simulate peak discharges or flood flows. A hydrologic analysis will be completed to

and estimates of water velocity, shear stresses, and stream power. Viewer, or other sources will be used to validate the models. Model results will include flood inundation maps

Hydraulic Study Report - Tributaries

include a summary of how the models may be used as tools to assess potential flooding associated with and model results for Jones Mill Brook, Snipe Island Brook, and the Huntington River. The report will be included as an appendix to the Scoping Study Report. projects. Maps and figures depicting the model results will be included in the report. The hydraulic report will different peak flows and to simulate potential flood reductions associated with specific flood mitigation Stone will prepare a hydraulic study report summarizing field data collection, model inputs, model validation,

following the interim meeting described in Section 2.3.4. River Hydraulic Study Report. One round of revisions will be completed to address the Town's comments Stone will share a final draft of the report with the Town for comment and review alongside the Winooski

Task 4: Hydraulic Study - Jones Mill Brook, Snipe Island Brook, and Huntington River

- Hydraulic models for Jones Mill Brook, Snipe Island Brook, and the Huntington River within project
- Hydraulic Study Report included as an appendix to the Scoping Study Report and presented at the alternatives analysis interim meeting.

Task 5: Alternatives Analysis

in lessening future flood damage. Richmond and the Winooski River watershed. Projects will be prioritized based on their assumed effectiveness stage, pulling from experience and expertise, knowledge of the FEMA HMGP, and familiarity with damages, as appropriate. The Stone team will maintain an open mind at the project identification and vetting involving multiple parcels and stream crossings along the same reach) to address long-term and repeated (i.e., buyout [or managed retreat] combined with floodplain reconnection and restoration, or projects more holistic projects that incorporate multiple approaches or types of engineering and nature-based solutions be considered will include both targeted, immediate potential solutions to flooding challenges, and broader, progress to the conceptual design phase and eventually into HMGP funding applications. Project concepts to Following the hydraulic studies, Stone's team will identify and vet potential flood mitigation projects to

project criteria align with the project's goals. Projects in the matrix will be evaluated in a community-driven initial evaluation of the project relative to screening criteria. Stone will work with the Town to ensure that alternatives analysis matrix. The matrix will include key project identification information along with an From the geospatial desktop analysis, hydraulic modeling, and field visits, project ideas will be entered into an landowners and key stakeholders. HMGP requirements for eligibility. The ideal project will be cost-effective, impactful, and supported by process based on criteria developed by the Stone team in coordination with the Town and informed by the

We anticipate that the alternatives analysis matrix will include the following criteria or project attributes:

- Project identification information:
- Location
- Type of project
- Eligibility Does the project fall into at least one of the HMGP eligible categories?

- Feasibility How constructable is this project? Are there any major potential challenges?
- Permitting Ease/Constraints What level of permitting will be required?
- contribute to long-term flood resiliency? Flood Mitigation Potential - Will this project have immediate flood-reduction benefits? Will it
- Community Alignment Has the community already expressed interest in or concern about this type of project, or this specific project?
- Cost-effectiveness Is the anticipated cost of the project relative to its benefits likely to be costeffective for HMGP funding?

providing a defensible and less biased comparison across projects where possible. Limitations and attention to each alternative's likelihood of passing the benefit cost analysis. process. SEAM Solutions will review and provide input on the draft project map and matrix, paying specific assumptions of the numerical scoring will be acknowledged in the project matrix and alternatives analysis community alignment, and cost-effectiveness. This scoring framework will streamline project comparisons, for low to high cost-effectiveness) for feasibility, permitting ease/constraints, flood mitigation potential, During this alternatives analysis, projects will be assigned preliminary numerical scores (i.e., a score of 1 to 3

eligible for HMGP funding: Our proposed approach to flood mitigation projects presented here focuses on the following types of projects

- Infrastructure projects such as culvert and bridge upsizing
- Roadway relocation, elevation, or soil stabilization projects to address reoccurring washouts
- Floodproofing of commercial and/or municipal buildings
- Natural resources projects including dam removals and floodplain reconnection
- Structural elevation
- Buyouts

implementation, to develop viable alternatives for the Town. along with our strong understanding of natural resource, roadway, and culvert and bridge project design and and/or elevating infrastructure such as tanks or electrical components. We will leverage this past experience, with flood resiliency in mind. This includes exploring options like relocation in addition to floodproofing is currently helping communities like Wolcott, Vermont, design and implement village wastewater projects station for the Town sewer system, the Town offices, and the Town Wastewater Treatment Facility. Stone has impacts for private residences, Volunteers' Green, the Town water system and water system well, a pump extensive experience with village wastewater feasibility assessments through engineering design support, and In addition to these example project types, our team will evaluate options for projects that mitigate flood

meeting will be to select one or more projects to progress to conceptual (30%) design. Details related to criteria are able to progress to the HMGP application stage within this project's scope and timeline. The goal of this timelines will be provided at this stage for the conceptual (30%) design phase to help determine which projects and recommendations for projects to progress to the conceptual design phase. Preliminary cost estimates and like cost will be refined for projects selected to move forward. meeting, Stone will review the project evaluations, hydraulic studies, alternatives analysis matrix development, Stone will then meet with the Town to review and discuss the results of the alternatives analysis. During this

Task 5: Alternatives Analysis

- Alternatives analysis matrix with supporting documentation included as an appendix to the Scoping
- Presentation of the alternatives analysis and recommendations at an interim public meeting



2.6. Task 6: Conceptual (30%) Designs

given timeframe. develop effective, accurate, and sound engineering designs to support a successful HMGP application in the While project feasibility and potential impact will be prioritized, the project team will consider the ability to the Scoping Study project due to funding application deadlines, and whether VEM is granted extensions. realistic about the number and scope of projects to develop conceptual preliminary engineering designs under completing conceptual designs to the 30% level for up to two selected alternatives. Our team will also be and stream restoration. Depending on the scale and scope of the preferred alternatives, our team anticipates mitigation alternatives range from targeted solutions like single bridge upsizing or floodproofing of a single the selected alternatives for full HMGP application development. The potential scope and efficacy of the flood historical structure to more holistic, large-scale projects combining multiple buyouts, floodplain reconnection, We understand that this task aims to complete conceptual-level engineering to further develop and evaluate

into the Benefit Cost Analysis (BCA). flood mitigation measure impacts the mapped flood zone area in Richmond. This data will be incorporated and quantify potential flood reductions. These model simulations will be used to quantify how the selected needed to inform additional field investigations that may be necessary during the final (100%) design stage. natural resources, and threatened and endangered species will be mapped using available geospatial data as identification of trees and vegetation that may need to be removed for construction. The presence of wetlands time for additional field data collection, including site-specific topographic and bathymetric survey and engineering stage and anticipating potential future project challenges. Our proposed scope of work allocates Stone will begin the conceptual design phase by identifying data gaps that need to be filled at the conceptual The models developed during the hydraulic studies will be updated to simulate proposed project conditions

We anticipate the preliminary design plans will include, at a minimum:

- Cover sheet,
- Notes sheet
- Existing conditions site plan sheet(s),
- Proposed conditions site plan sheet(s), including proposed access and construction sequence,
- Longitudinal profile sheets,
- Typical cross sections sheets, and
- Details sheet:

archeological resource assessment or subsequent investigations should they be required following SHPO's alternative project site is not yet known, this scope of work does not include time or budget for an necessary parties to identify the specific needs for each project. A Vermont State Historic Preservation Project Alteration Permits, Wetlands Permits, Stormwater Construction General Permits, and archeological and implementation phase. review. Those costs will be included in the opinion of probable cost for the final (100%) design and Review Form will be completed and submitted to SHPO for the selected alternative. Since the selected historic preservation review for the State Historic Preservation Office (SHPO); and will coordinate with all obtaining Construction General Permits, Stormwater Permits, Army Corps of Engineers permits, Stream Stone will identify and summarize all necessary permits and regulatory applications. Our team has experience

engineering and oversight. Our engineers will clearly outline a preliminary construction sequencing probable cost to the conceptual (30%) design level for final (100%) design, construction, and construction Stone has vast experience in cost estimating and construction sequencing and will prepare opinions of

year and 5-year averages) and the experience Stone has gained with similar projects, with contingencies in the Benefit Cost Analysis (BCA). included for individual project area constraints. This cost estimate will be used to determine cost-effectiveness Opinions of Probable Cost for construction will be informed by the most recent VTrans item unit cost data (2-

Task 6: Conceptual (30%) Design(s)

- Conceptual (30%) design plans, OPC, and permitting needs for the selected alternative(s)
- Summary of the basis of design and conceptual (30%) design plans included in the final Scoping
- Presentation of the conceptual (30%) designs at a public meeting

2.7. Task 7: Benefit Cost Analysis (BCA)

Multiple project types can be combined into the same BCA analysis, sometimes increasing the benefits must be cost-effective, with a Benefit-Cost Ratio greater than 1, to be eligible for FEMA HMGP funding social benefits) will be developed from the conceptual (30%) design and hydraulic analysis phases. Projects analysis. Data on proposed project costs, flood mitigation benefits, and co-benefits (i.e., ecosystem restoration, accuracy of the BCA analysis. We will work with the Town to obtain past damages data to complete the BCA years, our team recommends using data from past damages wherever possible to strengthen and improve the damages based on professional opinion. Given the extent of flooding that Richmond has experienced in recent analysis includes data on proposed project costs and benefits along with data on past damages or estimated compared to the costs. FEMA BCA guidance. SEAM Solutions will lead with review and support from Stone. Input required for this The Stone team will complete a BCA for the selected alternative(s) using FEMA's BCA Toolkit and following

support the BCA results. These materials will be used to support the HMGP application. Deliverables for this task will include a report generated from the BCA Toolkit along with a narrative to

Task 7: Benefit Cost Analysis (BCA)

BCA Toolkit Report and supporting narrative for HMGP application for selected alternative(s

Task 8: Scoping Study Final Report & HMGP Application Materials

Town to review. The report will include the following appendices: and other analyses, conceptual designs, and preliminary BCA results in a final scoping study report for the The Stone team will summarize the existing data reviewed, field instigations completed, hydraulic modeling

- Hydraulic Study Report Winooski River
- Hydraulic Study Report Jones Mill Brook, Snipe Island Brook, Huntington River
- Alternatives Analysis Matrix
- Conceptual (30%) Design Plans for Selected Alternative(s)
- Project Location Maps

recommendations for progressing viable alternatives that were not selected for this round of HMGP funding potential flood mitigation benefits, BCA narratives to accompany the BCA Toolkit Report, and report and conceptual designs, Stone will complete one round of revisions and finalize technical materials A draft report will be provided to the Town for review and comment. Following the Town's review of the In addition, the report will include a summary of the basis of design for the selected alternative(s) and