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MEMORANDUM

To:	USEPA Region 3; City of Huntington, WV
From:	Jonathan Smith, Eugenia Hart, Hillary Yonce
Date:	January 15, 2020
Subject:	Huntington, WV Greenstreet 10%-20% Progress (Feasibility) Design

This memo summarizes the design of a suite of green street improvements developed for three blocks of Madison Avenue in the City of Huntington, West Virginia. The attached 10-20% progress (feasibility) design sheets should be considered a component of this memo as they contain graphical representations which are referenced herein. These sheets represent and advancement beyond the conceptual design stage to consider practice sizing, configuration, modelling, and construction feasibility.

Key community drivers for these projects are not regulatory in nature, but rather are related to the suite of benefits that green infrastructure may offer such as flood reduction, aesthetics, quality of life improvements, and protecting the Ohio River.

1.0 GREEN STREET FEASIBILITY DESIGN

The progress design for green street implementation along Madison Avenue represents the evolution of community consideration of green infrastructure to address local needs. This consideration began at a community workshop held in Mid-2018 in which community members identified green infrastructure elements which would be applicable and appropriate for the greater West Huntington area in which the Madison Avenue project is located and helped develop a green infrastructure plan encompassing all of West Huntington. These efforts were further advanced at a community charette held on May 14rd and 15th 2019 which resulted in a concept design for Madison Avenue which included streetscape modifications and the inclusion of street side/bump out bioretention practices. The community led concept design focused on revitalizing the Madison Avenue area using green infrastructure practices that would make the urban corridor a destination location which fosters safe pedestrian and bicycle uses. This memo and the associated feasibility plan sheets represent further advancement of the concept design to provide additional documentation which may be used to procure funding or additional stakeholder support.

Key feasibility design features for Madison Avenue include the following green infrastructure features:

- Street trees planted in existing pervious/vegetated areas along both sides of the roadway along Madison Avenue between W 17th Street and W 13th Street

- Street trees planted in existing pervious/vegetated areas along both sides of the railroad track to the east of J&L Supply Co, Inc. between the two disconnected road segments of W 15th Street
- Conversion of existing pervious/vegetated areas to urban bioretention along Madison Avenue and the corner of Madison Avenue and W 14th Street
- Conversion of existing impervious areas within the sidewalk extent to urban bioretention along Madison Avenue and the corner of Madison Avenue and W 14th Street

Additional non green infrastructure (street scape and conventional infrastructure) elements of the proposed feasibility design include:

- Installation of new or extended subsurface drainage system to provide overflow/underdrain connection for all proposed bioretention areas. To the extent possible the location of proposed bioretention areas was selected to utilize existing infrastructure
- Modification of street cross-section to provide for a dedicated bike lane between W 17th St. and W 14th St. Additional bike lanes are proposed along the east side of W. 15th St as part of the proposed Rails-to-Trails project at this location.
- Installation of a median separator at W 16th St. and inclusion of wayfinding signs at the Hwy 52 northbound offramp and on both side of Madison Avenue

The feasibility design differs from the concept design in one important aspect. The previously proposed permeable pavement sidewalk on the south side of Madison Avenue and incorporated into the cross-walks at the Madison Avenue/ 15th St. intersection have been omitted from the feasibility design. During design evaluation of green infrastructure practices proposed by the concept design it was determined that street side bioretention would likely provide water quality management sufficient to comply with sizing guidelines for the state of West Virginia.

1.1 DRAINAGE AREA DETAILS

The Madison Avenue drainage area to proposed green infrastructure features is approximately 2.0 acres in size, extending approximately from W 16th Street down to W 13th Street, including some drainage parallel to W 13th Street, W 14th Street, and the railroad tracks near W 15th Street. Based on land use type digitized from high-resolution aerial imagery from resources such as Google Earth, the total drainage area is approximately 0.2 acres pervious surface (10%), and 1.8 acres impervious surface (90%). The drainage area to each individually proposed bioretention feature along Madison Avenue ranges 0.05 – 0.28 acres in size, with imperviousness ranging 0.03 – 0.27 acres.

The existing road extent is approximately 40 feet wide and 1,400 feet (0.26 miles) long, with vegetated areas running periodically along the roadside. The roadway is largely commercial and industrial in nature, with sidewalks present on both sides of the road.

1.2 GREEN STREET FEATURES

The green street features proposed in the progress design for Madison Avenue are bioretention. Bioretention are practices that capture and store stormwater runoff and pass it through a bed of engineered soil media for water quality treatment. The feature descriptions and requirements summarized below are based on the West Virginia Department of Environmental Protection “West Virginia Stormwater Management and Design Guidance Manual” from November 2012.

Due to the highly impervious nature of the project extent, the green infrastructure is considered "urban bioretention" which includes street bioretention (such as stormwater curb extensions), engineered tree pits (or extended tree boxes), and stormwater planters.

In this geographic area of Huntington, soils are tight, and the Web Soil Survey classifies the entire project area as "urban land" soils which may be considered hydrologic soil group (HSG) type D which are characterized as clay types with high runoff potential and very low infiltration capacity. Due to the existing soil types, the urban bioretention proposed along Madison Avenue are considered "level 1" which require an underdrain, at least 18 inches of soil media, and no infiltration sump. This design practice allows for 60% volume reduction for the design volume of the practice, as well as 70% TSS reduction, 55% TP reduction, and 64% TN reduction.

Design criteria for **bioretention** include the following items:

- Pretreatment present
- Ponding depth 6 – 18" (6 inches recommended for urban bioretention, however specific designs may be considered for up to 12 inches)
- Side slopes 3:1 maximum
- Choker layer of 1 inch choker stone for every 1 foot of soil media
- Soil media 18-inch minimum
- Underdrain pipes 4 – 6 inches
- Underdrain stone/gravel layer
- Overflow structure for larger flows
- Soil media should have an infiltration rate of at least 2 inches per hour

There are specific criteria related to construction details, surface cover/planting, and maintenance as well. Placement of all bioretention features will be made based on avoiding potential interference with existing underground utilities.

Urban bioretention is usually limited to 2,500 square feet of drainage area to individual units, however this is a general rule. Larger drainage areas are allowed with sufficient flow controls to "ensure proper function, safety, and community acceptance." While impervious contributing drainage areas to individual bioretention cells along Madison Avenue range from 1,509 to 12,025 square feet, the frequency of units along the roadway should work in tandem to provide sufficient treatment. Further, the sidestreet bioretention devices may be designed as "offline" practices in which excessive flows do not enter the practice but continue along the gutter line to the next practice or curb inlet. For the entire impervious drainage area of 77,411 square feet (some impervious area converted to bioretention), the total footprint of bioretention represents approximately 3% of the impervious contributing drainage area.

1.2.1 Sizing Green Street Features

Sizing the bioretention features along Madison Avenue was conducted using the following resources:

- EPA's National Stormwater Calculator (SWC) tool
- West Virginia Stormwater Management and Design Guidance Manual from November 2012 Chapter 4.2.3 on Bioretention

EPA National Stormwater Calculator

Within the EPA SWC tool, the following site characteristics were identified and parameterized. Note that using the EPA SWC tool was an iterative process which involved identifying potential urban bioretention

footprints and toggling various design parameters within the approved ranges (such as media, gravel, and ponding depths) to identify the best conceptual configuration:

1. Site Location: Madison Avenue, Huntington West Virginia
2. Site Drainage Area: 2.0 acres
3. Soil Type: Clay (High Runoff)
4. Soil Drainage: 0.2 inches/hour (low end of published range for urban soils in the area based on the Web Soil Survey)
5. Topography: Flat (2% Slope)
6. Precipitation/Evaporation: nearest gage: HUNTINGTON SWG PL
7. Land Cover: 10% Lawn, 90% Impervious
8. LID Controls:
    a. Design Storm: 1.0 inches
    b. 100% of impervious area to be treated by Street Planters
        i. Note: Street Planters in the tool allow for inputs related to ponding, soil media, and gravel which for example Rain Gardens do not allow for a gravel layer.
    c. Street Planters: 11.5-inch ponding height, 18 inch soil media thickness (assumed porosity of 0.25 from WV Guidance), 2 in/hr soil media conductivity, 18-inch gravel layer thickness (assumed porosity of 0.4 from WV Guidance), pre-treatment present
        i. This configuration meets the WV Guidance requirement that when ponding depth is less than 12 inches, that surface storage account for at least 50% of total design volume. This requirement may be reduced when "impractical."
    d. "Size for Design Storm" Result: 3% Capture Ratio (3% of impervious area as the required minimum bioretention footprint)
9. Project Cost: Re-Development Type, Moderate Site Suitability, Cost Region Detroit
10. Results: Water Balance and Cost Approximations are summarized in Appendix A.

Treatment Volume Calculations

The total footprint of bioretention along Madison Avenue as part of the feasibility design is approximately 2,484 square feet (0.06 acres) which provides ample treatment capacity and implementation flexibility (Table 1). The total treatment volume associated with each bioretention feature is calculated using the following typical BMP design equation:

$$Design\ Volume = Surface\ Area \times \left(depth_{media} \times porosity_{media} + depth_{gravel} \times porosity_{gravel} + depth_{ponding}\right)$$

Based on the minimum required combined footprint (3% capture ratio) of bioretention features along Madison Avenue (2,322 square feet), the total minimum required combined storage volume for all bioretention features is 4,802 cubic feet. By contrast, the feasibility design capture ratio is 3.2% of the total impervious drainage area.

Table 1. Bioretention features feasibility design specifications

Bioretention Feature	Surface Area (ft^2)	Treatment Volume (ft^3)
Urban Bioretention Features (14 individual features) Feasibility Design	2,484	4,802
Minimum Required Sum	***2,322***	***4,490***

The feasibility design for bioretention features along Madison Avenue is approximately 7% greater surface area and treatment volume than the required minimum based on the EPA SWC tool analysis. Given the relative uncertainty regarding subsurface utility main and laterals this apparent overdesign is appropriate as the treatment volume achievable during final design will likely be reduced due to these potential conflicts. Additional changes to both design parameters and footprints of proposed bioretention features are possible in later stages of design.

1.3 CONCEPT DESIGN COSTS

The EPA National Stormwater Calculator tool provides preliminary, planning level only, cost estimates for capital construction and annual maintenance costs associated with each GI design concept evaluated by the tool. Although these costs are for planning purposes only and should be followed up with more robust site-specific costs estimating approaches, they do provide a relative basis to compare different GI scenarios. The tool generated costs are summarized in Table 2 and provided in more detail in Appendix A.

Table 2 Summary of EPA National Stormwater Calculator generated costs

Concept Design	Capital Cost	
	Low	High
Madison Avenue	$42,477	$58,753

1.4 ADDITIONAL RESOURCES

National Stormwater Calculator

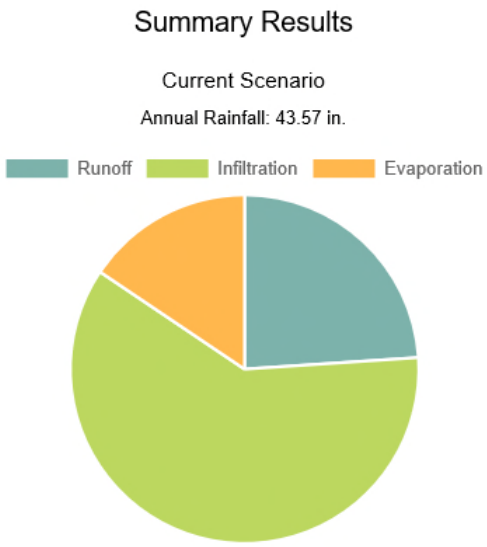
https://www.epa.gov/water-research/national-stormwater-calculator

West Virginia Stormwater Management and Design Guidance Manual

https://dep.wv.gov/WWE/Programs/stormwater/MS4/Pages/StormwaterManagementDesignandGuidanceManual.aspx

APPENDIX A: MADISON AVENUE EPA NATIONAL SWC

The following screen-shots are from the Results tab of the EPA National Stormwater Calculator tool[1] as implemented for the Madison Avenue green street feasibility design. Note that the following water balance (Figure 1) and cost summary (Figure 2) are associated with the EPA Stormwater Calculator proposed sizing (3% capture ratio) for total urban bioretention area. Although comparative analysis of the current conditions was not performed, It is expected that the water balance would report primarily runoff given the high level of imperviousness and near lack of infiltrative surfaces in the current condition.



Statistic	Current Scenario
Average Annual Rainfall (inches)	43.57
Average Annual Runoff (inches)	10.47
Days per Year with Rainfall	81.54
Days per Year with Runoff	18.59
Percent of Wet Days Retained	77.21
Smallest Rainfall w/ Runoff (inches)	0.11
Largest Rainfall w/o Runoff (inches)	1.04
Max Rainfall Retained (inches)	1.14

Figure 1. Water balance for Madison Avenue urban bioretention design from EPA National Stormwater Calculator

[1] Model files will be provided as a separate deliverable for further evaluation with the Stormwater Calculator

Cost Summary

Estimate of Probable Capital Costs (estimates in 2018 US.$)

Maintenance Costs | Graphical View

	Drainage Area %	Has Pre-Treatment?	Current Scenario (C)		Baseline Scenario (B)		Difference (C - B)	
Cost By LID Control Type	**Current / Baseline**	**Current / Baseline**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Disconnection	0 / 0	No / No	$0.00	$0.00	$0.00	$0.00	$0	$0
Rainwater Harvesting	0 / 0	No / No	$0.00	$0.00	$0.00	$0.00	$0	$0
Rain Gardens	0 / 0	Yes / NA	$0.00	$0.00	$0.00	$0.00	$0	$0
Green Roofs	0 / 0	No / No	$0.00	$0.00	$0.00	$0.00	$0	$0
Street Planters	100 / 0	No / No	$42,477.26	$58,735.03	$0.00	$0.00	$42,477.26	$58,735.03
Infiltration Basins	0 / 0	Yes / NA	$0.00	$0.00	$0.00	$0.00	$0	$0
Permeable Pavement	0 / 0	Yes / NA	$0.00	$0.00	$0.00	$0.00	$0	$0
Total	**100 / 0**	**Varies**	**$42,477.26**	**$58,735.03**	**$0.00**	**$0.00**	**$42,477.26**	**$58,735.03**

Note: site complexity variables that affect cost shown below:

	Current Scenario	Baseline Scenario
Dev. Type	Re-Development	NA
Site Suitability	Moderate	NA
Topography	Flat (2% Slope)	NA
Soil Type	D	NA
Cost Region	Detroit(273 miles) 1.01	NA

Chart Key	
D - Disconnection	IB - Infiltration Basins
RH - Rain Harvesting	PP - Permeable Pavement
RG - Rain Gardens	
GR - Green Roofs	
SP - Street Planters	

Figure 2. Cost estimate for Madison Avenue urban bioretention design from EPA National Stormwater Calculator