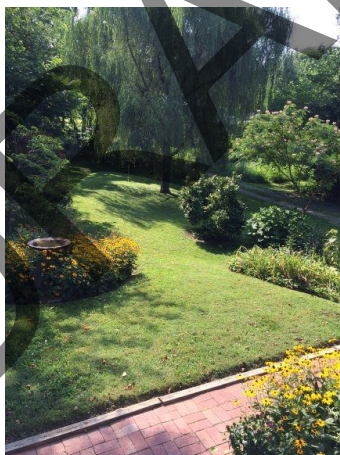


Hill Street to Mason Street Draft Proposed Alternative Analysis City of Harrisonburg, VA

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1 Executive Summary

Residents of the neighborhood between North Mason Street and Hill Street have experienced recurring flooding, prompting this drainage assessment to evaluate the adequacy of the existing stormwater infrastructure, identify areas of concern, and evaluate the feasibility of infrastructure improvements. This effort is part of the City's broader Drainage Improvement Program, established in 2019 to support neighborhood-scale solutions for stormwater concerns. The total contributing drainage area within the project limits is approximately 119.26 acres. Although the project limits are not located within a Federal Emergency Management Agency (FEMA) mapped floodplain, it is subject to urban flooding, as evidenced by the May 6, 2024 storm event.

The study is structured in two phases. Phase I has been completed and included field survey efforts, development of a one-dimensional (1-D) Personal Computer Storm Water Management Model (PCSWMM) hydrologic and hydraulic model, and an evaluation of existing conditions. The results of Phase I are documented in the *Hill Street to Mason Street Existing Conditions Analysis Report*, dated September 2025.

Phase II, documented in this report, focuses on evaluating the feasibility of expanding stormwater infrastructure, exploring alternative conveyance alignments to reduce the frequency and severity of flooding throughout the neighborhood, and evaluating the feasibility of incorporating green infrastructure. The ultimate goal of this study is to provide the City with a clear understanding of infrastructure needs and to support the development of a more effective and resilient stormwater management system for the community.

Multiple flood reduction alternative scenarios were modeled and summarized below:

- Alternative One: Conveyance System Upgrades and Storage within City Right-of-Way
- Alternative Two: Conveyance System Upgrades and Storage

Results of the alternatives were compared against the existing conditions flood depth to evaluate the effectiveness of the alternatives. The scoring matrix indicates that Alternative One provides the highest level of performance; however, it also represents the most costly option. The project team will continue to coordinate with the City of Harrisonburg to identify a recommended alternative that best mitigates flooding within the neighborhood between North Mason Street and Hill Street.



Figure 1: Map of Drainage Study Project Limits

2 Introduction

This section provides an overview of the project background and summarizes key observations and results from the Phase I analysis.

2.1 Background

Flood events within the drainage study project limits (Figure 1), a neighborhood located in northeastern quadrant of Harrisonburg, Virginia (the City), have resulted in a range of impacts to residents, from temporary road closures to varying degrees of property and structural inundation. Over 70% of the service requests for this project limits are concerns impacting private properties. In response to recurring drainage concerns, the City initiated this comprehensive drainage improvement study to evaluate the adequacy of the existing stormwater infrastructure, identify areas of concern, and develop feasible solutions to help mitigate the flooding. This effort is part of the City's broader Drainage Improvement Program, established in 2019 to support neighborhood-scale solutions for stormwater concerns.

2.2 Summary of Phase I

The study was conducted in two phases. Phase I, documented in the *Hill Street to Mason Street Existing Conditions Analysis*, dated September 2025, included field survey efforts, development

of a one-dimensional (1-D) PCSWMM hydrologic and hydraulic model, and an evaluation of existing conditions. The model was calibrated using rainfall data and documented flood extents from the May 6, 2024 event, and validated against photographic evidence to ensure it accurately reflected observed flooding conditions. In addition to the May 6, 2024 storm event used for model calibration, preliminary model results were presented at a Public Meeting hosted by the City on June 2, 2025. During this meeting, attendees were invited to review the preliminary model results, mark locations where they had personally experienced flooding on a large-scale map, and complete a detailed survey. The feedback collected through this process provided valuable insight into the community's flooding concerns and helped validate the model results. This validated model was then used to assess the performance of the existing conveyance system under 2-year and 10-year design storm events.

As part of the existing conditions analysis, each storm drain pipe segment within the study area was assigned a level of service (LOS) classification based on annual return intervals ranging from 2-year to 10-year storms. LOS indicates the ability of each pipe to convey runoff without flooding, assuming normal depth tailwater conditions. A pipe was considered insufficient if the hydraulic grade line exceeded the upstream rim elevation or resulted in roadway ponding. Results show that approximately 60% of the system is undersized for a 2-year storm, while only 31% can accommodate a 10-year storm or greater, highlighting significant capacity limitations. These classifications represent current system performance and may change with future upstream or downstream improvements.

The analysis also identified critical flooding locations, including the intersection of Hill Street and East Gay Street, East Wolfe Street, and East Elizabeth Street. Private property flooding was reported west of Hill Street and East Gay Street, north of East Wolfe Street between Broad Street and Myrtle Street, and east of Broad Street between East Wolfe Street and East Elizabeth Street. While flooding occurs in other areas as well, these locations represent the most critical concerns. Mitigating the flooding experienced in these areas will be the primary focus of Phase II.

3 Modeling Methodology

Details of the modeling parameters and data used for Phase I are provided in the *Hill Street to Mason Street Existing Conditions Analysis*; this section focuses on the modeling approaches applied to evaluate proposed improvements. The validated existing conditions model from Phase I served as the basis for evaluating all proposed improvements.

3.1 Rainfall Data

Rain gages were created for the two analyzed design storms in PCSWMM using the *Design Storm Creator* tool. Table 1 lists the rainfall depths and return periods used in this study. The rainfall depths are taken from NOAA Atlas 14 for the Type B 24-hour duration storm specific to Harrisonburg, Virginia. These values are consistent with the values utilized during Phase I.

Table 1: 24-Hour Rainfall Depths

Return Period	Rainfall Depths (in)
2-Year	2.62
10-Year	3.86

3.2 Subbasin Parameters

The subbasin delineations from the Phase I model were utilized; however, select subbasins were subdivided to account for proposed inlets incorporated into the updated model. Subdivision was based on topographic data from the Digital Elevation Model (DEM), and each subdivided subbasin was assigned to its corresponding modeled inlet. Land use characteristics, impervious area, infiltration parameters, and soil moisture values were applied, consistent with those used in Phase I.

For each subdivided subbasin, flow paths were defined, using existing topography and aerial imagery, to represent the longest route runoff would take to reach the associated stormwater inlet. Using these flow paths, PCSWMM internally calculated subbasin width by dividing the subbasin area by the flow length. Average slope was also computed within PCSWMM based on existing topography to represent the slope along the defined flow path.

3.3 Conduits

Several additional, proposed conduits were incorporated into the model, and hydraulic loss coefficients were applied to account for energy losses at pipe entrances, exits, and bends. These coefficients were developed based on standard PCSWMM modeling practices and values from the Virginia Department of Transportation (VDOT) Drainage Manual to reflect site-specific conditions such as pipe bends and confluences. Entrance and exit losses were included to simulate head loss associated with flow entering or leaving a conduit, while bend losses were applied where abrupt changes in flow direction occur. A summary of the coefficients used is provided in Table 2 below.

Table 2: Conduit Losses Utilized

Loss Description	Loss Coefficient
Entrance Loss	0.35
Exit Loss for Pipes Discharging to Manholes	0.25
Exit Loss for Pipes Discharging to Open Channels	0.50
Bend Loss: 90°	0.70
Bend Loss: 45°	0.50
Bend Loss: 20°	0.25

In accordance with Chapter 2, Section 2.3.2.13 of the City’s Design and Construction Standards Manual, all proposed pipes are reinforced concrete with a minimum diameter of 15 inches. A Manning’s n-value of 0.013 was applied to all proposed concrete pipes.

3.4 Structures – Inlets and Manholes

Several proposed inlets and manholes were added to the model and represented as junction nodes with appropriate rim and invert elevations assigned based on site conditions. Where feasible, minimum structure heights were used to establish inverts, or inverts were set to tie into the existing conveyance system. Additionally, consistent with feedback from the City during a progress meeting, structure depths were limited to eight feet wherever practicable.

As in Phase I, inlet openings were not explicitly modeled in this study. For the purposes of this analysis, it was assumed that all surface runoff reaching an inlet is fully captured by the structure. Evaluating inlet hydraulic efficiency or capture capacity was outside the scope of this work, as the primary focus was on assessing the capacity of the subsurface pipe network.

3.5 Underground Storage

Proposed underground storage facilities were modeled as storage nodes with a tabular storage curve defined by a stage–area relationship. This approach represents the available storage volume as a function of water depth, allowing the model to accurately simulate how storage capacity changes with rising water levels. The stage–area curve was developed based on the geometry of the proposed underground facility, ensuring that the model reflects site-specific conditions for detention and flow attenuation.

3.6 Outfall

Consistent with Phase I, the model's boundary outfall was set at the box culvert beneath North Mason Street near East Market Street, with a normal depth boundary condition applied to represent downstream hydraulic behavior. This approach estimates tailwater elevation assuming steady, uniform flow at normal depth, using the culvert's slope, roughness, and geometry. The normal depth assumption was necessary due to the lack of downstream data, such as surveyed elevations, flow records, or structural details, which precluded more data-dependent boundary conditions. This method is a widely accepted hydraulic modeling practice, providing a reasonable estimate of tailwater effects while maintaining hydraulic continuity and avoiding speculative parameters.

Care was taken to develop proposed alternatives that do not increase peak flow at the outfall, ensuring that the upstream improvements recommended in this report do not cause adverse impacts downstream of the modeled area.

4 Alternative Analysis

The existing conditions model developed in Phase I served as the basis of analysis for each of the proposed alternatives. Two alternatives have been developed, each expanding stormwater infrastructure and identifying alternative conveyance alignment options within the neighborhood. The primary objective is to reduce flooding frequency and severity throughout the neighborhood while ensuring that proposed improvements do not create adverse impacts or increase downstream flowrates beyond existing conditions. The alternatives also explored opportunities for water quality improvements using green infrastructure. Each alternative is designed to meet the level of service for a 10-year storm event. Detailed descriptions of all evaluated alternatives, including those eliminated after preliminary analysis, are provided below.

4.1 Alternatives Considered but Not Advanced

This section presents alternatives evaluated during the preliminary analysis that were subsequently eliminated due to feasibility constraints and varying site conditions.

Upstream Attenuation

Upstream attenuation was initially explored to determine whether managing runoff in the upper portions of the watershed could reduce peak flowrates and lessen demand on the downstream conveyance system. During the project kickoff meeting on October 23, 2025, the City confirmed that full parcel acquisition would not be supported. As a result, large-scale stormwater management facilities such as wet ponds or regional detention basins were deemed infeasible due to the absence of City-owned property and the lack of suitable vacant parcels within the upstream drainage area. Following this constraint, several potential locations for smaller distributed practices, such as bioretention facilities, situated on undeveloped and non-treed portions of private properties throughout the neighborhood were identified. Based on discussions during the progress meeting held on December 12, 2025, the City determined that further analysis of these sites should not be pursued as the anticipated flood-mitigation benefits of these small-scale practices would be minimal, with meaningful reductions in runoff expected only during more frequent, low-intensity storm events such as the 1- and 2-year storms, and insufficient to address the larger flooding issues within the system.

To minimize property acquisition while maximizing upstream attenuation, an alternative was evaluated that incorporated underground stormwater detention within existing alleyways throughout the project area, with only limited new conveyance infrastructure proposed within the public right-of-way. This concept was technically feasible only when utilizing extremely deep infrastructure due to the significant elevation changes across the alleyways, ranging from approximately 40 feet to 15 feet. This significant topographic drop limits the feasibility of installing underground storage without resorting to deep excavation and deep conveyance connections, which was not preferred by the City. Additionally, these constraints would result in significant construction impacts, higher costs, and increased risks during installation. Therefore, shallower configurations were explored to reduce construction complexity and cost, but substantially larger storage structures were required within the alleyways. The increased footprint of these facilities would necessitate easements from adjacent private property owners, reducing the practicality of the approach. For these reasons, the alternative involving underground stormwater detention within the alleyways was not advanced for further consideration.

Mason Street Alignment

A conveyance system alignment was evaluated that involved rerouting the existing stormwater flows west toward new infrastructure along North Mason Street. While this alignment was initially considered feasible, achieving the required pipe cover along North Mason Street necessitated installing extremely deep pipes and structures in the upstream portions of the project area. In addition, North Mason Street contains multiple existing stormwater conveyance systems and several buried utilities that would need to be addressed during design and construction. The roadway also serves as a primary, heavily traveled corridor within the downtown area, which

would significantly increase construction impacts, traffic disruptions, and utility coordination challenges. Due to the need for deep infrastructure, extensive utility conflicts, and the high level of disruption associated with construction along a major roadway, this alternative was not advanced for further consideration.

4.2 Alternative One

Alternative One proposes the upsizing of existing pipes and the construction of new conveyance infrastructure. Improvements proposed in this alternative were focused on those within the public right-of-way or on City property to minimize the number of easements required from private property owners. This alternative also includes the construction of underground detention facilities on City property.

At the intersection of Hill Street and East Gay Street, existing stormwater pipes will be upsized, and new stormwater inlets and pipes will be constructed. The existing stormwater pipe at 365 Hill Street (Real Estate Tax ID 033 N 10) will be abandoned, and the stormwater runoff from the intersection will be routed west through stormwater pipes in an alleyway to Sterling Street. Temporary construction easements will be required to install the stormwater pipes in the alleyway. There is an existing 6- and 8-inch sanitary sewer line that runs through the alleyway as well. However, it does not appear to be in conflict with the proposed improvements, and 5 feet horizontal separation should be feasible. Proposed pipes will be installed along the east side of Sterling Street, routing the water south to the existing system at the Sterling Street and East Rock Street intersection. It is likely this alignment will be in conflict with an existing 8-inch sanitary sewer line that will need to be relocated.

At the intersection of Sterling Street and East Rock Street a new conveyance system will be installed along the northern side of East Rock Street. The connection with the existing stormwater system that continues south along Sterling Street will be maintained. Vertical conflicts with an 8- and 14-inch water line and 8-inch sanitary sewer line are likely at the intersection. However, no public utility conflicts are anticipated along East Rock Street until reaching the intersection with Myrtle Street. At the intersection the conveyance system is routed south along Myrtle Street along the east side of the roadway. Vertical conflicts with a 4-inch water line and a 4- and 6-inch sanitary sewer line are likely at the intersection. No public utility conflicts are anticipated along Myrtle Street until reaching the intersection with East Wolfe Street, as 5 feet of horizontal separation from the public utility lines should be feasible. The connections to the existing stormwater pipes within the alleyways will be maintained along Myrtle Street.

At the intersection of Hill Street and East Wolfe Street, stormwater will be collected and routed west along the southern side of East Wolfe Street through new stormwater pipes and inlets. The only public utility conflicts anticipated along East Wolfe Street from Hill Street to Myrtle Street are vertical conflicts with water lines at each of the three intersections along the alignment.

At the intersection of Myrtle Street and East Wolfe Street, this proposed system will tie into the proposed system from Myrtle Street and continue west along East Wolfe Street. The existing conveyance system along East Wolfe Street will be upsized but continue along East Wolfe Street to Broad Street rather than being conveyed south along the alleyway adjacent to 325 East Wolfe

Street. The connection to the existing conveyance system will remain in place. While no horizontal conflicts with public utilities are anticipated, a vertical conflict with two separate 8-inch sanitary sewer lines and a 4-inch water line is anticipated. Along Broad Street maintaining five feet of horizontal separation from the existing 8-inch sanitary sewer line may be infeasible as the conveyance system continues south to the intersection with East Elizabeth Street.

At the intersection of Sterling Street and East Elizabeth Street, stormwater runoff will be collected and routed west along East Elizabeth Street through new stormwater pipes and inlets to the intersection of Broad Street. The only public utility conflicts anticipated along East Elizabeth Street from Sterling Street to Broad Street are vertical conflicts with sanitary sewer and water lines at each of the three lateral stormwater pipes that tie into the proposed conveyance system alignment.

The majority of the existing system at the intersection of Broad Street and East Elizabeth Street will be upsized. A permanent and temporary construction easement will be required at the northwest corner of the intersection. All of the runoff will be routed west to proposed underground detention facilities on City property at 110 North Mason Street (Real Estate Tax Number 034 R 0 1 2) and 215 East Elizabeth Street (Real Estate Tax Number 034 U 16). The underground detention facilities will then discharge south to the existing conveyance system at the intersection of North Mason Street and East Market Street. A permanent drainage easement will be required for the outfall pipe of the detention facility. The existing stormwater pipe crossing just west of the intersection will be abandoned as all runoff will be routed to the detention facility. Vertical utility conflicts are anticipated with an 8-inch sanitary sewer line and 3-inch water line that interconnects the detention facilities.

In this alternative, several structures along Sterling Street and Broad Street were deeper than the preferred eight-foot structure depth, but no structure is deeper than eleven-foot. As the design progresses, further analysis is recommended to evaluate the feasibility of shallower structures in these locations.

Based on the results of the PCSWMM model, the outfall of the system discharges 127.92 cubic feet per second (cfs) of stormwater runoff compared to the 153.75 cfs that was discharging through the box culvert in existing conditions. In addition to this runoff, there was 57.63 cfs of runoff bypassing the conveyance system and discharging via an overland flow link at the outfall of the existing conditions model. The improvements have significantly decreased the runoff discharging to the existing downstream conveyance system, decreasing the potential flooding downstream of the project area.

While public utility conflicts have been identified based on the City's sanitary sewer and water line GIS information; additional conflicts with private utilities are expected and are recommended to be addressed during detailed design. A review of the National Wetlands Inventory indicates that no wetlands are present within the project area; therefore, no wetland-related environmental permits are anticipated for project construction.

All proposed improvements can be seen in the proposed improvement map included in Appendix A.

4.3 Alternative Two

Alternative Two proposes the upsizing of existing pipes and the construction of new conveyance infrastructure. Improvements proposed in this alternative were focused on those within alleyways throughout the project area to minimize the amount of work within the right-of-way and therefore minimize the number of utility conflicts. This alternative also includes the construction of underground detention facilities on City property.

At the intersection of Hill Street and East Gay Street, existing stormwater pipes will be upsized, and new stormwater inlets and pipes will be constructed. The existing stormwater pipe at 365 Hill Street (Real Estate Tax ID 033 N 10) will be abandoned, and the stormwater runoff from the intersection will be routed west through stormwater pipes in an alleyway to Sterling Street. Temporary construction easements will be required to install the stormwater pipes in the alleyway. There is an existing 6- and 8-inch sanitary sewer line that runs through the alleyway as well. However, it does not appear to be in conflict with the proposed improvements, and 5 feet horizontal separation should be feasible. Proposed pipes will be installed along the east side of Sterling Street, routing the water south to the existing system at the Sterling Street and East Rock Street intersection. It is likely this alignment will be in conflict with an existing 8-inch sanitary sewer line that will need to be relocated.

At the intersection of Sterling Street and East Rock Street the existing conveyance system will be upsized and routed south to the existing conveyance system along the alleyway. The existing conveyance system within the alleyway will be upsized to just east of Broad Street. At this location the conveyance system will be routed south and tie into the existing conveyance system along East Wolfe Street. Temporary construction easements will be required to install the stormwater pipes in the alleyway. Public utility conflicts are not anticipated within the alleyways, however, vertical utility conflicts are anticipated along the alignment at Sterling Street and Myrtle Street.

The existing conveyance system along East Wolfe Street will be upsized but continue along East Wolfe Street to Broad Street rather than being conveyed south along the alleyway adjacent to 325 East Wolfe Street. The connection to the existing conveyance system will remain in place. While no horizontal conflicts with public utilities are anticipated, a vertical conflict with two separate 8-inch sanitary sewer lines and a 4-inch water line is anticipated. Along Broad Street maintaining five feet of horizontal separation from the existing 8-inch sanitary sewer line may be infeasible as the conveyance system continues south to the intersection with East Elizabeth Street.

The majority of the existing system at the intersection of Broad Street and East Elizabeth Street will be upsized. A permanent and temporary construction easement will be required at the northwest corner of the intersection. All of the runoff will be routed west to proposed underground detention facilities on City/County property at 110 North Mason Street (Real Estate Tax Number 034 R 0 1 2) and City property 215 East Elizabeth Street (Real Estate Tax Number 034 U 16). The underground detention facilities will then discharge south to the existing conveyance system at the intersection of North Mason Street and East Market Street. A permanent drainage easement will be required for the outfall pipe of the detention facility. The existing stormwater pipe crossing just west of the intersection will be abandoned as all runoff will be routed to the detention facility.

Vertical utility conflicts are anticipated with an 8-inch sanitary sewer line and 3-inch water line that interconnects the detention facilities.

At the intersection of Hill Street and East Rock Street, new stormwater inlets and pipes will be constructed and routed south along the roadway and then west through the series of stormwater pipes in the alleyways between Hill Street and Sterling Street. Temporary construction easements will be required to install the stormwater pipes in the alleyways. No public utility conflicts are anticipated along Hill Street, however, there may be a vertical conflict with an existing 4-inch sanitary sewer line within the alleyway.

At the intersection of Hill Street and East Wolfe Street, stormwater will be collected and routed west along the southern side of East Wolfe Street through new stormwater pipes and inlets to the intersection with Sterline Street. At the intersection the runoff will be routed north to the upsized conveyance system along the alleyway. The only public utility conflicts anticipated along East Wolfe Street are vertical conflicts with a 4-inch water line and 8-inch sanitary sewer line at the intersection of East Wolfe and Sterling Street.

At the intersection of Sterling Street and East Elizabeth Street, stormwater runoff will be collected and routed west along East Elizabeth Street through new stormwater pipes and inlets to the intersection of Broad Street. The only public utility conflicts anticipated along East Elizabeth Street from Sterling Street to Broad Street are vertical conflicts with sanitary sewer and water lines at each of the three lateral stormwater pipes that tie into the proposed conveyance system alignment.

In this alternative, several structures along Sterling Street and Broad Street were deeper than the preferred eight-foot structure depth, but no structure is deeper than eleven-foot. As the design progresses, further analysis is recommended to evaluate the feasibility of shallower structures in these locations.

Based on the results of the PCSWMM model, the outfall of the system discharges 127.69 cfs of stormwater runoff compared to the 153.75 cfs that was discharging through the box culvert in existing conditions. In addition to this runoff, there was 57.63 cfs of runoff bypassing the conveyance system and discharging via an overland flow link at the outfall of the existing conditions model. The improvements have significantly decreased the runoff discharging to the existing downstream conveyance system, decreasing the potential flooding downstream of the project area.

While public utility conflicts have been identified based on the City's sanitary sewer and water line GIS information; additional conflicts with private utilities are expected and are recommended to be addressed during detailed design. A review of the National Wetlands Inventory indicates that no wetlands are present within the project area; therefore, no wetland-related environmental permits are anticipated for project construction.

All proposed improvements can be seen in the proposed improvement map included in Appendix B.

5 Evaluation Criteria

To ensure a comprehensive and objective assessment of proposed drainage improvement alternatives, a structured scoring methodology was developed. This framework evaluates each alternative across multiple dimensions, reflecting both technical performance and broader community and environmental impacts. The criterion were selected to adhere to the five essential findings outlined in the Drainage Improvement Program Manual. These findings include demonstrating the necessity of the project, assessing feasibility, confirming the benefits outweigh any potential impacts, ensuring public benefit, and verifying the adequacy of the outfall. Each criterion is assigned a specific weight to reflect its relative importance, and alternatives are scored on a scale from 0 to 10. The final score for each criterion is calculated by multiplying the assigned score by its weight, and the total score is the sum of these weighted values. The subsections below provide a description of each criterion and Subsection 5.5 provides justification for the scores assigned to each alternative.

5.1 Civic Impact

Flood Mitigation Potential

This criterion assesses the effectiveness of the alternative in reducing flooding. It considers impacts on both private properties and public infrastructure within the County right-of-way. Higher scores are awarded to alternatives that mitigate structural flooding, while those that only reduce flooding on private property receive lower scores.

Population Affected

This criterion assesses the number of residents or businesses benefited by the alternative. Higher scores are awarded to alternatives that affect a larger number of residents or businesses, while those alternatives that only benefit residents or businesses in certain areas receive lower scores.

Implementation Cost

This evaluates the estimated construction cost of the alternative. Lower-cost solutions receive higher scores, while those with significant financial requirements are scored lower.

5.2 Environment

Water Quality Features

This criterion evaluated alternatives that contribute to water quality improvements and offer potential for regulatory credits (e.g., VESMP/TMDL).

Enhancement of Natural Systems

This criterion measures the extent to which the alternative enhances the surrounding natural environment. This may include the creation or restoration of aquatic or wetland habitats, implementation of Best Management Practices (BMPs), or the provision of riparian buffers.

Permitting and Compliance

This assesses the complexity and number of environmental permits required. Alternatives that necessitate fewer and less complex approvals from state or federal agencies are scored higher, reflecting a lower risk of regulatory delays.

5.3 Constructability & Operations

Residential Community Disruption & Duration

This criterion evaluates the extent and duration of disruptions to residential areas. Alternatives that cause permanent access issues or long-term construction impacts receive lower scores, while those with minimal or short-term disruptions are rated higher.

Non-residential Community Disruption & Duration

Like the residential criterion, this evaluates impacts on businesses and non-residential facilities. Alternatives that maintain access and minimize disruption score higher.

Operation and Maintenance

This measures the long-term maintenance requirements of the proposed infrastructure. Alternatives that require routine maintenance with easy access are preferred, while those with complex or intensive maintenance needs are scored lower.

Land Acquisition/Available Easements

This criterion considers the extent of land acquisition required. Alternatives that rely on publicly owned land or require minimal easements are rated higher, while those necessitating the purchase of private parcels receive lower scores.

Site Constraints / Infrastructure Impact

This evaluates the extent to which the alternative affects existing infrastructure, particularly recently constructed utilities or facilities. Alternatives that avoid or minimize such impacts are scored more favorably.

5.4 Other Benefits

This captures any supplementary advantages offered by the alternative, such as the creation of park space, alignment with other Capital Improvement Projects (CIPs), or the replacement of aging infrastructure. Alternatives providing multiple co-benefits are rated higher.

5.5 Alternative Scoring

The following section presents the detailed scoring results for the two drainage improvement alternatives evaluated. These scores are derived from the structured evaluation framework outlined above.

Each alternative has been assessed using a standardized 0 to 10 scoring scale for each criterion, with scores weighted according to the relative importance of each factor. The resulting weighted scores provide a quantitative basis for comparing the overall effectiveness, feasibility, and value of each proposed solution. This approach ensures transparency and consistency in the decision-making process and supports the selection of the most beneficial and sustainable alternative for implementation. Scoring matrices for each alternative can be found in Appendices A and B.

Alternative One

Alternative One received an overall score of 7.39. The scoring matrix in Appendix A provides a detailed evaluation for each of the categories described above. For Alternative One, the lowest

score was in the Enhancement of Natural Systems, as the proposed improvements involve installing and upsizing pipe systems. Given the residential nature of the project area, opportunities to enhance natural conditions are limited; however, a water quality feature could be included with the underground storage facility. The highest scores for this alternative are in the categories of Flood Mitigation Potential, Permitting and Compliance, and Other Accrued Benefits. Because the improvements primarily involve installing and upsizing pipe systems, the flooding has been mitigated, and the work is anticipated to be completed without environmental permits.

Alternative Two

Alternative Two received an overall score of 6.49. The scoring matrix in Appendix B provides a detailed breakdown for each evaluation category. As with Alternative One, the lowest score for Alternative Two falls under the Enhancement of Natural Systems. This is primarily because the proposed improvements focus on installing new pipe systems and upsizing existing pipes. Given the residential nature of the project area, opportunities to enhance natural conditions are limited; however, a water quality feature could be included with the underground storage facility. The highest scores for this alternative are in the categories of Flood Mitigation Potential and Permitting and Compliance. Because the improvements primarily involve installing and upsizing pipe systems, the flooding has been mitigated, and the work is anticipated to be completed without environmental permits. The largest scoring variation between the two alternatives is the necessity for temporary construction easements within the alleyways as land acquisition/available easements is weighted at 18%.

6 Project Cost Estimate

A detailed opinion of probable project cost for each of the alternatives can be found in Appendix A and B and summarized in Table 3 below. Bid tabulations from recent City of Harrisonburg projects were utilized to develop the unit prices along with recent VDOT state-wide and Staunton district bid tabulations.

Table 3: Project Cost Estimate

Alternative	Project Cost Estimate
Alternative One	\$19,330,125.36
Alternative Two	\$17,601,696.03

7 Water Quality Assessment

The underground detention facility proposed in both alternatives also provides an opportunity to incorporate a water quality treatment component. The total drainage area to the facility is approximately 109.32 acres, with 40.62 acres being impervious area. If a chamber-based system is selected, it can be configured to function as a filtering manufactured treatment device, such as the StormTech Isolator Row Plus, which provides a total phosphorus removal efficiency of approximately 40%. Alternatively, if the detention system is constructed using pipes or vaults, a hydrodynamic separator could be installed upstream of the facility to provide pretreatment. Hydrodynamic separators achieve a total phosphorus removal efficiency of approximately 20%.

Table 4 below provides a summary of the potential water quality benefits calculated by the VRRM, version 4.1, associated with the underground detention facility.

Table 4: Potential Water Quality Benefits

Alternative	Efficiency	Total Phosphorus Removed (lbs)	Total Nitrogen Removed (lbs)
Filtering MTD	40%	32.54	0
Hydrodynamic MTD	20%	16.27	0

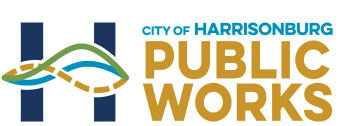
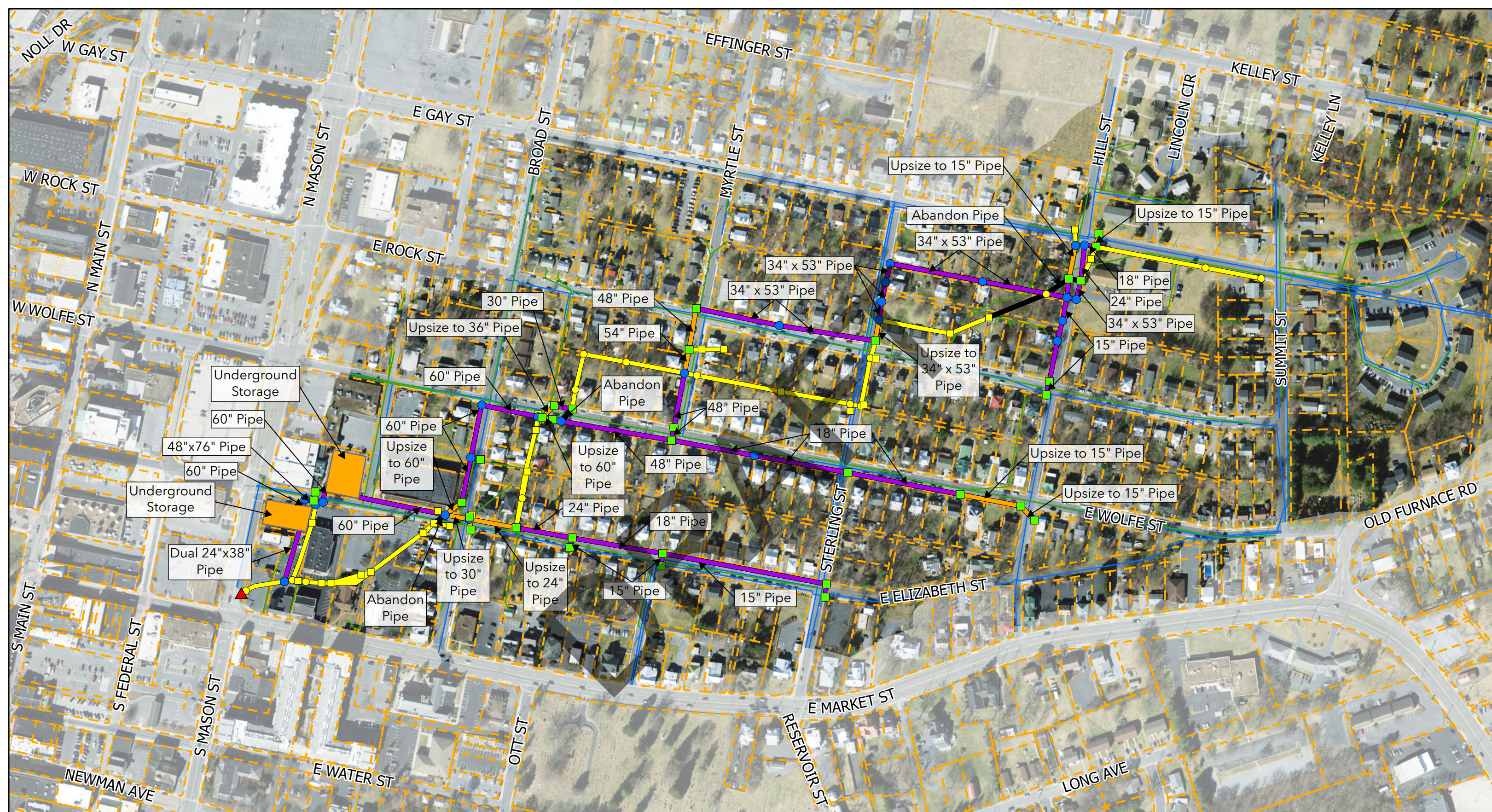
8 Recommendations

The evaluation of the proposed alternatives demonstrated that both alternatives are effective at mitigating flooding experienced during a 10-year storm event when compared to existing-conditions flood depths. Using the established scoring matrix, which incorporated criteria such as hydraulic performance, constructability, anticipated maintenance needs, community impacts, and cost, Alternative One achieved the highest overall score. However, Alternative One also represents the highest capital cost and would require more extensive construction activities within the public right-of-way than Alternative Two.

Given these findings, the project team recommends continued coordination with the City of Harrisonburg to refine the preferred alternative. This effort will include validating the hydraulic benefits, reviewing potential phasing strategies to manage cost, and confirming that the recommended improvements align with the City’s long-term stormwater management objectives and available funding resources. Through this collaborative process, a final recommended alternative will be developed that effectively reduces flooding, minimizes impacts to adjacent properties and infrastructure, and provides a sustainable solution for the neighborhood.

Appendix A: Alternative One

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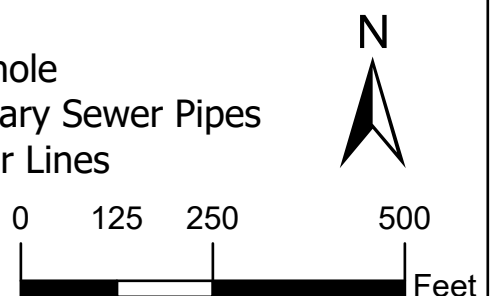


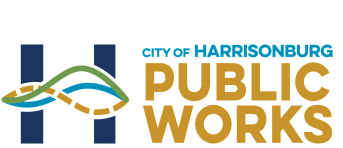
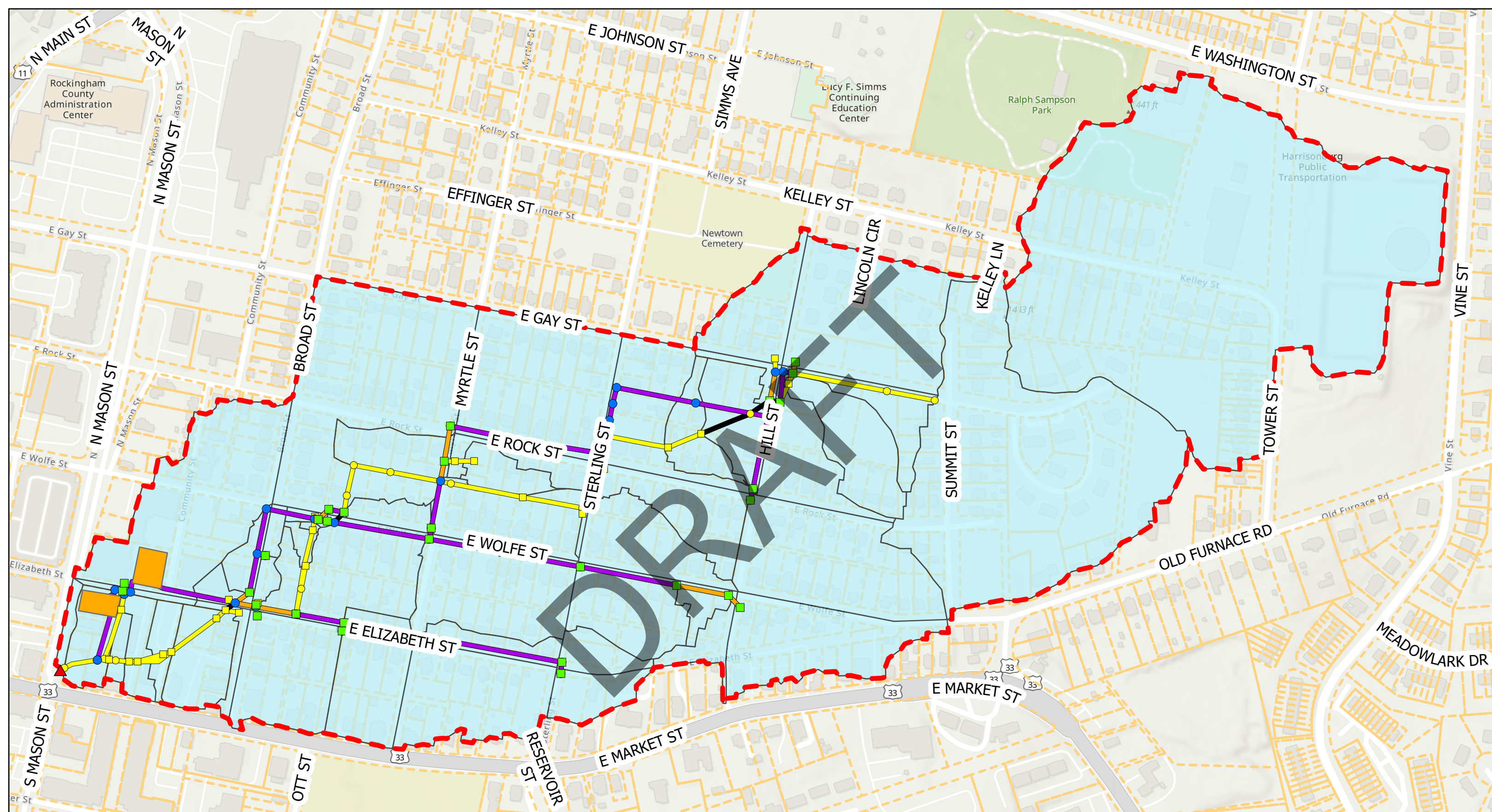
**Hill Street to N Mason Street
Alternative One
Conceptual Improvements**



Legend

- GIS Parcel Boundary
- Proposed Underground Storage
- Proposed / Replaced Inlet
- Proposed / Replaced Manhole
- Proposed Storm Pipe
- Upsized Storm Pipe
- Abandoned Storm Pipe
- Existing Storm Pipe
- Existing Inlet
- Outfall
- Existing Manhole
- Existing Sanitary Sewer Pipes
- Existing Water Lines



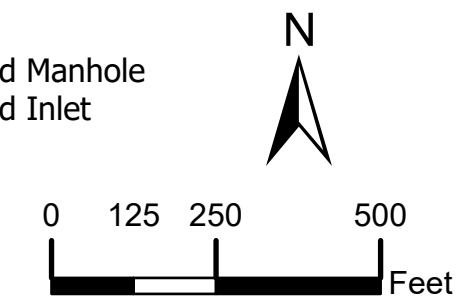


**Hill Street to N Mason Street
Alternative One
Project Limits Layout**



Legend

- - - Study Area
- Drainage Area (119.26 acres)
- GIS Parcel Boundary
- Existing Storm Pipe
- Abandoned Storm Pipe
- Upsized Storm Pipe
- Proposed Storm Pipe
- Proposed Underground Storage
- Existing Manhole
- Existing Inlet
- Proposed / Replaced Manhole
- Proposed / Replaced Inlet
- ▲ Outfall



ALTERNATIVE SELECTION CRITERIA
HILL STREET TO MASON STREET DRAINAGE ANALYSIS
ALTERNATIVE ONE

CRITERIA	DEFINITION	WEIGHT	SCORING SCALE DESCRIPTIONS			SCORE	W*S	NOTES
			0-3	4-7	8-10			
CIVIC IMPACT		26%					2.15	
Flood Mitigation Potential	Reduction in flooding experienced on private property and within the City Right-of-Way.	16%	<i>Does not reduce roadway or structural flooding. Only reduces nuisance flooding (e.g. nuisance erosion and siltation, damage to landscaping, standing water in yard).</i>	<i>Reduces roadway flooding experienced and mitigates flooding for 2-year storm event.</i>	<i>Reduces roadway and structural flooding and mitigates flooding for 10-year or greater storm event.</i>	10	1.6	The alternative will reduce roadway and structural flooding and mitigate flooding for the 10-year storm.
Population Affected	The number of properties (residential, business/commercial, public, schools, hospitals, places of worship) that will see a benefit from the project.	5%	<i>Less than 10 properties.</i>	<i>Between 10 - 50 properties.</i>	<i>Greater than 50 properties.</i>	8	0.4	The alternative will benefit more than 50 properties.
Implementation Cost	Construction cost associated with the alternative.	5%	<i>Construction cost is greater than \$18,000,000.</i>	<i>Construction cost is between \$10,000,000 and \$18,000,000.</i>	<i>Construction cost is less than \$10,000,000.</i>	3	0.15	The construction cost is estimated to be greater than \$18,000,000.
ENVIRONMENT		15%					0.9	
Water Quality Features	Enhancement or implementation of a water quality feature -- could include creation of BMP facility, restoration of degraded/eroding channels.	5%	<i>Does not have the potential to provide VESMP/TMDL credits (0 points).</i>		<i>Provides the opportunity to provide VESMP/TMDL credits.</i>	8	0.4	The underground detention facility could be designed to provide a water quality benefit.
Enhancement of Natural Systems	Enhancement or creation of habitat, open space, riparian buffer, urban tree canopy, or use of Green Infrastructure.	5%	<i>Does not enhance the surrounding natural system (0 points).</i>		<i>Enhances surrounding natural system.</i>	0	0	The alternative does not enhance the surrounding natural system.
Permitting and Compliance	Extent of environmental state/federal regulatory approvals that are required and from how many different agencies.	5%	<i>Involves many and/or complex environmental state/federal agency approvals.</i>	<i>Involves some and/or less complex environmental state/federal agency approvals.</i>	<i>Involves few to no environmental state/federal agency approvals.</i>	10	0.5	It is anticipated that the work can be completed without environmental permits.
CONSTRUCTABILITY & OPERATIONS		53%					3.74	
Residential Community Disruption & Duration	Adverse impacts to citizens' access to their neighborhood or community assets -- includes the nature (temporary or permanent) and duration of impacts.	4%	<i>Causes permanent impacts to access of neighborhood or community facility (0 points) and/or has a construction duration over 2 years.</i>	<i>Causes temporary impacts to access of neighborhood or community facility and/or has longer construction duration.</i>	<i>Does not inhibit access to neighborhood or community facility and/or has short construction duration (under 12 months).</i>	4	0.16	The proposed construction will disrupt several residential roadways and driveways. These impacts will be minor and will not impact the entire neighborhood. Care will be taken to ensure all homes are accessible throughout construction.
Non-Residential Community Disruption & Duration	Adverse impacts to non-residential streets as well as access to a place of business or other non-residential facility -- includes the nature (temporary or permanent) and duration of impacts.	4%	<i>Causes permanent impacts to non-residential streets, access of business, or non-residential facility (0 points) and/or has a construction duration over 2 years.</i>	<i>Causes temporary impacts to non-residential streets, access of business, or non-residential facility and/or has longer construction duration.</i>	<i>Does not impact non-residential streets nor inhibits access of business or non-residential facility and/or has short construction duration (under 12 months).</i>	5	0.2	The proposed construction will disrupt non-residential streets and will temporarily disrupt the use of the City-owned parking lots for the construction of the underground detention facilities. Care will be taken to ensure all businesses or non-residential facilities are accessible throughout construction.

ALTERNATIVE SELECTION CRITERIA
HILL STREET TO MASON STREET DRAINAGE ANALYSIS
ALTERNATIVE ONE

CRITERIA	DEFINITION	WEIGHT	SCORING SCALE DESCRIPTIONS			SCORE	W*S	NOTES
			0-3	4-7	8-10			
Operation and Maintenance	O&M requirements of the alternative to maintain successful operation and extend longevity of the proposed infrastructure.	17%	<i>Involves significant maintenance procedures and/or difficult access (e.g. curb cut to bioretention or rain garden, detention pond, swales).</i>	<i>Involves medium maintenance procedures and access (e.g. closed drainage system, riprap channel, outfall stabilization).</i>	<i>Involves typical maintenance procedures and easy access (e.g. concrete ditch conveyance, curb and gutter, curb cut).</i>	8	1.36	The majority of the work includes upsized pipes and additional pipes. They will require typical maintenance. The underground detention facility will require significant maintenance procedures.
Land Acquisition/ Available Easements	The acquisition of land that is required for implementation of the alternative -- may require standard easements for infrastructure or entire parcels and could include public or private property.	18%	<i>Requires extensive acquisition (e.g. 15 or more private landowners AND/OR requires easements that significantly impacts use of parcels AND/OR requires taking entire parcels AND/OR requires removal of habitable structures).</i>	<i>Requires some land acquisition (easements) from public and/or private land owners (e.g. 2-14 private landowners AND/OR requires easements that moderately impacts use of the parcels AND/OR requires extensive moving of uninhabitable structures or fences).</i>	<i>Requires minimal land acquisition from publicly owned land (e.g. Only 1 landowner or project completely within City owned parcels or ROW AND/OR requires easements that minimally impacts (only 1-3 feet along edge of property) use of the parcels AND/OR does not require moving uninhabitable structures or fences).</i>	9	1.62	The majority of the work will be done within the City's right-of-way.
Site Constraints / Infrastructure Impact	Alternatives that require reconstruction of recently constructed (10-years) infrastructure, relocation of infrastructure such as public/private utilities, streets, sidewalks, etc., and/or are further complicated by significant site constraints.	10%	<i>Poor site access, major grading required and/or causes significant impact to public/private utilities, especially recently constructed.</i>	<i>Site access somewhat constrained and/or causes some impact to infrastructure.</i>	<i>No apparent site constraints and/or causes little to no impact to infrastructure.</i>	4	0.4	The alternative will impact City sewer and water lines throughout the project area. Additional conflicts with private utilities is anticipated.
OTHER BENEFITS		6%					0.6	
Other Accrued Benefits	Additional project benefits in addition to reduced flooding -- may include additional park space, traffic calming, executing other CIP projects concurrently, or replacement of infrastructure that is in poor condition.	6%	<i>Provides no additional benefits (0 points).</i>	<i>Provides some additional benefits.</i>	<i>Provides significant additional benefits.</i>	10	0.6	Upgrading the drainage infrastructure throughout the project area will provide an opportunity to also replace any aging water or sewer lines. This would also provide an opportunity to regrade the roadways throughout the project area.
TOTAL ASC SCORE		100%				7.39/10		

Hill Street to N Mason Street									
Alternative 1 Analysis - HGL Results									
Node Name	Rim Elevation (ft)	Existing Conditions 2-Year HGL (ft)	Height of HGL above Rim Elevation (ft)	Existing Conditions 10-Year HGL (ft)	Height of HGL above Rim Elevation (ft)	Alternative 1 2-Year HGL (ft)	Height of HGL above Rim Elevation (ft)	Alternative 1 10-Year HGL (ft)	Height of HGL above Rim Elevation (ft)
J1	1388.46	Proposed	Proposed	Proposed	Proposed	1380.8	-7.66	1381.76	-6.70
J10	1384.29	Proposed	Proposed	Proposed	Proposed	1377.34	-6.95	1378.34	-5.95
J100	1352.35	Proposed	Proposed	Proposed	Proposed	1344.17	-8.18	1345.48	-6.87
J101	1402.02	Proposed	Proposed	Proposed	Proposed	1398.19	-3.832	1398.70	-3.32
J102	1362.22	Proposed	Proposed	Proposed	Proposed	1358.18	-4.04	1358.67	-3.55
J103	1418.70	Proposed	Proposed	Proposed	Proposed	1411.26	-7.44	1411.59	-7.11
J104	1404.87	Proposed	Proposed	Proposed	Proposed	1400.6	-4.273	1400.75	-4.12
J106	1348.17	Proposed	Proposed	Proposed	Proposed	1341.07	-7.102	1342.24	-5.93
J107	1390.94	Proposed	Proposed	Proposed	Proposed	1383.95	-6.988	1384.34	-6.60
J108	1420.37	Proposed	Proposed	Proposed	Proposed	1416.33	-4.042	1416.79	-3.58
J11	1337.25	Proposed	Proposed	Proposed	Proposed	1331.69	-5.56	1336.52	-0.73
J110	1352.46	Proposed	Proposed	Proposed	Proposed	1348.62	-3.838	1349.05	-3.41
J111	1352.60	Proposed	Proposed	Proposed	Proposed	1349.39	-3.207	1350.23	-2.37
J12	1337.87	Proposed	Proposed	Proposed	Proposed	1331.39	-6.48	1335.78	-2.09
J13	1405.37	Proposed	Proposed	Proposed	Proposed	1401.45	-3.92	1401.69	-3.68
J14	1364.88	Proposed	Proposed	Proposed	Proposed	1358.94	-5.94	1360.59	-4.29
J15	1358.88	Proposed	Proposed	Proposed	Proposed	1355.16	-3.72	1358.02	-0.86
J2	1370.40	Proposed	Proposed	Proposed	Proposed	1365.25	-5.15	1366.75	-3.65
J20	1347.71	Proposed	Proposed	Proposed	Proposed	1343.94	-3.766	1344.04	-3.67
J3	1370.18	Proposed	Proposed	Proposed	Proposed	1366.69	-3.49	1367.16	-3.02
J32	1367.22	Proposed	Proposed	Proposed	Proposed	1361.84	-5.38	1363.09	-4.13
J4	1400.50	Proposed	Proposed	Proposed	Proposed	1393.16	-7.34	1395.64	-4.86
J5	1410.75	Proposed	Proposed	Proposed	Proposed	1405.12	-5.63	1405.36	-5.39
J6	1400.00	Proposed	Proposed	Proposed	Proposed	1392.24	-7.76	1394.06	-5.94
J7	1405.00	Proposed	Proposed	Proposed	Proposed	1399.35	-5.65	1399.82	-5.18
J8	1396.34	Proposed	Proposed	Proposed	Proposed	1389.73	-6.61	1390.82	-5.52
J85	1358.91	Proposed	Proposed	Proposed	Proposed	1353.76	-5.15	1355.57	-3.34
J9	1392.16	Proposed	Proposed	Proposed	Proposed	1385	-7.16	1385.96	-6.20
J_B	1419.75	1408.99	-10.76	1410.75	-9.00	1408.99	-10.76	1411.12	-8.63
J_BB	1412.00	1407.08	-4.92	1408.10	-3.90	1407.13	-4.87	1407.99	-4.01
DI_A	1403.07	1401.75	-1.32	1403.33	0.26	1399.9	-3.17	1402.24	-0.83
DI_B	1403.12	1401.47	-1.65	1403.17	0.05	1399.39	-3.73	1401.54	-1.58
GI_C	1400.82	1401.16	0.34	1401.90	1.08	1398.63	-1.99	1400.59	-0.23
DI_G	1399.18	1400.46	1.28	1400.58	1.40	1394.71	-4.47	1397.40	-1.78
DI_D	1403.00	1401.63	-1.37	1403.10	0.10	1401.64	-1.36	1402.03	-0.97
MH_E	1401.78	1401.01	-0.77	1402.29	0.51	1398.01	-3.77	1398.29	-3.49
DI_F	1399.14	1400.46	1.32	1400.58	1.44	1395.01	-4.13	1395.35	-3.79
MH_H	1397.37	1396.39	-0.98	1396.52	-0.85	1391.95	-5.42	1391.95	-5.42
GI_I	1388.14	1388.46	0.32	1388.61	0.47	1385.05	-3.09	1385.29	-2.85
GI_J	1385.07	1386.75	1.68	1386.86	1.79	1380.32	-4.75	1380.90	-4.17
MH_K	1380.93	1381.71	0.78	1381.80	0.87	1372.87	-8.06	1375.28	-5.65
DI_L	1379.86	1380.18	0.32	1380.30	0.44	1371.32	-8.54	1372.06	-7.80
MH_N	1379.49	1379.82	0.33	1380.03	0.54	1376.45	-3.04	1376.70	-2.79
DI_M	1379.97	1380.17	0.2	1380.29	0.32	1377.51	-2.46	1377.90	-2.07
MH_R	1382.22	1378.25	-3.97	1378.85	-3.37	1375.28	-6.94	1375.70	-6.52
DI_Q	1382.48	1379.55	-2.93	1379.77	-2.71	1379.55	-2.93	1379.80	-2.68
DI_P	1382.17	1378.61	-3.56	1378.65	-3.52	1378.61	-3.56	1378.67	-3.50
MH_O	1381.45	1377.6	-3.85	1378.17	-3.28	1374.46	-6.99	1374.84	-6.61
GI_V	1373.16	1371.58	-1.58	1372.01	-1.15	1368.17	-4.99	1368.54	-4.62
MH_BB	1363.34	1364.39	1.05	1364.58	1.24	1360.53	-2.81	1360.92	-2.42
MH_AA	1363.26	1363.7	0.44	1363.81	0.55	1357.7	-5.56	1360.03	-3.23
DI_W	1367.22	1367.5	0.28	1367.65	0.43	Removed	Removed	Removed	Removed
GI_Z	1364.88	1364.29	-0.59	1364.59	-0.29	1363.68	-1.2	1363.86	-1.02
DI_X	1364.05	1364.28	0.23	1364.46	0.41	1361.13	-2.92	1361.42	-2.63
DI_Y	1363.88	1363.99	0.11	1364.11	0.23	1358.73	-5.15	1360.93	-2.95
MH_AA	1363.26	1363.7	0.44	1363.81	0.55	1357.7	-5.56	1360.03	-3.23
J_KKK	1358.13	1359.95	1.82	1360.06	1.93	1354.5	-3.63	1355.94	-2.19
MH_KKK	1356.07	1356.17	0.1	1356.29	0.22	1352.97	-3.1	1353.59	-2.48
J_CC	1353.73	1355.78	2.05	1355.89	2.16	1351.29	-2.44	1352.43	-1.30
DI_CC	1352.03	1352.27	0.24	1352.39	0.36	1346.12	-5.91	1349.76	-2.27
MH_EE	1351.64	1351.67	0.03	1352.06	0.42	1347.26	-4.38	1351.14	-0.50
DI_FF	1351.50	1351.65	0.15	1352.04	0.54	1346.69	-4.81	1350.17	-1.33
GI_JJJ	1351.25	1351.54	0.29	1351.93	0.68	1346.1	-5.15	1349.05	-2.20
DI_DD	1351.53	1351.67	0.14	1351.89	0.36	1346.12	-5.41	1349.36	-2.17
GI_III	1350.79	1351.55	0.76	1351.91	1.12	1349.54	-1.25	1349.54	-1.25
MH_GG	1350.93	1351.07	0.14	1351.37	0.44	1345.75	-5.18	1348.22	-2.71
GI_HH	1350.26	1350.61	0.35	1350.82	0.56	1347.38	-2.88	1347.94	-2.32
GI_JJ2	1346.49	1347.4	0.91	1347.58	1.09	1344.77	-1.72	1344.86	-1.63
J_KK	1346.19	1345.96	-0.23	1346.18	-0.01	1343.49	-2.7	1344.06	-2.13
MH_KK	1346.24	1345.84	-0.4	1346.05	-0.19	1343.19	-3.05	1344.05	-2.19
DI_LL	1342.17	1342.51	0.34	1342.80	0.63	1340.6	-1.57	1340.74	-1.43
GI_MM	1341.80	1342.34	0.54	1342.65	0.85	1338.51	-3.29	1340.13	-1.67
DI_SS	1342.14	1342.43	0.29	1342.58	0.44	1338.89	-3.25	1341.26	-0.88
J_LLL	1342.14	1342.49	0.35	1342.74	0.60	1338.42	-3.72	1340.06	-2.08
DI_NN	1342.61	1340.82	-1.79	1341.01	-1.60	1336.63	-5.98	1339.50	-3.11
MH_LLL	1340.74	1340.82	0.08	1341.01	0.27	1333.32	-7.42	1338.70	-2.04
DI_OO	1340.84	1341.04	0.2	1341.14	0.30	1338.9	-1.94	1339.02	-1.82
DI_RR	1340.80	1340.91	0.11	1341.08	0.28	1337.15	-3.65	1337.26	-3.54
DI_QQ	1340.27	1340.68	0.41	1340.86	0.59	1336.47	-3.8	1336.49	-3.78
GI_PP	1339.52	1339.72	0.2	1339.93	0.41	1334.76	-4.76	1334.81	-4.71
GI_TT	1334.95	1335.31	0.36	1335.63	0.68	1332.41	-2.54	1332.53	-2.42
DI_UU	1334.85	1335.26	0.41	1335.52	0.67	1331.51	-3.34	1331.72	-3.13
GI_VV	1332.57	1330.59	-1.98	1333.19	0.62	1329.11	-3.46	1330.18	-2.39
GI_WW	1332.08	1329.98	-2.1	1333.16	1.08	1329.11	-2.97	1330.17	-1.91
J_EEE	1332.16	1329.65	-2.51	1332.59	0.43	1329.11	-3.05	1330.17	-1.99
GI_XX	1332.55	1329.67	-2.88	1332.43	-0.12	1329.11	-3.44	1330.17	-2.38
MH_YY	1330.47	1329.53	-0.94	1331.91	1.44	1329.11	-1.36	1330.17	-0.30
DI_LLL	1337.60	1337.62	0.02	1337.73	0.13	1335.73	-1.87	1336.20	-1.40
DI_GGG	1337.13	1335.64	-1.49	1337.18	0.05	1335.11	-2.02	1335.49	-1.64
MH_FFF	1336.91	1332.59	-4.32	1333.01	-3.90	1332.62	-4.29	1333.07	-3.84
GI_HHH	1334.04	1331.66	-2.38	1332.55	-1.49	1331.49	-2.55	1331.83	-2.21
J_BBB	1330.25	1329.24	-1.01	1331.08	0.83	1329.11	-1.14	1330.17	-0.08
MH_BBB & GI_CCC	1330.70	1328.64	-2.06	1330.09	-0.61	1328.52	-2.18	1329.36	-1.34
DI_U	1424.30	1424.41	0.11	1424.47	0.17	1421.23	-3.07	1423.23	-1.07
DI_T	1423.85	1424.03	0.18	1424.16	0.31	1420.44	-3.41	1420.89	-2.96
DI_S	1417.89	1418.09	0.2	1418.14	0.25	1410.5	-7.39	1410.74	-7.15



**Hill Street to Mason Street
Proposed Alternative Analysis
Draft Conceptual
Opinion of Probable Construction Cost
Alternative One
February 2026**



Item	Description	Quantity	Unit	Unit Cost	Total
Engineering Design					
1	Engineering Design	15%	% of Construction Subtotal	\$	1,907,123.00
Engineering Design Subtotal					\$ 1,907,123.00
Site Acquisition					
2	Permanent Drainage Easement	4,160	SF	\$ 40.00	\$ 166,400.00
3	Temporary Construction Easement	9,250	SF	\$ 10.00	\$ 92,500.00
Site Acquisition Subtotal					\$ 258,900.00
Private Utilities					
4	Private Utility Relocations	5%	% of Construction Subtotal	\$	635,708.00
Private Utilities Subtotal					\$ 635,708.00
Construction					
5	Mobilization	1	LS	\$ 634,000.00	\$ 634,000.00
6	Clearing and Grubbing	1	LS	\$ 25,000.00	\$ 25,000.00
7	Demolition				
	Sawcut and Remove Existing Asphalt Pavement	6,470	LF	\$ 35.00	\$ 226,450.00
	Remove & Dispose of Existing Sidewalk	920	SY	\$ 20.00	\$ 18,400.00
	Remove & Dispose of Existing Driveway	1,200	SY	\$ 40.00	\$ 48,000.00
	Remove & Dispose of Existing Curb & Gutter	6,470	LF	\$ 20.00	\$ 129,400.00
	Remove & Dispose of Existing Pipe	1,050	LF	\$ 45.00	\$ 47,250.00
	Remove & Dispose of Existing Drainage Structure	28	EA	\$ 1,750.00	\$ 49,000.00
	Flowable Fill	28	CY	\$ 220.00	\$ 6,124.36
8	Earthwork				
	Excavation	20,040	CY	\$ 70.00	\$ 1,402,800
9	Structures and Infrastructure				
	Pipe (15" RCP, Class III)	1,242	LF	\$ 100.00	\$ 124,200.00
	Pipe (18" RCP, Class III)	1,214	LF	\$ 150.00	\$ 182,100.00
	Pipe (24" RCP, Class III)	391	LF	\$ 250.00	\$ 97,750.00
	Pipe (19" x 30" HECP, Class III)	38	LF	\$ 300.00	\$ 11,400.00
	Pipe (30" RCP, Class III)	127	LF	\$ 275.00	\$ 34,925.00
	Pipe (24" x 38" HECP, Class III)	300	LF	\$ 325.00	\$ 97,500.00
	Pipe (36" RCP, Class III)	42	LF	\$ 300.00	\$ 12,600.00
	Pipe (34" x 53" HECP, Class III)	1,092	LF	\$ 400.00	\$ 436,800.00
	Pipe (48" RCP, Class III)	873	LF	\$ 400.00	\$ 349,200.00
	Pipe (54" RCP, Class III)	68	LF	\$ 500.00	\$ 34,000.00
	Pipe (60" RCP, Class III)	882	LF	\$ 600.00	\$ 529,200.00
	Pipe (48" x 76" HECP, Class III)	52	LF	\$ 650.00	\$ 33,800.00
	Underground Storage Facility	2	LS	\$ 500,000.00	\$ 1,000,000.00
	Inlet (Drop or Curb)	31	EA	\$ 12,000.00	\$ 372,000.00
	Manhole (MH-1 or 2)	21	EA	\$ 10,000.00	\$ 210,000.00
	Junction Box, JB-1	4	EA	\$ 22,000.00	\$ 88,000.00
	Select Material (CBR 15, For Drainage)	10,020	CY	\$ 70.00	\$ 701,400.00
	Pavement Patching for Utility Trench	5,830	LF	\$ 180.00	\$ 1,049,400.00
	Mill & Overlay	19,500	SY	\$ 45.00	\$ 877,500.00
10	*Site Development & Restoration	1	LS	\$ 615,700.00	\$ 615,700.00
11	Erosion Control	1	LS	\$ 263,900.00	\$ 263,900.00
12	Restoration				
	Hydraulic Cement Concrete Sidewalk (4" Thick)	920	SY	\$ 90.00	\$ 82,800.00
	Driveway (7" Concrete)	1,200	SY	\$ 175.00	\$ 210,000.00
	Curb & Gutter (St'd.)	6,470	LF	\$ 50.00	\$ 323,500.00
	Topsoil (Class B, 4")	1	AC	\$ 23,000.00	\$ 23,000.00
	Hydroseed	150	LBS	\$ 30.00	\$ 4,500.00
	Fertilizer (15-30-15)	2	TON	\$ 1,000.00	\$ 2,000.00
	Lime	0.3	TON	\$ 500.00	\$ 150.00
13	Public Utility Relocation	1	LS	\$ 879,600.00	\$ 879,600.00
14	Traffic Control	1	LS	\$ 879,600.00	\$ 879,600.00
Construction Subtotal					\$ 12,714,149.36
Contingencies					
15	Contingency	30%	% of Construction Subtotal	\$	3,814,245.00
Contingencies Subtotal					\$ 3,814,245.00
Total					\$ 19,330,125.36

* Site development and restoration may consist of any temporary access roads, laydown areas, small pavement areas for off-street parking during maintenance, parking lot restoration, and potential screening.

Appendix B: Alternative Two

DRAFT

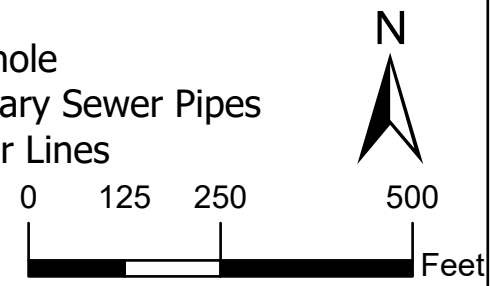


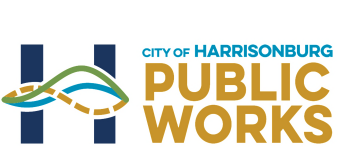
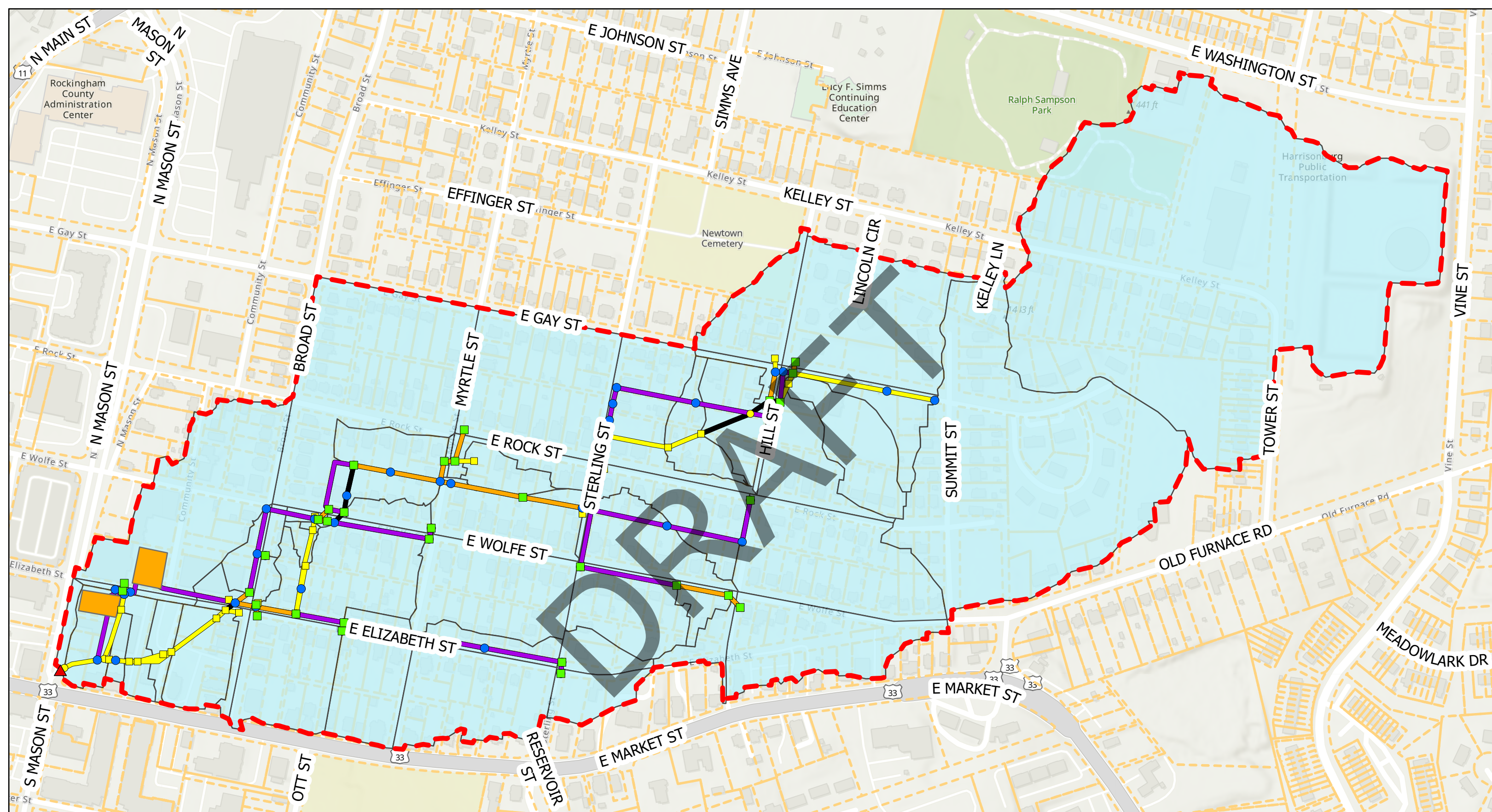
**Hill Street to N Mason Street
Alternative Two
Conceptual Improvements**



Legend

- GIS Parcel Boundary
- Proposed Underground Storage
- Proposed / Replaced Inlet
- Proposed / Replaced Manhole
- Proposed Storm Pipe
- Upsized Storm Pipe
- Abandoned Storm Pipe
- Existing Storm Pipe
- ▲ Outfall
- Existing Inlet
- Existing Manhole
- Existing Sanitary Sewer Pipes
- Existing Water Lines



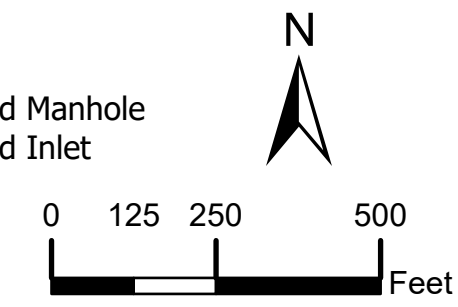


Hill Street to N Mason Street Alternative Two Project Limits Layout



Legend

- Study Area
- Drainage Area (119.26 acres)
- GIS Parcel Boundary
- Existing Storm Pipe
- Abandoned Storm Pipe
- Upsized Storm Pipe
- Proposed Pipe
- Proposed Storm Pipe
- Proposed Underground Storage
- Existing Manhole
- Existing Inlet
- Proposed / Replaced Manhole
- Proposed / Replaced Inlet
- Outfall

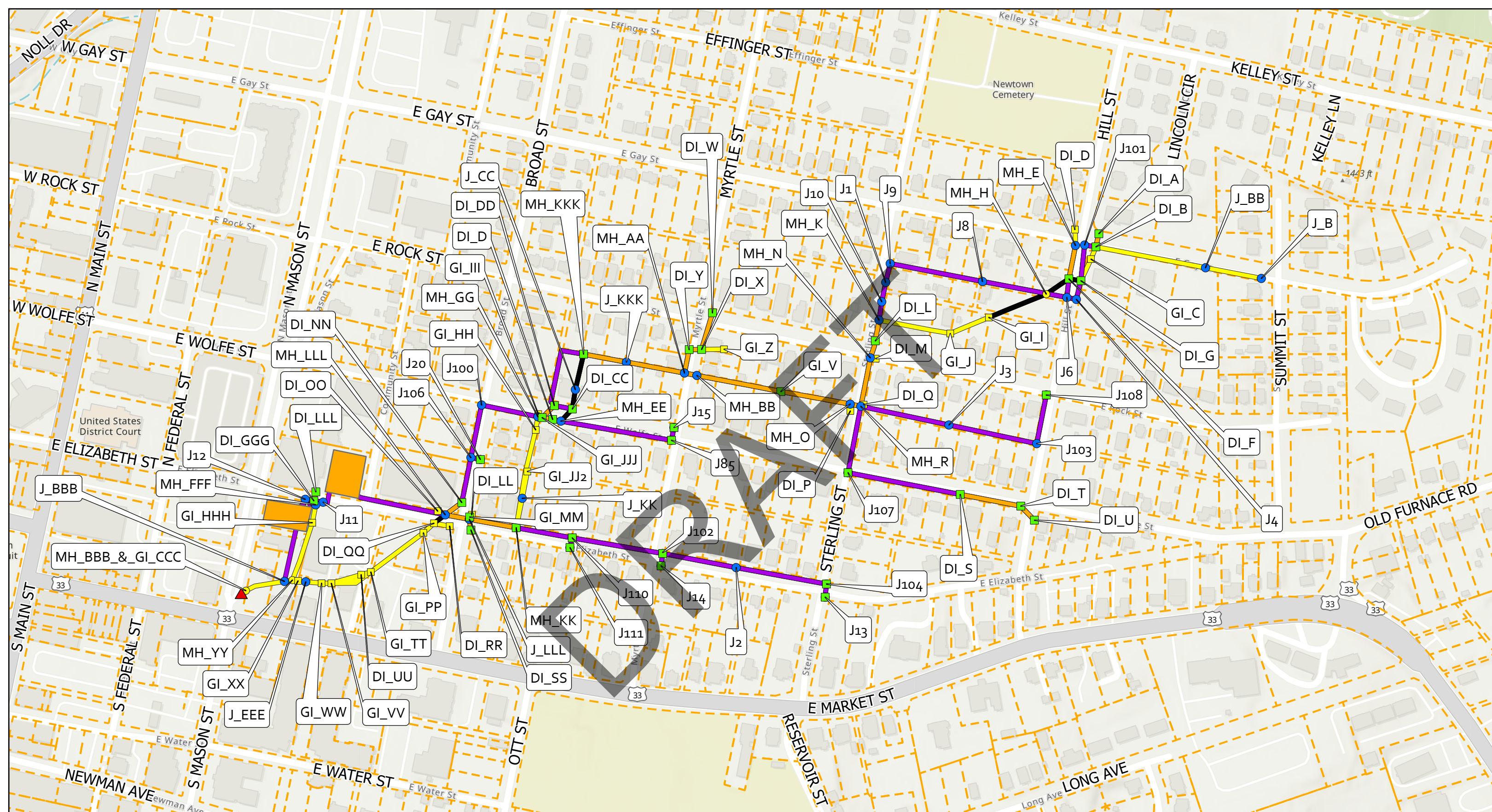


ALTERNATIVE SELECTION CRITERIA
HILL STREET TO MASON STREET DRAINAGE ANALYSIS
ALTERNATIVE TWO

CRITERIA	DEFINITION	WEIGHT	SCORING SCALE DESCRIPTIONS			SCORE	W*S	NOTES
			0-3	4-7	8-10			
CIVIC IMPACT		26%					2.2	
Flood Mitigation Potential	Reduction in flooding experienced on private property and within the City Right-of-Way.	16%	<i>Does not reduce roadway or structural flooding. Only reduces nuisance flooding (e.g. nuisance erosion and siltation, damage to landscaping, standing water in yard).</i>	<i>Reduces roadway flooding experienced and mitigates flooding for 2-year storm event.</i>	<i>Reduces roadway and structural flooding and mitigates flooding for 10-year or greater storm event.</i>	10	1.6	The alternative will reduce roadway and structural flooding and mitigate flooding for the 10-year storm.
Population Affected	The number of properties (residential, business/commercial, public, schools, hospitals, places of worship) that will see a benefit from the project.	5%	<i>Less than 10 properties.</i>	<i>Between 10 - 50 properties.</i>	<i>Greater than 50 properties.</i>	8	0.4	The alternative will benefit more than 50 properties.
Implementation Cost	Construction cost associated with the alternative.	5%	<i>Construction cost is greater than \$18,000,000.</i>	<i>Construction cost is between \$10,000,000 and \$18,000,000.</i>	<i>Construction cost is less than \$10,000,000.</i>	4	0.2	The construction cost is estimated to be greater than \$10,000,000 but less than \$18,000,000.
ENVIRONMENT		15%					0.9	
Water Quality Features	Enhancement or implementation of a water quality feature -- could include creation of BMP facility, restoration of degraded/eroding channels.	5%	<i>Does not have the potential to provide VESMP/TMDL credits (0 points).</i>		<i>Provides the opportunity to provide VESMP/TMDL credits.</i>	8	0.4	The underground detention facility could be designed to provide a water quality benefit.
Enhancement of Natural Systems	Enhancement or creation of habitat, open space, riparian buffer, urban tree canopy, or use of Green Infrastructure.	5%	<i>Does not enhance the surrounding natural system (0 points).</i>		<i>Enhances surrounding natural system.</i>	0	0	The alternative does not enhance the surrounding natural system.
Permitting and Compliance	Extent of environmental state/federal regulatory approvals that are required and from how many different agencies.	5%	<i>Involves many and/or complex environmental state/federal agency approvals.</i>	<i>Involves some and/or less complex environmental state/federal agency approvals.</i>	<i>Involves few to no environmental state/federal agency approvals.</i>	10	0.5	It is anticipated that the work can be completed without environmental permits.
CONSTRUCTABILITY & OPERATIONS		53%					2.91	
Residential Community Disruption & Duration	Adverse impacts to citizens' access to their neighborhood or community assets -- includes the nature (temporary or permanent) and duration of impacts.	4%	<i>Causes permanent impacts to access of neighborhood or community facility (0 points) and/or has a construction duration over 2 years.</i>	<i>Causes temporary impacts to access of neighborhood or community facility and/or has longer construction duration.</i>	<i>Does not inhibit access to neighborhood or community facility and/or has short construction duration (under 12 months).</i>	7	0.28	The proposed construction will disrupt some residential roadways and driveways. These impacts will be minor and will not impact the entire neighborhood. Care will be taken to ensure all homes are accessible throughout construction.
Non-Residential Community Disruption & Duration	Adverse impacts to non-residential streets as well as access to a place of business or other non-residential facility -- includes the nature (temporary or permanent) and duration of impacts.	4%	<i>Causes permanent impacts to non-residential streets, access of business, or non-residential facility (0 points) and/or has a construction duration over 2 years.</i>	<i>Causes temporary impacts to non-residential streets, access of business, or non-residential facility and/or has longer construction duration.</i>	<i>Does not impact non-residential streets nor inhibits access of business or non-residential facility and/or has short construction duration (under 12 months).</i>	5	0.2	The proposed construction will disrupt non-residential streets and will temporarily disrupt the use of the City-owned parking lots for the construction of the underground detention facilities. Care will be taken to ensure all businesses or non-residential facilities are accessible throughout construction.

ALTERNATIVE SELECTION CRITERIA
HILL STREET TO MASON STREET DRAINAGE ANALYSIS
ALTERNATIVE TWO

CRITERIA	DEFINITION	WEIGHT	SCORING SCALE DESCRIPTIONS			SCORE	W*S	NOTES
			0-3	4-7	8-10			
Operation and Maintenance	O&M requirements of the alternative to maintain successful operation and extend longevity of the proposed infrastructure.	17%	<i>Involves significant maintenance procedures and/or difficult access (e.g. curb cut to bioretention or rain garden, detention pond, swales).</i>	<i>Involves medium maintenance procedures and access (e.g. closed drainage system, riprap channel, outfall stabilization).</i>	<i>Involves typical maintenance procedures and easy access (e.g. concrete ditch conveyance, curb and gutter, curb cut).</i>	7	1.19	The majority of the work includes upsized pipes and additional pipes. They will require typical maintenance. The underground detention facility will require significant maintenance procedures. The majority of the pipes will be located in alleyways which can be challenging to access.
Land Acquisition/ Available Easements	The acquisition of land that is required for implementation of the alternative -- may require standard easements for infrastructure or entire parcels and could include public or private property.	18%	<i>Requires extensive acquisition (e.g. 15 or more private landowners AND/OR requires easements that significantly impacts use of parcels AND/OR requires taking entire parcels AND/OR requires removal of habitable structures).</i>	<i>Requires some land acquisition (easements) from public and/or private land owners (e.g. 2-14 private landowners AND/OR requires easements that moderately impacts use of the parcels AND/OR requires extensive moving of uninhabitable structures or fences).</i>	<i>Requires minimal land acquisition from publicly owned land (e.g. Only 1 landowner or project completely within City owned parcels or ROW AND/OR requires easements that minimally impacts (only 1-3 feet along edge of property) use of the parcels AND/OR does not require moving uninhabitable structures or fences).</i>	3	0.54	Work within the alleyways will require temporary construction easements from 15 or more private landowners.
Site Constraints / Infrastructure Impact	Alternatives that require reconstruction of recently constructed (10-years) infrastructure, relocation of infrastructure such as public/private utilities, streets, sidewalks, etc., and/or are further complicated by significant site constraints.	10%	<i>Poor site access, major grading required and/or causes significant impact to public/private utilities, especially recently constructed.</i>	<i>Site access somewhat constrained and/or causes some impact to infrastructure.</i>	<i>No apparent site constraints and/or causes little to no impact to infrastructure.</i>	7	0.7	The alternative will impact City sewer and water lines throughout the project area. Additional conflicts with private utilities is anticipated.
OTHER BENEFITS		6%					0.48	
Other Accrued Benefits	Additional project benefits in addition to reduced flooding -- may include additional park space, traffic calming, executing other CIP projects concurrently, or replacement of infrastructure that is in poor condition.	6%	<i>Provides no additional benefits (0 points).</i>	<i>Provides some additional benefits.</i>	<i>Provides significant additional benefits.</i>	8	0.48	Upgrading the drainage infrastructure throughout the project area will provide an opportunity to also replace any aging water or sewer lines. This would also provide an opportunity to regrade the roadways throughout the project area.
TOTAL ASC SCORE		100%				6.49/10		

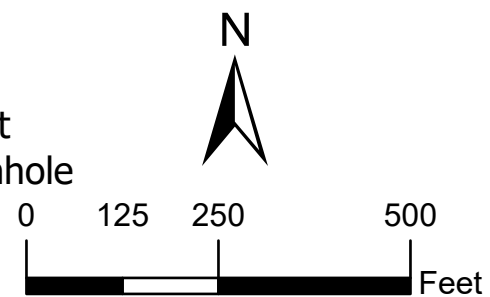


**Hill Street to N Mason Street
Alternative Two
Analyzed Nodes**



Legend

- GIS Parcel Boundary
- Proposed Underground Storage
- Proposed / Replaced Inlet
- Proposed / Replaced Manhole
- Proposed Storm Pipe
- Upsized Storm Pipe
- Abandoned Storm Pipe
- Existing Storm Pipe
- ▲ Outfall
- Existing Inlet
- Existing Manhole



Hill Street to N Mason Street									
Alternative 2 Analysis - HGL Results									
Node Name	Rim Elevation (ft)	Existing Conditions 2-Year HGL (ft)	Height of HGL above Rim Elevation (ft)	Existing Conditions 10-Year HGL (ft)	Height of HGL above Rim Elevation (ft)	Alternative 2 2-Year HGL (ft)	Height of HGL above Rim Elevation (ft)	Alternative 2 10-Year HGL (ft)	Height of HGL above Rim Elevation (ft)
J1	1388.46	Proposed	Proposed	Proposed	Proposed	1380.7	-7.76	1382.51	-5.95
J10	1384.29	Proposed	Proposed	Proposed	Proposed	1377.41	-6.88	1381.31	-2.98
J100	1352.35	Proposed	Proposed	Proposed	Proposed	1344.17	-8.18	1345.46	-6.89
J101	1402.02	Proposed	Proposed	Proposed	Proposed	1398.31	-3.712	1398.89	-3.13
J102	1362.22	Proposed	Proposed	Proposed	Proposed	1358.15	-4.07	1358.59	-3.63
J103	1423.59	Proposed	Proposed	Proposed	Proposed	1415.42	-8.17	1415.63	-7.96
J104	1404.87	Proposed	Proposed	Proposed	Proposed	1400.62	-4.253	1400.78	-4.09
J106	1348.17	Proposed	Proposed	Proposed	Proposed	1341.14	-7.032	1342.26	-5.91
J107	1390.94	Proposed	Proposed	Proposed	Proposed	1384.07	-6.868	1385.38	-5.56
J108	1420.37	Proposed	Proposed	Proposed	Proposed	1416.76	-3.612	1418.77	-1.60
J11	1337.25	Proposed	Proposed	Proposed	Proposed	1331.68	-5.57	1336.49	-0.76
J110	1352.46	Proposed	Proposed	Proposed	Proposed	1348.61	-3.848	1349.04	-3.42
J111	1352.60	Proposed	Proposed	Proposed	Proposed	1349.39	-3.207	1350.23	-2.37
J12	1337.87	Proposed	Proposed	Proposed	Proposed	1331.38	-6.49	1335.76	-2.11
J13	1405.37	Proposed	Proposed	Proposed	Proposed	1401.44	-3.93	1401.69	-3.68
J14	1364.88	Proposed	Proposed	Proposed	Proposed	1358.94	-5.94	1360.56	-4.32
J15	1358.88	Proposed	Proposed	Proposed	Proposed	1352.68	-6.2	1353.33	-5.55
J2	1383.04	Proposed	Proposed	Proposed	Proposed	1378.734	-4.308	1378.89	-4.15
J20	1347.71	Proposed	Proposed	Proposed	Proposed	1343.94	-3.766	1344.04	-3.67
J3	1402.94	Proposed	Proposed	Proposed	Proposed	1392.953	-9.982	1393.16	-9.77
J4	1400.50	Proposed	Proposed	Proposed	Proposed	1393.13	-7.37	1395.02	-5.48
J6	1400.00	Proposed	Proposed	Proposed	Proposed	1392.13	-7.87	1393.18	-6.82
J8	1396.34	Proposed	Proposed	Proposed	Proposed	1389.63	-6.71	1390.58	-5.76
J85	1358.91	Proposed	Proposed	Proposed	Proposed	1352.15	-6.76	1352.46	-6.45
J9	1392.16	Proposed	Proposed	Proposed	Proposed	1384.9	-7.26	1385.79	-6.37
J_B	1419.75	1408.99	-10.76	1410.75	-9.00	1408.99	-10.76	1411.10	-8.65
J_BB	1412.00	1407.08	-4.92	1408.10	-3.90	1407.15	-4.85	1407.91	-4.09
DI_A	1403.07	1401.75	-1.32	1403.33	0.26	1400.07	-3	1402.48	-0.59
DI_B	1403.12	1401.47	-1.65	1403.17	0.05	1399.18	-3.94	1400.76	-2.36
GI_C	1400.82	1401.16	0.34	1401.90	1.08	1398.65	-2.17	1399.96	-0.86
DI_G	1399.18	1400.46	1.28	1400.58	1.40	1394.71	-4.47	1396.86	-2.32
DI_D	1400.00	1401.63	1.63	1403.10	3.10	1401.66	-1.34	1402.27	-0.73
MH_E	1401.78	1401.01	-0.77	1402.29	0.51	1398.01	-3.77	1398.28	-3.50
DI_F	1399.14	1400.46	1.32	1400.58	1.44	1395.16	-3.98	1395.72	-3.42
MH_H	1397.37	1396.39	-0.98	1396.52	-0.85	1391.95	-5.42	1391.95	-5.42
GI_I	1388.14	1388.46	0.32	1388.61	0.47	1385.05	-3.09	1385.29	-2.85
GI_J	1385.07	1386.75	1.68	1386.86	1.79	1380.32	-4.75	1380.86	-4.21
MH_K	1380.93	1381.71	0.78	1381.80	0.87	1376.73	-4.2	1380.11	-0.82
DI_L	1379.86	1380.18	0.32	1380.30	0.44	1376.09	-3.77	1378.89	-0.97
MH_N	1379.49	1379.82	0.33	1380.03	0.54	1376.01	-3.48	1378.37	-1.12
DI_M	1379.97	1380.17	0.2	1380.29	0.32	1377.51	-2.46	1378.83	-1.14
MH_R	1382.22	1378.25	-3.97	1378.85	-3.37	1375.51	-6.71	1377.01	-5.21
DI_Q	1382.48	1379.55	-2.93	1379.77	-2.71	1379.55	-2.93	1379.80	-2.68
DLP	1382.17	1378.61	-3.56	1378.65	-3.52	1378.61	-3.56	1378.67	-3.50
MH_O	1381.45	1377.6	-3.85	1378.17	-3.28	1374.7	-6.75	1375.84	-5.61
GI_V	1373.16	1371.58	-1.58	1372.01	-1.15	1368.73	-4.43	1369.36	-3.80
MH_BB	1363.34	1364.39	1.05	1364.58	1.24	1358.44	-4.9	1360.27	-3.07
MH_AA	1363.26	1363.7	0.44	1363.81	0.55	1357.4	-5.86	1359.01	-4.25
DI_W	1367.22	1367.5	0.28	1367.65	0.43	1360.75	-6.47	1364.06	-3.16
GI_Z	1364.88	1364.29	-0.59	1364.59	-0.29	1363.68	-1.2	1363.86	-1.02
DI_X	1364.05	1364.28	0.23	1364.46	0.41	1357.94	-6.11	1361.63	-2.42
DI_Y	1363.88	1363.99	0.11	1364.11	0.23	1357.69	-6.19	1360.41	-3.47
MH_AA	1363.26	1363.7	0.44	1363.81	0.55	1357.4	-5.86	1359.01	-4.25
J_KKK	1358.13	1359.95	1.82	1360.06	1.93	1353.52	-4.61	1357.05	-1.08
MH_KKK	1356.07	1356.17	0.1	1356.29	0.22	1351.03	-5.04	1354.43	-1.64
J_CC	1353.73	1355.78	2.05	1355.89	2.16	1351.07	-2.66	1351.07	-2.66
DI_CC	1352.03	1352.27	0.24	1352.39	0.36	1346.96	-5.07	1351.17	-0.86
MH_EE	1351.64	1351.67	0.03	1352.06	0.42	1346.25	-5.39	1349.45	-2.19
DI_FF	1351.50	1351.65	0.15	1352.04	0.54	1346.19	-5.31	1349.24	-2.26
GI_JJJ	1351.25	1351.54	0.29	1351.93	0.68	1346.13	-5.12	1348.99	-2.26
DI_DD	1351.53	1351.67	0.14	1351.89	0.36	1346.94	-4.59	1351.11	-0.42
GI_LII	1350.79	1351.55	0.76	1351.91	1.12	1349.54	-1.25	1349.54	-1.25
MH_GG	1350.93	1351.07	0.14	1351.37	0.44	1345.77	-5.16	1348.18	-2.75
GI_HH	1350.26	1350.61	0.35	1350.82	0.56	1347.38	-2.88	1347.83	-2.43
GI_JJ2	1346.49	1347.4	0.91	1347.58	1.09	1344.77	-1.72	1344.86	-1.63
J_KK	1346.19	1345.96	-0.23	1346.18	-0.01	1343.49	-2.7	1343.79	-2.40
MH_KK	1346.24	1345.84	-0.4	1346.05	-0.19	1343.11	-3.13	1343.78	-2.46
DI_LL	1342.17	1342.51	0.34	1342.80	0.63	1340.6	-1.57	1340.74	-1.43
GI_MM	1341.80	1342.34	0.54	1342.65	0.85	1338.24	-3.56	1339.35	-2.45
DI_SS	1342.14	1342.43	0.29	1342.58	0.44	1338.87	-3.27	1340.41	-1.73
J_LLL	1342.14	1342.49	0.35	1342.74	0.60	1338.26	-3.88	1339.28	-2.86
DI_NN	1342.61	1340.82	-1.79	1341.01	-1.60	1336.62	-5.99	1339.48	-3.13
MH_LLL	1340.74	1340.82	0.08	1341.01	0.27	1333.31	-7.43	1338.64	-2.10
DI_OO	1340.84	1341.04	0.2	1341.14	0.30	1338.9	-1.94	1339.02	-1.82
DI_RR	1340.80	1340.91	0.11	1341.08	0.28	1337.15	-3.65	1337.26	-3.54
DI_QQ	1340.27	1340.68	0.41	1340.86	0.59	1336.47	-3.8	1336.49	-3.78
GI_PP	1339.52	1339.72	0.2	1339.93	0.41	1334.76	-4.76	1334.81	-4.71
GI_TT	1334.95	1335.31	0.36	1335.63	0.68	1332.41	-2.54	1332.53	-2.42
DI_UU	1334.85	1335.26	0.41	1335.52	0.67	1331.51	-3.34	1331.72	-3.13
GI_VV	1332.57	1330.59	-1.98	1333.19	0.62	1329.11	-3.46	1330.17	-2.40
GI_WW	1332.08	1329.98	-2.1	1333.16	1.08	1329.11	-2.97	1330.17	-1.91
J_EEE	1332.16	1329.65	-2.51	1332.59	0.43	1329.11	-3.05	1330.17	-1.99
GI_XX	1332.55	1329.67	-2.88	1332.43	-0.12	1329.11	-3.44	1330.17	-2.38
MH_YY	1330.47	1329.53	-0.94	1331.91	1.44	1329.11	-1.36	1330.17	-0.30
DI_LLL	1337.60	1337.62	0.02	1337.73	0.13	1335.73	-1.87	1336.20	-1.40
DI_GGG	1337.13	1335.64	-1.49	1337.18	0.05	1335.11	-2.02	1335.49	-1.64
MH_FFF	1336.91	1332.59	-4.32	1333.01	-3.90	1332.62	-4.29	1333.07	-3.84
GI_HHH	1334.04	1331.66	-2.38	1332.55	-1.49	1331.49	-2.55	1331.83	-2.21
J_BBB	1330.25	1329.24	-1.01	1331.08	0.83	1329.11	-1.14	1330.17	-0.08
MH_BBB & GI_CCC	1330.70	1328.64	-2.06	1330.09	-0.61	1328.51	-2.19	1329.35	-1.35
DI_U	1424.30	1424.41	0.11	1424.47	0.17	1421.23	-3.07	1423.23	-1.07
DI_T	1423.85	1424.03	0.18	1424.16	0.31	1420.44	-3.41	1420.89	-2.96
DI_S	1417.89	1418.09	0.2	1418.14	0.25	1410.51	-7.38	1410.77	-7.12



**Hill Street to Mason Street
Proposed Alternative Analysis
Draft Conceptual
Opinion of Probable Construction Cost
Alternative Two
February 2026**



Item	Description	Quantity	Unit	Unit Cost	Total
Engineering Design					
1	Engineering Design	15%	% of Construction Subtotal	\$	1,745,128.00
Engineering Design Subtotal					\$ 1,745,128.00
Site Acquisition					
2	Permanent Drainage Easement	4,160	SF	\$ 40.00	\$ 166,400.00
3	Temporary Construction Easement	21,670	SF	\$ 10.00	\$ 216,700.00
Site Acquisition Subtotal					\$ 383,100.00
Private Utilities					
4	Private Utility Relocations	3%	% of Construction Subtotal	\$	349,026.00
Private Utilities Subtotal					\$ 349,026.00
Construction					
5	Mobilization	1	LS	\$ 582,600.00	\$ 582,600.00
6	Clearing and Grubbing	1	LS	\$ 150,000.00	\$ 150,000.00
7	Demolition				
	Sawcut and Remove Existing Asphalt Pavement	5,250	LF	\$ 35.00	\$ 183,750.00
	Remove & Dispose of Existing Sidewalk	750	SY	\$ 20.00	\$ 15,000.00
	Remove & Dispose of Existing Driveway	920	SY	\$ 40.00	\$ 36,800.00
	Remove & Dispose of Existing Curb & Gutter	5,250	LF	\$ 20.00	\$ 105,000.00
	Remove & Dispose of Existing Pipe	2,070	LF	\$ 45.00	\$ 93,150.00
	Remove & Dispose of Existing Drainage Structure	35	EA	\$ 1,750.00	\$ 61,250.00
	Flowable Fill	55	CY	\$ 220.00	\$ 12,086.03
8	Earthwork				
	Excavation	17,000	CY	\$ 70.00	\$ 1,190,000
9	Structures and Infrastructure				
	Pipe (15" RCP, Class III)	1,194	LF	\$ 100.00	\$ 119,400.00
	Pipe (18" RCP, Class III)	1,579	LF	\$ 150.00	\$ 236,850.00
	Pipe (24" RCP, Class III)	799	LF	\$ 250.00	\$ 199,750.00
	Pipe (19" x 30" HECP, Class III)	39	LF	\$ 300.00	\$ 11,700.00
	Pipe (30" RCP, Class III)	75	LF	\$ 275.00	\$ 20,625.00
	Pipe (24" x 38" HECP, Class III)	300	LF	\$ 325.00	\$ 97,500.00
	Pipe (34" x 53" ECP, Class III)	816	LF	\$ 400.00	\$ 326,400.00
	Pipe (54" RCP, Class III)	1,066	LF	\$ 500.00	\$ 533,000.00
	Pipe (43" x 68" HECP, Class III)	191	LF	\$ 550.00	\$ 105,050.00
	Pipe (60" RCP, Class III)	828	LF	\$ 600.00	\$ 496,800.00
	Pipe (48" x 76" HECP, Class III)	53	LF	\$ 650.00	\$ 34,450.00
	Underground Storage Facility	2	LS	\$ 500,000.00	\$ 1,000,000.00
	Inlet (Drop or Curb)	32	EA	\$ 12,000.00	\$ 384,000.00
	Manhole (MH-1 or 2)	29	EA	\$ 10,000.00	\$ 290,000.00
	Junction Box, JB-1	4	EA	\$ 22,000.00	\$ 88,000.00
	Select Material (CBR 15, For Drainage)	8,500	CY	\$ 70.00	\$ 595,000.00
	Pavement Patching for Utility Trench	4,930	LF	\$ 180.00	\$ 887,400.00
	Mill & Overlay	16,500	SY	\$ 45.00	\$ 742,500.00
10	*Site Development & Restoration	1	LS	\$ 596,800.00	\$ 596,800.00
11	Erosion Control	1	LS	\$ 255,800.00	\$ 255,800.00
12	Restoration				
	Hydraulic Cement Concrete Sidewalk (4" Thick)	750	SY	\$ 90.00	\$ 67,500.00
	Driveway (7" Concrete)	920	SY	\$ 175.00	\$ 161,000.00
	Curb & Gutter (St'd.)	5,250	LF	\$ 50.00	\$ 262,500.00
	Topsoil (Class B, 4")	2.5	AC	\$ 23,000.00	\$ 57,500.00
	Hydroseed	375	LBS	\$ 30.00	\$ 11,250.00
	Fertilizer (15-30-15)	5	TON	\$ 1,000.00	\$ 5,000.00
	Lime	0.8	TON	\$ 500.00	\$ 375.00
13	Public Utility Relocation	1	LS	\$ 426,300.00	\$ 426,300.00
14	Traffic Control	1	LS	\$ 682,100.00	\$ 682,100.00
Construction Subtotal					\$ 11,634,186.03
Contingencies					
15	Contingency	30%	% of Construction Subtotal	\$	3,490,256.00
Contingencies Subtotal					\$ 3,490,256.00
Total					\$ 17,601,696.03

* Site development and restoration may consist of any temporary access roads, laydown areas, small pavement areas for off-street parking during maintenance, parking lot restoration, and potential screening.

Appendix C: Potential Water Quality Improvements

DRAFT

Drainage Area A

VRRM 4.1, 2024

Filtering MTD

Drainage Area A Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals	Land Cover Rv	Composite Loading P
Forest (acres)					0.00	0.00	0.00
Mixed Open (acres)					0.00	0.00	0.00
Managed Turf (acres)		68.70			68.70	0.20	0.68
Impervious Cover (acres)		40.62			40.62	0.95	0.86
Total					109.32		

CLEAR BMP AREAS

Total Phosphorus Available for Removal in D.A. A (lb/yr) 81.36
 Post Development Treatment Volume in D.A. A (ft³) 189,954

Composite Loading N
0.00
0.00
7.21
12.33

Stormwater Best Management Practices (RR = Runoff Reduction)

--Select from dropdown lists--

Practice	Runoff Reduction Credit (%)	Mixed Open Credit Area (acres)	Managed Turf Credit Area (acres)	Impervious Cover Credit Area (acres)	Volume from Upstream Practice (ft ³)	Runoff Reduction (ft ³)	Remaining Runoff Volume (ft ³)	Total BMP Treatment Volume (ft ³)	Phosphorus Removal Efficiency (%)	Phosphorus Load from Upstream Practices (lb)	Untreated Phosphorus Load to Practice (lb)	Phosphorus Removed By Practice (lb)	Remaining Phosphorus Load (lb)	Downstream Practice to be Employed
1. Vegetated Roof (RR)														
1.a. Vegetated Roof #1 (P-FIL-02)	45					0	0	0	0		0.00	0.00	0.00	
1.b. Vegetated Roof #2 (P-FIL-02)	60					0	0	0	0		0.00	0.00	0.00	
2. Rooftop Disconnection (RR)														
2.a. Simple Disconnection to A/B Soils (P-FIL-01)	50				0	0	0	0	0	0.00	0.00	0.00	0.00	
2.b. Simple Disconnection to C/D Soils (P-FIL-01)	25				0	0	0	0	0	0.00	0.00	0.00	0.00	
2.c. To Soil Amended Filter Path as per specifications (existing C/D soils) (P-FIL-08)	50				0	0	0	0	0	0.00	0.00	0.00	0.00	
2.d. To Dry Well or French Drain #1, Micro-Infiltration #1 (P-FIL-04)	50				0	0	0	0	25	0.00	0.00	0.00	0.00	
2.e. To Dry Well or French Drain #2, Micro-Infiltration #2 (P-FIL-04)	90				0	0	0	0	25	0.00	0.00	0.00	0.00	
2.f. To Rain Garden #1, Micro-Bioretenion #1 (P-FIL-05)	40				0	0	0	0	25	0.00	0.00	0.00	0.00	
2.g. To Rain Garden #2, Micro-Bioretenion #2 (P-FIL-05)	80				0	0	0	0	50	0.00	0.00	0.00	0.00	
2.h. To Rainwater Harvesting (P-BAS-04)	0				0	0	0	0	0	0.00	0.00	0.00	0.00	
2.i. To Stormwater Planter, Urban Bioretention (P-FIL-05)	40				0	0	0	0	25	0.00	0.00	0.00	0.00	
3. Permeable Pavement (RR)														
3.a. Permeable Pavement #1 (P-FIL-03)	45				0	0	0	0	25	0.00	0.00	0.00	0.00	
3.b. Permeable Pavement #2 (P-FIL-03)	75					0	0	0	25	0.00	0.00	0.00	0.00	
4. Grass Channel (RR)														
4.a. Grass Channel A/B Soils (P-CNV-01)	20				0	0	0	0	15	0.00	0.00	0.00	0.00	
4.b. Grass Channel C/D Soils (P-CNV-01)	10				0	0	0	0	15	0.00	0.00	0.00	0.00	
4.c. Grass Channel with Compost Amended Soils as per specs (P-FIL-08)	20				0	0	0	0	15	0.00	0.00	0.00	0.00	
5. Dry Swale (RR)														
5.a. Dry Swale #1 (P-CNV-02)	40				0	0	0	0	20	0.00	0.00	0.00	0.00	
5.b. Dry Swale #2 (P-CNV-02)	60				0	0	0	0	40	0.00	0.00	0.00	0.00	
6. Bioretention (RR)														
6.a. Bioretention #1 or Micro-Bioretention #1 or Urban Bioretention (P-FIL-05)	40				0	0	0	0	25	0.00	0.00	0.00	0.00	
6.b. Bioretention #2 or Micro-Bioretention #2 (P-FIL-05)	80				0	0	0	0	50	0.00	0.00	0.00	0.00	
7. Infiltration (RR)														
7.a. Infiltration #1 (P-FIL-04)	50				0	0	0	0	25	0.00	0.00	0.00	0.00	
7.b. Infiltration #2 (P-FIL-04)	90				0	0	0	0	25	0.00	0.00	0.00	0.00	
8. Extended Detention Pond (RR)														
8.a. ED #1 (P-BAS-03)	0				0	0	0	0	15	0.00	0.00	0.00	0.00	
8.b. ED #2 (P-BAS-03)	15				0	0	0	0	15	0.00	0.00	0.00	0.00	
9. Sheetflow to Filter/Open Space (RR)														
9.a. Sheetflow to Conservation Area, A/B Soils (P-FIL-07)	75				0	0	0	0	0	0.00	0.00	0.00	0.00	

Nitrogen Removal Efficiency (%)	Nitrogen Load from Upstream Practices (lbs)	Untreated Nitrogen Load to Practice (lbs)	Nitrogen Removed By Practice (lbs)	Remaining Nitrogen Load (lbs)
1. Vegetated Roof (RR)				
0		0.00	0.00	0.00
0		0.00	0.00	0.00
2. Rooftop Disconnection (RR)				
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00
40	0.00	0.00	0.00	0.00
60	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
40	0.00	0.00	0.00	0.00
3. Permeable Pavement (RR)				
25	0.00	0.00	0.00	0.00
25		0.00	0.00	0.00
4. Grass Channel (RR)				
20	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00
5. Dry Swale (RR)				
25	0.00	0.00	0.00	0.00
35	0.00	0.00	0.00	0.00
6. Bioretention (RR)				
40	0.00	0.00	0.00	0.00
60	0.00	0.00	0.00	0.00
7. Infiltration (RR)				
15	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00
8. Extended Detention Pond (RR)				
10	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00
9. Sheetflow to Filter/Open Space (RR)				
0	0.00	0.00	0.00	0.00

9.b. Sheetflow to Conservation Area, C/D Soils (P-FIL-07)	50				0	0	0	0	0	0.00	0.00	0.00	0.00	
9.c. Sheetflow to Vegetated Filter Strip, A Soils or Compost Amended B/C/D Soils (Spec P-FIL-07 & P-FIL-08)	50				0	0	0	0	0	0.00	0.00	0.00	0.00	
10. Regenerative Stormwater Conveyance														
10.a. Regenerative Stormwater Conveyance (P-CNV-04)	0				0	0	0	0	20	0.00	0.00	0.00	0.00	
10.b. Regenerative Stormwater Conveyance (P-CNV-04)	0				0	0	0	0	40	0.00	0.00	0.00	0.00	
11. Tree BMP														
11.a. Trees over Pervious, A/B (P-FIL-09)	16				0	0	0	0	0	0.00	0.00	0.00	0.00	
11.b. Trees over Pervious, C/D (P-FIL-09)	12				0	0	0	0	0	0.00	0.00	0.00	0.00	
11.c. Trees over Impervious (P-FIL-09)	3.5				0	0	0	0	0	0.00	0.00	0.00	0.00	

0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
10. Regenerative Stormwater Conveyance				
25	0.00	0.00	0.00	0.00
35	0.00	0.00	0.00	0.00
11. Tree BMP				
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00

TOTAL IMPERVIOUS COVER TREATED (ac)	0.00	AREA CHECK: OK.
TOTAL MIXED OPEN TREATED (ac)	0.00	AREA CHECK: OK.
TOTAL MANAGED TURF AREA TREATED (ac)	0.00	AREA CHECK: OK.
TOTAL RUNOFF REDUCTION IN D.A. A (ft ³)	0	
TOTAL PHOSPHORUS AVAILABLE FOR REMOVAL IN D.A. A (lb/yr)	81.36	
TOTAL PHOSPHORUS REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.00	
TOTAL PHOSPHORUS REMAINING AFTER APPLYING RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	81.36	
SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS		

TOTAL RUNOFF REDUCTION IN D.A. A (ft ³)	0
NITROGEN REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.00
SEE WATER QUALITY COMPLIANCE TAB FOR SITE CALCULATIONS (Information Only)	

12. Wet Swale (no RR)														
12.a. Wet Swale #1 (P-CNV-03)	0				0	0	0	0	20	0.00	0.00	0.00	0.00	
12.b. Wet Swale #2 (P-CNV-03)	0				0	0	0	0	40	0.00	0.00	0.00	0.00	
13. Filtering Practices (no RR)														
13.a. Filtering Practice #1 (P-FIL-06)	0				0	0	0	0	60	0.00	0.00	0.00	0.00	
13.b. Filtering Practice #2 (P-FIL-06)	0				0	0	0	0	65	0.00	0.00	0.00	0.00	
14. Constructed Wetland (no RR)														
14.a. Constructed Wetland #1 (P-BAS-01)	0				0	0	0	0	50	0.00	0.00	0.00	0.00	
14.b. Constructed Wetland #2 (P-BAS-01)	0				0	0	0	0	75	0.00	0.00	0.00	0.00	
15. Wet Ponds (no RR)														
15.a. Wet Pond #1 (P-BAS-02)	0				0	0	0	0	50	0.00	0.00	0.00	0.00	
15.b. Wet Pond #1 (Coastal Plain) (P-BAS-02)	0				0	0	0	0	45	0.00	0.00	0.00	0.00	
15.c. Wet Pond #2 (P-BAS-02)	0				0	0	0	0	75	0.00	0.00	0.00	0.00	
15.d. Wet Pond #2 (Coastal Plain) (P-BAS-02)	0				0	0	0	0	65	0.00	0.00	0.00	0.00	
16. Manufactured Treatment Devices (no RR)														
16.a. Manufactured Treatment Device-Hydrodynamic	0				0	0	0	0	20	0.00	0.00	0.00	0.00	
16.b. Manufactured Treatment Device-Filtering	0		68.70	40.62	0	0	189,954	189,954	40	0.00	81.36	32.54	48.82	
16.c. Manufactured Treatment Device-Generic	0				0	0	0	0	20	0.00	0.00	0.00	0.00	

12. Wet Swale (Coastal Plain) (no RR)				
25	0.00	0.00	0.00	0.00
35	0.00	0.00	0.00	0.00
13. Filtering Practices (no RR)				
30	0.00	0.00	0.00	0.00
45	0.00	0.00	0.00	0.00
14. Constructed Wetland (no RR)				
25	0.00	0.00	0.00	0.00
55	0.00	0.00	0.00	0.00
15. Wet Ponds (no RR)				
30	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00
40	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00
16. Manufactured BMP (no RR)				
0	0.00	0.00	0.00	0.00
0	0.00	996.13	0.00	996.13
0	0.00	0.00	0.00	0.00

TOTAL IMPERVIOUS COVER TREATED (ac)	40.62	AREA CHECK: OK.
TOTAL MIXED OPEN TREATED (ac)	0.00	AREA CHECK: OK.
TOTAL MANAGED TURF AREA TREATED (ac)	68.70	AREA CHECK: OK.
TOTAL PHOSPHORUS REMOVAL REQUIRED ON SITE (lb/yr)	0.00	
TOTAL PHOSPHORUS AVAILABLE FOR REMOVAL IN D.A. A (lb/yr)	81.36	
TOTAL PHOSPHORUS REMOVED WITHOUT RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	32.54	
TOTAL PHOSPHORUS REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.00	
TOTAL PHOSPHORUS LOAD REDUCTION ACHIEVED IN D.A. A (lb/yr)	32.54	
TOTAL PHOSPHORUS REMAINING AFTER APPLYING BMP LOAD REDUCTIONS IN D.A. A (lb/yr)	48.82	

SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS

NITROGEN REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.00
NITROGEN REMOVED WITHOUT RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.00
TOTAL NITROGEN REMOVED IN D.A. A (lb/yr)	0.00

DRAFT

Drainage Area B

Hydrodynamic MTD

VRRM 4.1, 2024

Drainage Area B Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals	Land Cover Rv	Composite Loading P
Forest (acres)					0.00	0.00	0.00
Mixed Open (acres)					0.00	0.00	0.00
Managed Turf (acres)		68.70			68.70	0.20	0.68
Impervious Cover (acres)		40.62			40.62	0.95	0.86
Total					109.32		

CLEAR BMP AREAS

Total Phosphorus Available for Removal in D.A. B (lb/yr)	81.36
Post Development Treatment Volume in D.A. B (ft3)	189,954

Composite Loading N
0.00
0.00
7.21
12.33

Stormwater Best Management Practices (RR = Runoff Reduction)

--Select from dropdown lists--

Practice	Runoff Reduction Credit (%)	Mixed Open Credit Area (acres)	Managed Turf Credit Area (acres)	Impervious Cover Credit Area (acres)	Volume from Upstream Practice (ft³)	Runoff Reduction (ft³)	Remaining Runoff Volume (ft³)	Total BMP Treatment Volume (ft³)	Phosphorus Removal Efficiency (%)	Phosphorus Load from Upstream Practices (lb)	Untreated Phosphorus Load to Practice (lb)	Phosphorus Removed By Practice (lb)	Remaining Phosphorus Load (lb)	Downstream Practice to be Employed
1. Vegetated Roof (RR)														
1.a. Vegetated Roof #1 (P-FIL-02)	45					0	0	0	0		0.00	0.00	0.00	
1.b. Vegetated Roof #2 (P-FIL-02)	60					0	0	0	0		0.00	0.00	0.00	
2. Rooftop Disconnection (RR)														
2.a. Simple Disconnection to A/B Soils (P-FIL-01)	50				0	0	0	0	0	0.00	0.00	0.00	0.00	
2.b. Simple Disconnection to C/D Soils (P-FIL-01)	25				0	0	0	0	0	0.00	0.00	0.00	0.00	
2.c. To Soil Amended Filter Path as per specifications (existing C/D Soils) (P-FIL-08)	50				0	0	0	0	0	0.00	0.00	0.00	0.00	
2.d. To Dry Well or French Drain #1, Micro-Infiltration #1 (P-FIL-04)	50				0	0	0	0	25	0.00	0.00	0.00	0.00	
2.e. To Dry Well or French Drain #2, Micro-Infiltration #2 (P-FIL-04)	90				0	0	0	0	25	0.00	0.00	0.00	0.00	
2.f. To Rain Garden #1, Micro-Bioretenion #1 (P-FIL-05)	40				0	0	0	0	25	0.00	0.00	0.00	0.00	
2.g. To Rain Garden #2, Micro-Bioretenion #2 (P-FIL-05)	80				0	0	0	0	50	0.00	0.00	0.00	0.00	
2.h. To Rainwater Harvesting (P-BAS-04)	0				0	0	0	0	0	0.00	0.00	0.00	0.00	
2.i. To Stormwater Planter, Urban Bioretention (P-FIL-05)	40				0	0	0	0	25	0.00	0.00	0.00	0.00	
3. Permeable Pavement (RR)														
3.a. Permeable Pavement #1 (P-FIL-03)	45				0	0	0	0	25	0.00	0.00	0.00	0.00	
3.b. Permeable Pavement #2 (P-FIL-03)	75					0	0	0	25	0.00	0.00	0.00	0.00	
4. Grass Channel (RR)														
4.a. Grass Channel A/B Soils (P-CNV-01)	20				0	0	0	0	15	0.00	0.00	0.00	0.00	
4.b. Grass Channel C/D Soils (P-CNV-01)	10				0	0	0	0	15	0.00	0.00	0.00	0.00	
4.c. Grass Channel with Compost Amended Soils as per specs (P-FIL-08)	20				0	0	0	0	15	0.00	0.00	0.00	0.00	
5. Dry Swale (RR)														
5.a. Dry Swale #1 (P-CNV-02)	40				0	0	0	0	20	0.00	0.00	0.00	0.00	
5.b. Dry Swale #2 (P-CNV-02)	60				0	0	0	0	40	0.00	0.00	0.00	0.00	
6. Bioretention (RR)														
6.a. Bioretention #1 or Micro-Bioretention #1 or Urban Bioretention (P-FIL-05)	40				0	0	0	0	25	0.00	0.00	0.00	0.00	
6.b. Bioretention #2 or Micro-Bioretention #2 (P-FIL-05)	80				0	0	0	0	50	0.00	0.00	0.00	0.00	
7. Infiltration (RR)														
7.a. Infiltration #1 (P-FIL-04)	50				0	0	0	0	25	0.00	0.00	0.00	0.00	
7.b. Infiltration #2 (P-FIL-04)	90				0	0	0	0	25	0.00	0.00	0.00	0.00	
8. Extended Detention Pond (RR)														
8.a. ED #1 (P-BAS-03)	0				0	0	0	0	15	0.00	0.00	0.00	0.00	
8.b. ED #2 (P-BAS-03)	15				0	0	0	0	15	0.00	0.00	0.00	0.00	
9. Sheetflow to Filter/Open Space (RR)														
9.a. Sheetflow to Conservation Area, A/B Soils (P-FIL-07)	75				0	0	0	0	0	0.00	0.00	0.00	0.00	

Nitrogen Removal Efficiency (%)	Nitrogen Load from Upstream Practices (lbs)	Untreated Nitrogen Load to Practice (lbs)	Nitrogen Removed By Practice (lbs)	Remaining Nitrogen Load (lbs)
1. Vegetated Roof (RR)				
0		0.00	0.00	0.00
0		0.00	0.00	0.00
2. Rooftop Disconnection (RR)				
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00
40	0.00	0.00	0.00	0.00
60	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
40	0.00	0.00	0.00	0.00
3. Permeable Pavement (RR)				
25	0.00	0.00	0.00	0.00
25		0.00	0.00	0.00
4. Grass Channel (RR)				
20	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00
5. Dry Swale (RR)				
25	0.00	0.00	0.00	0.00
35	0.00	0.00	0.00	0.00
6. Bioretention (RR)				
40	0.00	0.00	0.00	0.00
60	0.00	0.00	0.00	0.00
7. Infiltration (RR)				
15	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00
8. Extended Detention Pond (RR)				
10	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00
9. Sheetflow to Filter/Open Space (RR)				
0	0.00	0.00	0.00	0.00

9.b. Sheetflow to Conservation Area, C/D Soils (P-FIL-07)	50				0	0	0	0	0	0.00	0.00	0.00	0.00	
9.c. Sheetflow to Vegetated Filter Strip, A Soils or Compost Amended B/C/D Soils (Spec P-FIL-07 & P-FIL-08)	50				0	0	0	0	0	0.00	0.00	0.00	0.00	

0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00

10. Regenerative Stormwater Conveyance														
10.a. Regenerative Stormwater Conveyance (P-CNV-04)	0				0	0	0	0	20	0.00	0.00	0.00	0.00	
10.b. Regenerative Stormwater Conveyance (P-CNV-04)	0				0	0	0	0	40	0.00	0.00	0.00	0.00	

10. Regenerative Stormwater Conveyance				
25	0.00	0.00	0.00	0.00
35	0.00	0.00	0.00	0.00

11. Tree BMP														
11.a. Trees over Pervious, A/B (P-FIL-09)	16				0	0	0	0	0	0.00	0.00	0.00	0.00	
11.b. Trees over Pervious, C/D (P-FIL-09)	12				0	0	0	0	0	0.00	0.00	0.00	0.00	
11.c. Trees over Impervious (P-FIL-09)	3.5				0	0	0	0	0	0.00	0.00	0.00	0.00	

11. Tree BMP				
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00

TOTAL IMPERVIOUS COVER TREATED (ac)	0.00	AREA CHECK: OK.
TOTAL MIXED OPEN TREATED (ac)	0.00	AREA CHECK: OK.
TOTAL MANAGED TURF AREA TREATED (ac)	0.00	AREA CHECK: OK.
TOTAL RUNOFF REDUCTION IN D.A. B (ft3)	0	
TOTAL PHOSPHORUS AVAILABLE FOR REMOVAL IN D.A. B (lb/yr)	81.36	
TOTAL PHOSPHORUS REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. B (lb/yr)	0.00	
TOTAL PHOSPHORUS REMAINING AFTER APPLYING RUNOFF REDUCTION PRACTICES IN D.A. B (lb/yr)	81.36	
SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS		

TOTAL RUNOFF REDUCTION IN D.A. B (ft3)	0
NITROGEN REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. B (lb/yr)	0.00
SEE WATER QUALITY COMPLIANCE TAB FOR SITE CALCULATIONS (Information Only)	

12. Wet Swale (no RR)														
12.a. Wet Swale #1 (P-CNV-03)	0				0	0	0	0	20	0.00	0.00	0.00	0.00	
12.b. Wet Swale #2 (P-CNV-03)	0				0	0	0	0	40	0.00	0.00	0.00	0.00	

12. Wet Swale (Coastal Plain) (no RR)				
25	0.00	0.00	0.00	0.00
35	0.00	0.00	0.00	0.00

13. Filtering Practices (no RR)														
13.a. Filtering Practice #1 (P-FIL-06)	0				0	0	0	0	60	0.00	0.00	0.00	0.00	
13.b. Filtering Practice #2 (P-FIL-06)	0				0	0	0	0	65	0.00	0.00	0.00	0.00	

13. Filtering Practices (no RR)				
30	0.00	0.00	0.00	0.00
45	0.00	0.00	0.00	0.00

14. Constructed Wetland (no RR)														
14.a. Constructed Wetland #1 (P-BAS-01)	0				0	0	0	0	50	0.00	0.00	0.00	0.00	
14.b. Constructed Wetland #2 (P-BAS-01)	0				0	0	0	0	75	0.00	0.00	0.00	0.00	

14. Constructed Wetland (no RR)				
25	0.00	0.00	0.00	0.00
55	0.00	0.00	0.00	0.00

15. Wet Ponds (no RR)														
15.a. Wet Pond #1 (P-BAS-02)	0				0	0	0	0	50	0.00	0.00	0.00	0.00	
15.b. Wet Pond #1 (Coastal Plain) (P-BAS-02)	0				0	0	0	0	45	0.00	0.00	0.00	0.00	
15.c. Wet Pond #2 (P-BAS-02)	0				0	0	0	0	75	0.00	0.00	0.00	0.00	
15.d. Wet Pond #2 (Coastal Plain) (P-BAS-02)	0				0	0	0	0	65	0.00	0.00	0.00	0.00	

15. Wet Ponds (no RR)				
30	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00
40	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00

16. Manufactured Treatment Devices (no RR)														
16.a. Manufactured Treatment Device-Hydrodynamic	0		68.70	40.62	0	0	189,954	189,954	20	0.00	81.36	16.27	65.09	
16.b. Manufactured Treatment Device-Filtering	0				0	0	0	0	20	0.00	0.00	0.00	0.00	
16.c. Manufactured Treatment Device-Generic	0				0	0	0	0	20	0.00	0.00	0.00	0.00	

16. Manufactured BMP (no RR)				
0	0.00	996.13	0.00	996.13
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00

TOTAL IMPERVIOUS COVER TREATED (ac)	40.62	AREA CHECK: OK.
TOTAL MIXED OPEN TREATED (ac)	0.00	AREA CHECK: OK.
TOTAL MANAGED TURF AREA TREATED (ac)	68.70	AREA CHECK: OK.
TOTAL PHOSPHORUS REMOVAL REQUIRED ON SITE (lb/yr)	0.00	
TOTAL PHOSPHORUS AVAILABLE FOR REMOVAL IN D.A. B (lb/yr)	81.36	
TOTAL PHOSPHORUS REMOVED WITHOUT RUNOFF REDUCTION PRACTICES IN D.A. B (lb/yr)	16.27	
TOTAL PHOSPHORUS REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. B (lb/yr)	0.00	
TOTAL PHOSPHORUS LOAD REDUCTION ACHIEVED IN D.A. B (lb/yr)	16.27	
TOTAL PHOSPHORUS REMAINING AFTER APPLYING BMP LOAD REDUCTIONS IN D.A. B (lb/yr)	65.09	

SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS

NITROGEN REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. B (lb/yr)	0.00
NITROGEN REMOVED WITHOUT RUNOFF REDUCTION PRACTICES IN D.A. B (lb/yr)	0.00
TOTAL NITROGEN REMOVED IN D.A. B (lb/yr)	0.00

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