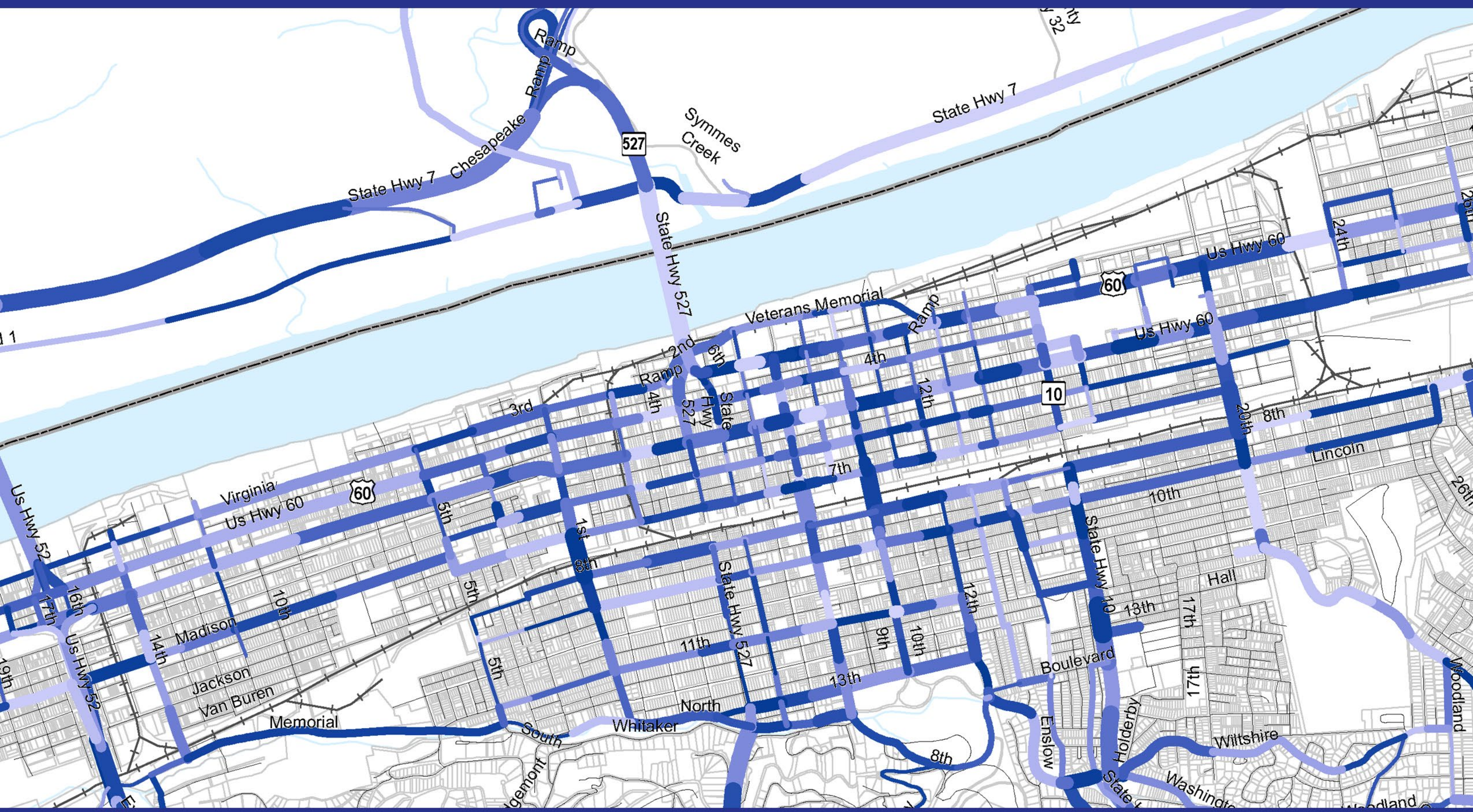
KYOVA
KENTUCKY • OHIO • WEST VIRGINIA
INTERSTATE PLANNING COMMISSION

Huntington Street Flooding Mitigation Plan

KYOVA Interstate Planning Commission and the City of Huntington



AECOM

150 Clay Street, Suite 410
Morgantown, WV 26501, USA

August 2017

The KYOVA Street Flooding Mitigation Plan is the result of a collaborative process involving the talents and efforts of the Street Flooding Mitigation Plan Steering Committee, an extensive list of stakeholders, local staff, elected officials, the West Virginia Department of Transportation, and Federal Highway Administration. In addition, the contributions from the people of the City of Huntington and Cabell County provided invaluable feedback during the planning process and through the review of the draft document.

Street Flooding Mitigation Plan Steering Committee

Paul Davis | Tri-State Transit Authority
Chandra Inglis-Smith | Federal Highway Administration
Jim Insco | City of Huntington
Gordon Merry | Cabell County EMS
Saleem Salameh | KYOVA Interstate Planning Commission
Breanna Shell | City of Huntington
Rob Watson | West Virginia Division of Highways
Bethany Wild | KYOVA Interstate Planning Commission
Sherry Wilkins | Huntington Stormwater Utility
Jennifer Woodall | Tri-State Transit Authority

Consultants

AECOM – West Virginia

Table of Contents

Contents

Executive Summary **ES-1**

Chapter 1. Introduction and Vision **1-1**

Background 1-1

Understanding 1-1

Chapter 2. Discovery and Analysis **2-1**

Planning Resources 2-1

Travel Demand Model 2-3

Bicycle and Pedestrian Circulation 2-25

Motorized System Assessment 2-35

Non-Motorized System Assessment 2-37

Network Conditions Economic Assessment 2-40

Emergency Services Response Assessment 2-49

Stormwater Model Development Process 2-49

Flooding and Green Infrastructure Alternatives 2-57

Chapter 3. Final Alternatives **3-1**

Foundations 3-1

Alternatives Testing 3-1

Recommendations 3-1

Stormwater Improvements 3-1

Complete Streets Improvements 3-3

Surface Transportation Project Cost Estimates 3-26

Chapter 4. Implementation **4-1**

Approach 4-1

Project Prioritization 4-1

Funding Opportunities 4-4

Appendix A - Green Infrastructure Types **A-1**

Appendix B - Implementation Resources **B-1**

Figures

Figure 2-01: Study Area....2-4
Figure 2-02: Base Year Validation Check (Before Calibration)....2-5
Figure 2-03: Base Year Validation Check (After Calibration)....2-6
Figure 2-04: Future Year No-Build Conditions....2-9
Figure 2-05: Scenario 1 Impacts....2-10
Figure 2-06: Scenario 2 Impacts....2-11
Figure 2-07: Scenario 3 Impacts....2-12
Figure 2-08: Scenario 4 Impacts....2-13
Figure 2-09: Scenario 5 Impacts....2-14
Figure 2-10: Scenario 6 Impacts....2-15
Figure 2-11: Scenario 7 Impacts....2-16
Figure 2-12: Scenario 8 Impacts....2-17
Figure 2-13: Scenario 9 Impacts....2-18
Figure 2-14: Scenario 10 Impacts....2-19
Figure 2-15: Scenario 11 Impacts....2-20
Figure 2-16: Scenario 12 Impacts....2-21
Figure 2-17: Scenario 13 Impacts....2-22
Figure 2-18: Existing Bicycle & Pedestrian Circulation....2-26
Figure 2-19: Circulation Area #1....2-27
Figure 2-20: Circulation Area #2....2-29
Figure 2-21: Circulation Area #3....2-30
Figure 2-22: Circulation Area #4....2-31
Figure 2-23: Circulation Area #5....2-33
Figure 2-24: Circulation Area #6....2-34
Figure 2-25: Circulation Area #7....2-36
Figure 2-26: Underpasses....2-38
Figure 2-27: Major / Minor Systems....2-54
Figure 2-28: Hal Greer Major System....2-54
Figure 2-29: Existing Model Configuration....2-56

Figure 2-30: Design Storm Profiles ... 2-57
Figure 2-31: Hal Greer Sewer Profile ... 2-58
Figure 2-32: Conveyance System ... 2-63
Figure 2-33: Combined Sewer Separation Alternative #1 System ... 2-65
Figure 2-34: Combined Sewer Separation Alternative #2 System ... 2-67
Figure 2-35: Combined Sewer Separation Alternative #3 System ... 2-69
Figure 2-36: Optimized Alternative System ... 2-74
Figure 2-37: Profiles of Existing vs. Alternative Models ... 2-78
Figure 3-01: 3rd Avenue Complete Street (25th Street to 16th Street) ... 3-6
Figure 3-02: 3rd Avenue Complete Street (16th Street to 13th Street) ... 3-6
Figure 3-03: 5th Avenue Complete Street (29th Street to 20th Street) ... 3-08
Figure 3-04: 5th Avenue Complete Street (20th Street to 16th Street) ... 3-08
Figure 3-05: 5th Avenue Complete Street (16th Street to 13th Street) ... 3-09
Figure 3-06: 20th Street Underpass (8th Avenue To 7th Avenue) ... 3-11
Figure 3-07: 20th Street Underpass (7th Avenue To 5th Avenue) ... 3-11
Figure 3-08: 16th Street Underpass (8th Avenue To 7th Avenue) ... 3-13
Figure 3-09: 16th Street Underpass (7th Avenue To 5th Avenue) ... 3-13
Figure 3-10: 10th Street Underpass (8th Avenue To 7th Avenue) ... 3-17
Figure 3-11: 10th Street Underpass (7th Avenue To 5th Avenue) ... 3-17
Figure 3-12: 8th Street Underpass (8th Avenue To 7th Avenue) ... 3-19
Figure 3-13: 8th Street Underpass (7th Avenue To 5th Avenue) ... 3-19
Figure 3-14: 1st Street Underpass (8th Avenue To 7th Avenue) ... 3-21
Figure 3-15: 1st Street Underpass (7th Avenue To 5th Avenue) ... 3-21
Figure 3-16: 5th Avenue Complete Street Part 2 (1st Street To 6th Street) ... 3-24
Figure 3-17: 5th Avenue Complete Street Part 2 (6th Street To 10th Street) ... 3-24
Figure 3-18: 5th Avenue Complete Street Part 2 (10th Street To 13th Street) ... 3-25

Tables

Table ES-1: Implementation of Plans ES-1
Table 2-01: Traffic Impacts of Street Closures 2-23
Table 2-02: 2040 Daily VMT and VHT Impacts of Street Closures 2-24
Table 2-03: Benefits of Kyova Street Flood Mitigation Plan Under Scenario 10, $M 2017 Dollars Over 20 Years 2-40
Table 2-04: Safety Benefit 2-44
Table 2-05: Travel Time Savings 2-45
Table 2-06: Travel Cost Savings 2-46
Table 2-07: Emissions Savings 2-47
Table 2-08: Operating and Maintenance Costs Avoided 2-48
Table 2-09: DWF / WWF Conditions 2-59
Table 2-10: Design Storm Conditions 2-59
Table 2-11: Example of Alternative Benefits 2-61
Table 2-12: Conveyance Alternative Benefits 2-62
Table 2-13: Conveyance Model Results 2-62
Table 2-14: Sewer Separation #1 Alternative Benefits 2-64
Table 2-15: Sewer Separation Alternative #1 Model Results 2-64
Table 2-16: Sewer Separation #2 Alternative Benefits 2-66
Table 2-17: Sewer Separation Alternative #2 Model Results 2-66
Table 2-18: Sewer Separation #3 Alternative Benefits 2-68
Table 2-19: Sewer Separation Alternative #3 Model Results 2-68
Table 2-20: Storage Alternative Benefits 2-70
Table 2-21: Storage Alternative Model Results 2-70
Table 2-22: Green #1 Alternative Benefits 2-71
Table 2-23: Green Infrastructure Alternative Model Results 2-71
Table 2-24: Optimized #1 Alternative Benefits 2-73
Table 2-25: Optimized Alternative Model Results 2-75
Table 2-26: Preferred Alternative Comparisons 2-75
Table 2-27: 5-Year Model Results For Separation #1A 2-77

Table 3-01: Recommended Stormwater Improvement Cost Estimates 3-3
Table 3-02: Trunk Storm Sewers 3-15
Table 3-03: Surface Transportation Project Cost Estimates 3-27
Table 4-01: Project Prioritization 4-2
Table 4-02: Project Ranking 4-3

Executive Summary

This Street Flooding Mitigation Plan is a multi-disciplinary study of community development related to transportation, stormwater management, and emergency services provisions and how to overcome issues that have been identified through on-going planning efforts of many local partners. Stakeholders in this process include the KYOVA Interstate Planning Commission, City of Huntington, Huntington Stormwater Utility, Cabell County Emergency Management, Marshall University, West Virginia Division of Highways, and the Federal Highway Administration.

The goal of the plan is evaluating and addressing mobility issues due to flooding and its effects on the City of Huntington. The City has long-standing problems with stormwater. When the city's sewer system was constructed more than a century ago, the stormwater and sewer systems were combined and remain so today. The system does not have the capacity to adequately handle the amount of stormwater runoff after a moderate rainfall event. Stormwater mixed with sewage backs up onto the streets, causing flooded roads and underpasses. Many of the most commonly flooded areas also happen to be located on major north-south and east-west connectors, which inhibit both regional and local traffic.

This plan addresses stormwater and transportation system improvements that will positively impact the traffic network and mitigation measures that can be taken to decrease the likelihood of future catastrophic events. Multi-modal in nature, this plan assesses the flow of vehicular traffic and the movement of public transit, bicycle, and pedestrian traffic throughout these problem areas. The primary issues that impact the study include:

Circulation

Multi-modal transportation issues abound in the area around the CSX rail network, with pedestrian traffic between parking areas, the downtown Central Business District, residential areas, and Marshall University. In addition, there is need for additional pedestrian and bike facilities connecting the main routes, additional options for circulation by all modes, and improved connections between parking and destinations.

The strategies have a common thread - each component of a transportation system contributes directly to the effectiveness of the other components. We cannot develop effective and efficient transportation options without first assessing the entire system and its successes and failures.

The project approach assessed all aspects of transportation, utilizing the resources that were available from KYOVA, the City of Huntington and others, but also supplementing that information with additional data collection and observation of the inter-relationship of the different travel modes. This perspective provided a holistic view of the system and provides surety that recommendations and implementation strategies complement each other and forward the overall goals of the network.
Stormwater & Green Infrastructure

Sustainability of the City's transportation network is obviously a high priority for residents and other stakeholders. This plan develops a green infrastructure strategy that complements the deficient storm system in key nodes and corridors around the community, especially considering the impacts those storm events have on the transportation network. Providing green solutions for water seamlessly integrates the sustainability goals of the community with the ability for future economic stability and growth.

The flood mitigation plan addresses stormwater improvements that will decrease the likelihood of nuisance flooding to the maximum extent practicable and provide a positive impact to the traffic network. The plan addresses the following locations:

- Flooding in five underpasses at 1st Street, 8th Street, 10th Street, 16th Street and 20th Street
- Street Flooding (5th Avenue and 3rd Avenue (US 60))

Implementation of Plans

As the recommendations were developed, the plan addresses City and MPO tools to carry forward those projects to construction. Planning-level cost estimates, project timelines, and funding opportunities are included to guide policy-makers through tough decisions.

The plan recommends development of nine unique projects that can all be broken down into subsections for phasing purposes, as appropriate. These projects are listed in **Table ES-1** below with additional details found in Chapter Three.

Table ES-1: Implementation of Plans

Project	Name	From	To	Timeframe (S,M,L)	Cost ($1,000)
1a	3rd Avenue Complete Street	25th Street	16th Street		
1b	3rd Avenue Complete Street	16th Street	13th Street		
2a	5th Avenue Complete Street Pt. 1	29th Street	20th Street		
2b	5th Avenue Complete Street Pt. 1	20th Street	16th Street		
2c	5th Avenue Complete Street Pt. 1	16th Street	13th Street		
3a	20th Street Underpass	8th Avenue	7th Avenue		
3b	20th Street Underpass	7th Avenue	5th Avenue		
4a	16th Street Underpass	8th Avenue	7th Avenue		
4b	16th Street Underpass	7th Avenue	5th Avenue		
5	Hal Greer Storm Separation	N/A	N/A		
6a	10th Street Underpass	8th Avenue	7th Avenue		
6b	10th Street Underpass	7th Avenue	5th Avenue		
7a	8th Street Underpass	8th Avenue	7th Avenue		
7b	8th Street Underpass	7th Avenue	5th Avenue		
8a	1st Street Underpass	8th Avenue	7th Avenue		
8b	1st Street Underpass	7th Avenue	5th Avenue		
9a	5th Avenue Complete Street Pt. 2	1st Street	6th Street		
9b	5th Avenue Complete Street Pt. 2	6th Street	10th Street		
9c	5th Avenue Complete Street Pt. 2	10th Street	13th Street		

Chapter 1. Introduction and Vision

Background

The KYOVA Interstate Planning Commission (IPC) undertook this street flooding mitigation plan to develop an approach to a unique problem – what can the City of Huntington do to alleviate flooding issues that affect traffic throughout downtown? This plan, attempts to address nuisance flooding through a multiple-pronged approach sensitive to the perspectives of many different agencies and organizations in the region. Flooding affects everyone and this plan addresses the direct impacts to the transportation system has and its effects on the entire population of Huntington.

Framework

The plan is broken into sections that will be useful to everyone from the average resident to project engineers and City Council members. Chapter Two addresses the discovery of data and existing information that could inform the planning process. This chapter includes information on planning resources, travel demand modeling, bicycle and pedestrian circulation, assessment of multimodal systems, travel economics, and emergency services. The study team compiled, reviewed, and assessed previous studies in problem areas around the city, placing high emphasis on main thoroughfares and underpasses that flood repeatedly including 3rd Avenue, 5th Avenue, 1st Street, 8th Street, 10th Street, 16th Street, and 20th Street.

The main objective of the plan is to create a comprehensive approach focusing on reducing street and nuisance flooding to the maximum extent possible. Chapter Three considers green infrastructure, separating the sewer system from the stormwater system, and creating a design template for rightsizing streets aimed at increasing utility of the transportation network for all users while minimizing the risk of flooding. The plan recommends a slate of projects that can be pursued by local leaders with support from the analysis provided herein.

Finally Chapter Four sets a phased implementation schedule for projects and identifies available funding sources at the local, state, regional, and national level. These projects are prioritized according to short, medium, and long-range timeframes.

Understanding

This Street Flooding Mitigation Plan is primarily a study of community development and how to overcome issues that have been identified through on-going planning efforts. Some of these issues are high-impact items that form the baseline of the planning process. Those issues include:

Circulation

Multi-modal transportation issues abound in the area around the CSX rail network, with pedestrian traffic between parking areas, the downtown Central Business District, residential areas, and Marshall University. In addition, there is a need for additional pedestrian and bike facilities connecting the main routes, options for circulation by all modes, and improved connections between parking and destinations.

Stormwater & Green Infrastructure

Sustainability of the City's transportation network is a high priority for residents and other stakeholders. Developing a stormwater strategy that complements the deficient storm system in key nodes and corridors around the community is a priority, especially considering the impacts those storm events have on the transportation network. Providing green solutions for water will seamlessly integrate the sustainability goals of the community with the ability for future economic stability and growth.

Implementation of Plans

The City and MPO need to have tools at their disposal to carry forward plan recommendations and vision to reality. This plan provides options for future funding of projects identified through the planning process.

Local Champions

Any planning and development exercise, no matter the scope, is poised to have an immense impact on the community. One of the highest priority components of this plan is to establish an open, accessible process whereby community members and other stakeholders can use the plan and its recommendations to champion project development and funding.

Chapter 2. Discovery and Analysis

Planning Resources

The purpose of this section is to identify the known planning resources and datasets that have been collected for the purpose of completing this plan. Through the use of these resources, the project team cooperatively developed this street flooding mitigation plan and implementation strategy. This plan meets the scope of work that has been developed in cooperation with KYOVA IPC and the City of Huntington.

The following resources have been identified and incorporated into the street flooding mitigation plan as available. This list represents questions from the project team and data requested from all disciplines involved in the planning process. This information assisted the team in achieving a comprehensive understanding of previous efforts and existing data pertaining to the effort.

Finance and Public Policy

- Zoning codes and implementation tools for the project area
- Grants in process that relate to this project
- Public financing mechanisms that have been used in the last 10 years

Stormwater & Green Infrastructure

The following stormwater system data was requested for CSO #12 sewershed to be able to model the existing sewer system:

1. GIS data for conveyance system assets like shapefiles for manholes, pipes, inlets/catch basins, pumps/pump stations, diversion chambers, regulators, outfalls, flap gates, storage data, topography (ground elevation data), weirs, orifices, subcatchments, etc. with the following attributes:
    a. Nodes (Invert elevation, rim elevation, ground elevation, max depth, bolted or sealed, type, etc.)
    b. Links (US node, DS node, length, material, type, US and DS offsets, size, shape, slopes)
    c. Pumps (pump curve, US and DS nodes, startup & shutoff depths, etc.)
    d. Weirs (type, crest and invert elevation, width, height, etc.)
    e. Orifice (type, crest and invert elevation, offset, etc.)
2. Contours, DTM or TIN surfaces.
3. Past reports/records of street flooding and/or basement back-ups within the watershed. This includes information on number of flood events, location and extent of flood, high water marks, roads affected during flood events, etc., including any photos of flooding.

Transportation

1. Current travel model - TransCAD
2. Current and past KYOVA Metropolitan Transportation Plans for last 10 years
3. KYOVA Congestion Management Process plan

4. City of Huntington Comprehensive Plan
5. Any bicycle / pedestrian planning documents from KYOVA and the City of Huntingon
6. KYOVA Downtown Huntington Access Study
7. GIS data layers
    a. Comprehensive plan for the City of Huntington
       (Land use layers – any future projections that may have been developed)
    b. Transportation routes
    c. Sidewalks and trails
    d. Census data to block level
    e. Localized data collected by KYOVA
    f. Travel Model outputs
    g. Aerial imagery from the Sheriff's Association
    h. Tax maps from the assessor's office
    i. Environmental layers
        i. Water
        ii. Wetlands

The following items were requested as part of the project but were not able to be provided. AECOM's recommendation is for KYOVA IPC and the City of Huntington to continue to work on the development of these datasets for future analysis and study.

1. Current development incentives used by the City of Huntington today (as well as any used in the past)
2. What transportation and public grants have been accessed in the last 10 years - such as TIGER, MAP-21, FEMA "Hazard Mitigation Grant", Department of Ecology- Competitive Flood Management grants, etc.
3. GIS data and information on existing land use, soil data, impervious and pervious areas, population data, receiving waters, known stream inflows, sediments in pipes
4. Field survey data on conveyance system assets like manholes, pipes, inlets/catch basins, pumps/ pump stations, diversion chambers, regulators, outfalls, flap gates, storage data, topography (ground elevation data), weirs, orifices, subcatchments, etc.
5. Pipeline inspection data/ CCTV videos
6. As-built drawings / record drawings of storm sewers and combined sewers located in the watershed and of various conveyance system assets

7. CAD drawings of the various conveyance system assets and roadway cross sections
8. Past H&H models of the combined sewer system and the dedicated storm sewer system (if any)
9. Combined sewer system and storm sewer system Hydraulic & Hydrologic Characterization Report(s)
10. Flow monitoring data within the sewershed (if any)
11. Rainfall / precipitation data (rain gages, radar rainfall, etc.)
12. Climate data (Temperature, wind speed, evaporation, snow etc.)
13. Other information, data or reports relevant to flooding in the watershed
14. Boundary condition data, such as river elevation, access-shaft HGL data, etc.
15. Brownfields
16. Housing statistics - Multi-family locations, densities, etc.
17. Employment projections at the smallest US Census geography available
18. Recreation and open space – existing and planned
19. Schools and school districts – bus routing

Travel Demand Model

The KYOVA 2040 Metropolitan Transportation Plan (MTP) used TransCAD to develop its latest iteration of a regional travel demand model. This model follows a four-step travel demand forecasting process of trip generation, trip distribution, mode split and trip assignment. Using the most recent assumptions from the 2040 Plan, this planning process has completed travel demand model runs to evaluate the traffic impacts of closing several flood-prone streets in the City of Huntington. The following section provides a description of the modeling methodology and the results of the impact analysis for the various street closure scenarios.

Base Year Model Calibration

The KYOVA regional travel demand model, the official Metropolitan Planning Organization model, maintained by the KYOVA IPC was used to evaluate traffic impacts of various street closure scenarios. **Figure 2-1** shows the boundary of the modeling analysis for the street closure locations analyzed in this study. Prior to using the model for any impact analysis, it is important that it replicates the existing travel conditions with reasonable accuracy especially in the study area. The model-estimated daily total two-way traffic volumes for the base year 2010 and the traffic counts are shown in **Figure 2-2**. There were several locations within the study area where the model volumes did not adequately match the traffic counts. This necessitated additional calibration to the base year model.

AECOM performed a calibration of the base year model by implementing an OD (Origin-Destination) matrix adjustment process. This process seeks to adjust the OD matrix to obtain assigned traffic volumes on the model network that closely match the actual traffic counts in the study area. **Figure 2-3** shows the total two-way daily model volumes and counts after the calibration process. The majority of the model volumes within the study area match the counts closely.

Figure 2-01: Study Area

Figure 2-02: Base Year Validation Check (Before Calibration)

Figure 2-03: Base Year Validation Check (After Calibration)

Future Year Model

The KYOVA model included a 2040 MTP Future Conditions scenario, which was used as the "No-Build" scenario (or "No-Closure" scenario) for the street closure modeling analysis. The trip table updates performed in the calibration year 2010 were carried forward to the 2040 No-Build scenario and an assignment run performed to obtain No-Build traffic volumes in the study area. **Figure 2-04** shows the future year No-Build scenario as an illustration of typical traffic patterns before any of the closures occur.

Thirteen street closure scenarios were analyzed for the 2040 conditions. Seven of these scenarios involved the closure of only one street and the remaining involved closing two or more streets in various combinations. The streets determined to be the most prone to flooding were identified by KYOVA IPC staff and stakeholders; the link in the model network representing these streets were deleted per the scenarios described below. Note that for each of the closure scenarios, the No-Build trip table was used to assign trips to the network that had the closure. This approach is suitable for short-term impacts and ensures that the impacts are due only to the re-routing of the trips and not also due to the changes in the trip distribution pattern that may occur when streets are closed. Long-term impacts of street closures could include shift in ODs or even loss in some trips.

Scenario 1 – Close 1st Street

In this scenario, 1st Street was assumed to be closed. **Figure 2-05** shows the model volumes for this scenario and the impacts of the closure on congestion (as measured by a ratio of volume to capacity). Traffic diverts to the parallel roadways with the highest diversion being to 8th Street (increase of about 7,100 vehicles/day). The diversions diminish further away from 1st Street.

Scenario 2 – Close 8th Street

In this scenario, 8th Street was assumed to be closed. **Figure 2-06** shows the model volumes for this scenario and the impacts of the closure on congestion. Traffic diverts primarily to 1st, 10th and 16th Streets when 8th Street is closed.

Scenario 3 – Close 10th Street

10th Street was assumed to be closed in this scenario. The model volumes and the impacts of the closure on congestion for this scenario are shown in **Figure 2-07**. Traffic diverts to the parallel roadways with the greatest diversion being to 8th Street (about 5,000 vehicles/day).

Scenario 4 – Close 16th Street

16th Street was assumed to be closed in this scenario. The model volumes for this scenario are shown in **Figure 2-08** as well as the impacts of the closure on congestion. About 10,000 vehicles/day divert to the nearby 20th Street with relatively fewer diversions to 1st, 8th and 10th Streets, which are further away.

Scenario 5 – Close 20th Street

In this scenario, 20th Street was assumed to be closed. **Figure 2-09** shows the model volumes for this scenario and the impacts of the closure on congestion. The greatest diversion is to nearby 16th Street (increase of about 6,200 vehicles/day).

Scenario 6 – Close 5th Ave

In this scenario, 5th Ave was assumed to be closed. **Figure 2-10** shows the model volumes for this scenario and the impacts of the closure on congestion. The impact of the closure is minimal on the underpasses (except for nearby 20th St) as it is much further away from those roadways and serves the east-west movement, as opposed to the north-south movement served by the underpasses.

Scenario 7 – Close 3rd Ave

3rd Ave was assumed to be closed in this scenario. The model volumes for this scenario are shown in **Figure 2-11**, along with the impacts of the closure on congestion. As in Scenario 6, the impact of the closure is relatively minor on the underpasses except for 20th St.

Scenario 8 – Close 16th and 20th Streets

This scenario analyzed the impacts of closing both 16th and 20th Streets. **Figure 2-12** shows the model volumes for this scenario and the impacts of the closure on congestion. Traffic on 10th Street increases by about 10,000 vehicles/day and about 8,700 vehicles/ day on 8th Street when both 16th and 20th Streets are closed.

Scenario 9 – Close 3rd and 5th Streets

This scenario analyzed the impacts of closing 3rd and 5th Avenues. **Figure 2-13** shows the model volumes for this scenario and the impacts of the closure on congestion. The impact is minimal on the underpasses as they serve movements in a different direction compared to the 3rd and 5th Avenues. An increase of 7,800 vehicles/day is expected on 20th Street under this closure scenario.

Scenario 10 – Close 16th, 20th, 3rd and 5th Streets

In this scenario, the impacts of closing 16th, 20th, 3rd and 5th Streets were analyzed. The model volumes for this scenario are shown in **Figure 2-14** with the impacts of the closure on congestion. Due to multiple roadways being closed in this scenario, the impact is relatively larger compared to the previous scenarios. Diversions as high as about 19,000 vehicles/day are expected on 10th Street and about 14,200 vehicles/ day on 8th Street.

Scenario 11 – Close all underpasses

All the underpasses (1st, 8th, 10th, 16th and 20th Streets) were assumed to be closed in this scenario. The model volumes for this scenario are shown in **Figure 2-15** with the impacts of the closure on congestion. The diversions have a much larger impact and affect both 3rd and 5th Avenues, as vehicles have to detour further away from their original route. Traffic increases of about 12,000 to 13,000 vehicles/day can be expected on 3rd and 5th Avenues in this scenario.

Scenario 12 – Close all underpasses, 3rd and 5th Avenues

All seven flood-prone streets were assumed to be closed in this scenario. **Figure 2-16** shows the model volumes for this scenario and the impacts of the closure on congestion. This scenario has the greatest impact on the volumes in the study area with the effects extending further away from the closure locations compared to the other scenarios.

Scenario 13 – Close all flood-prone streets except 1st Street

In this scenario, 1st Street was assumed to remain open with the remaining six flood-prone streets closed. **Figure 2-17** shows the model volumes for this scenario and the impacts of the closure on congestion. As many as 36,000 vehicles are expected to divert to 1st Street when all of the other six flood-prone roadways are assumed to be closed.

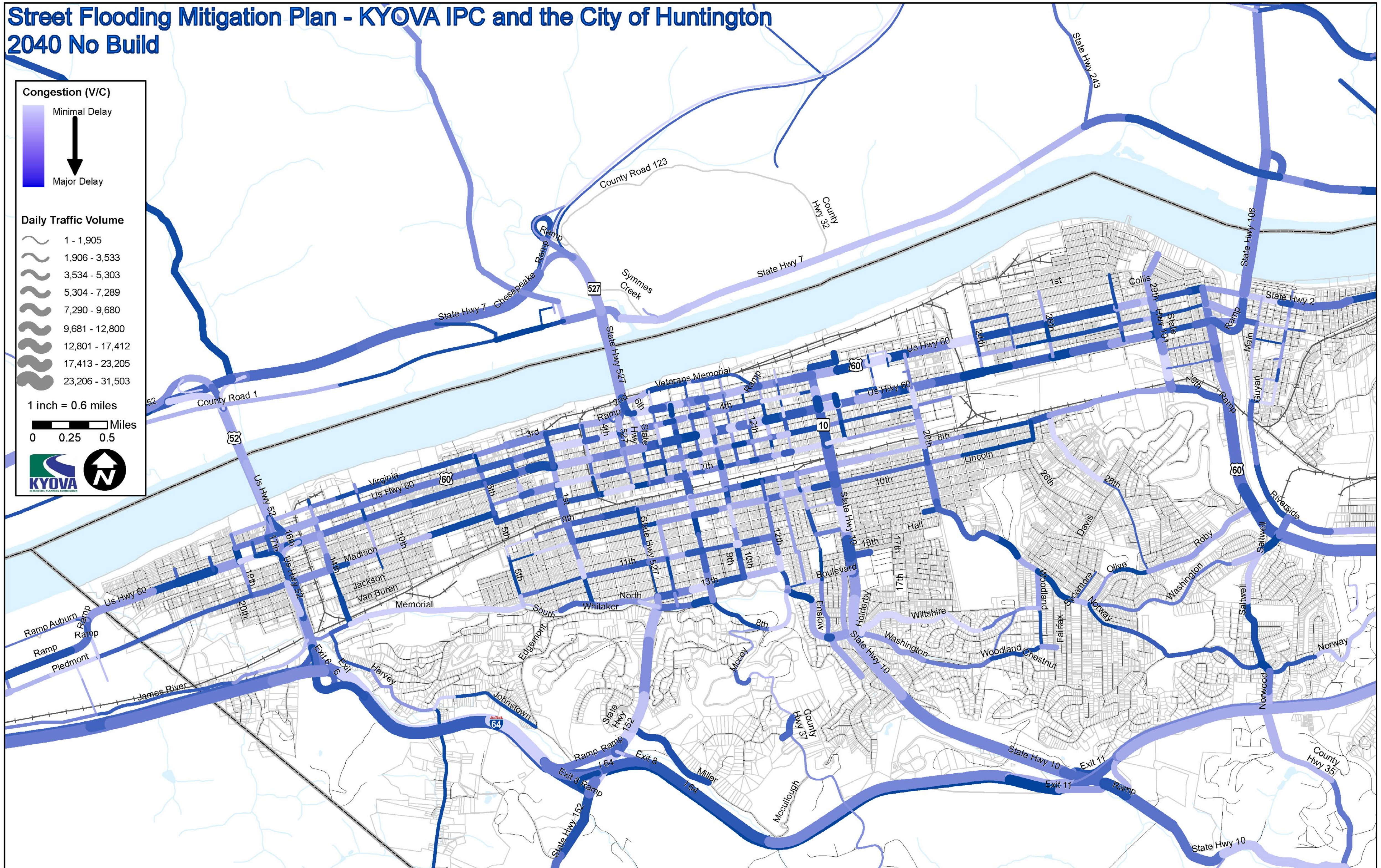


Figure 2-04: Future Year No-Build Conditions

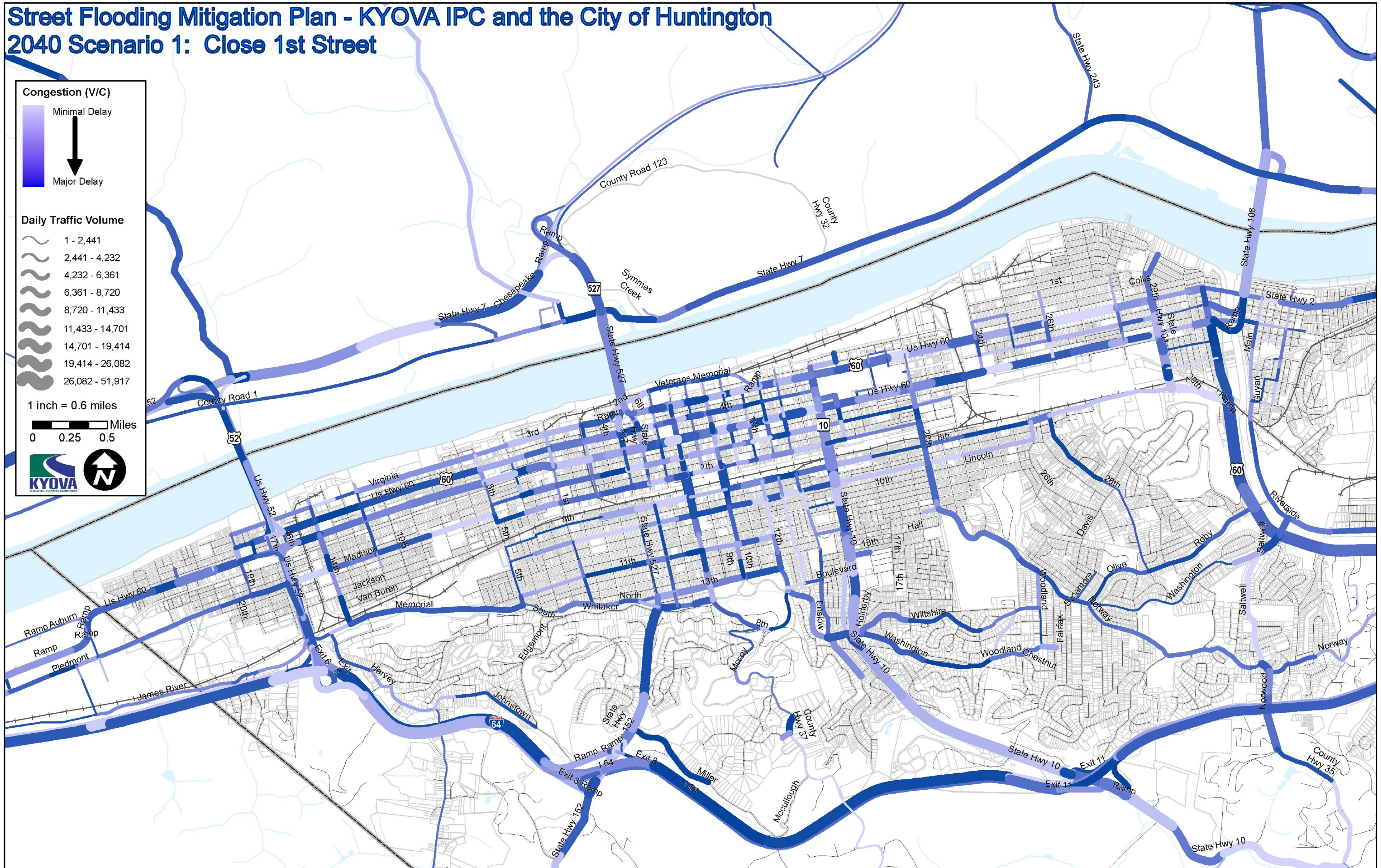


Figure 2-05: Scenario 1 Impacts

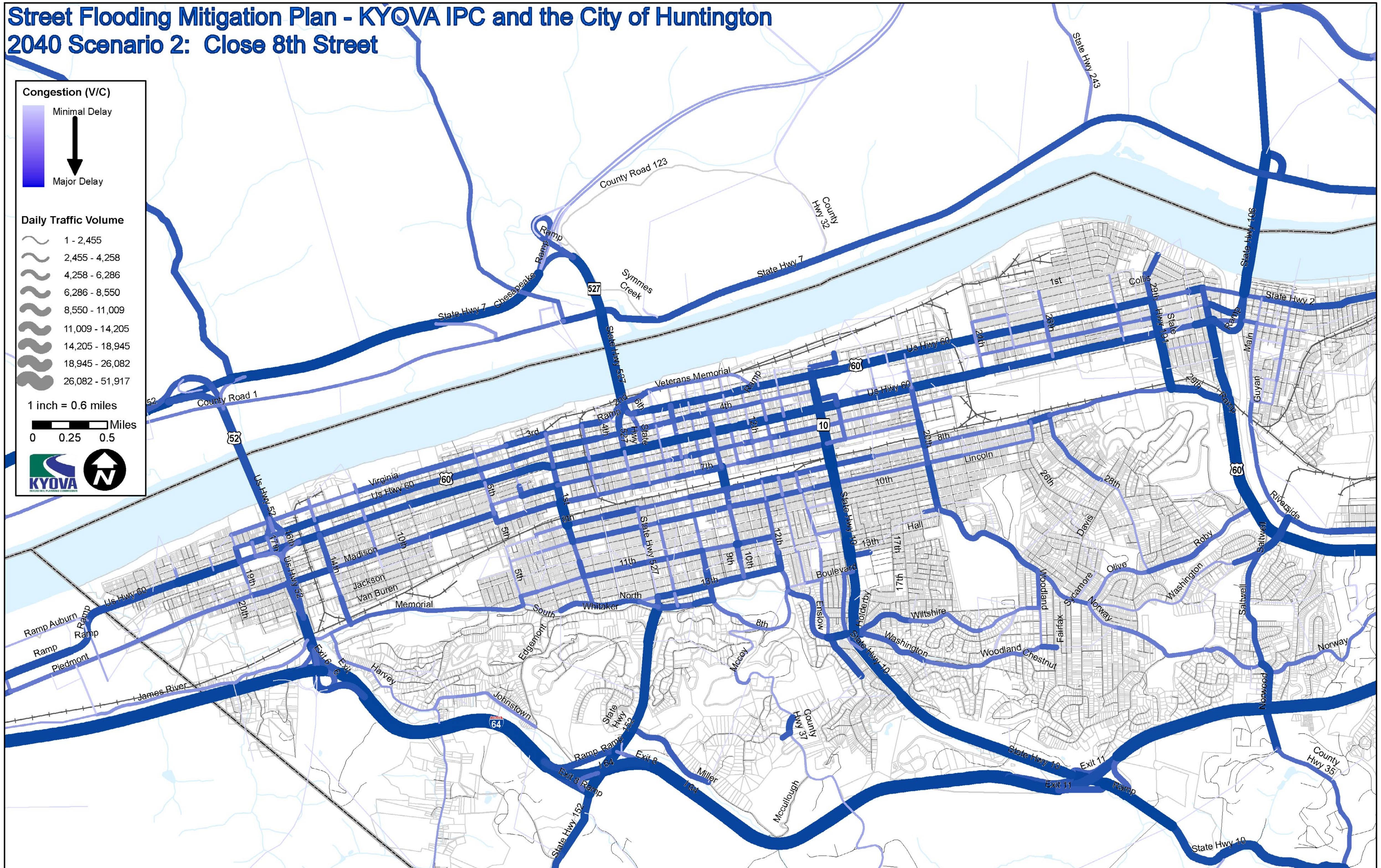


Figure 2-06: Scenario 2 Impacts

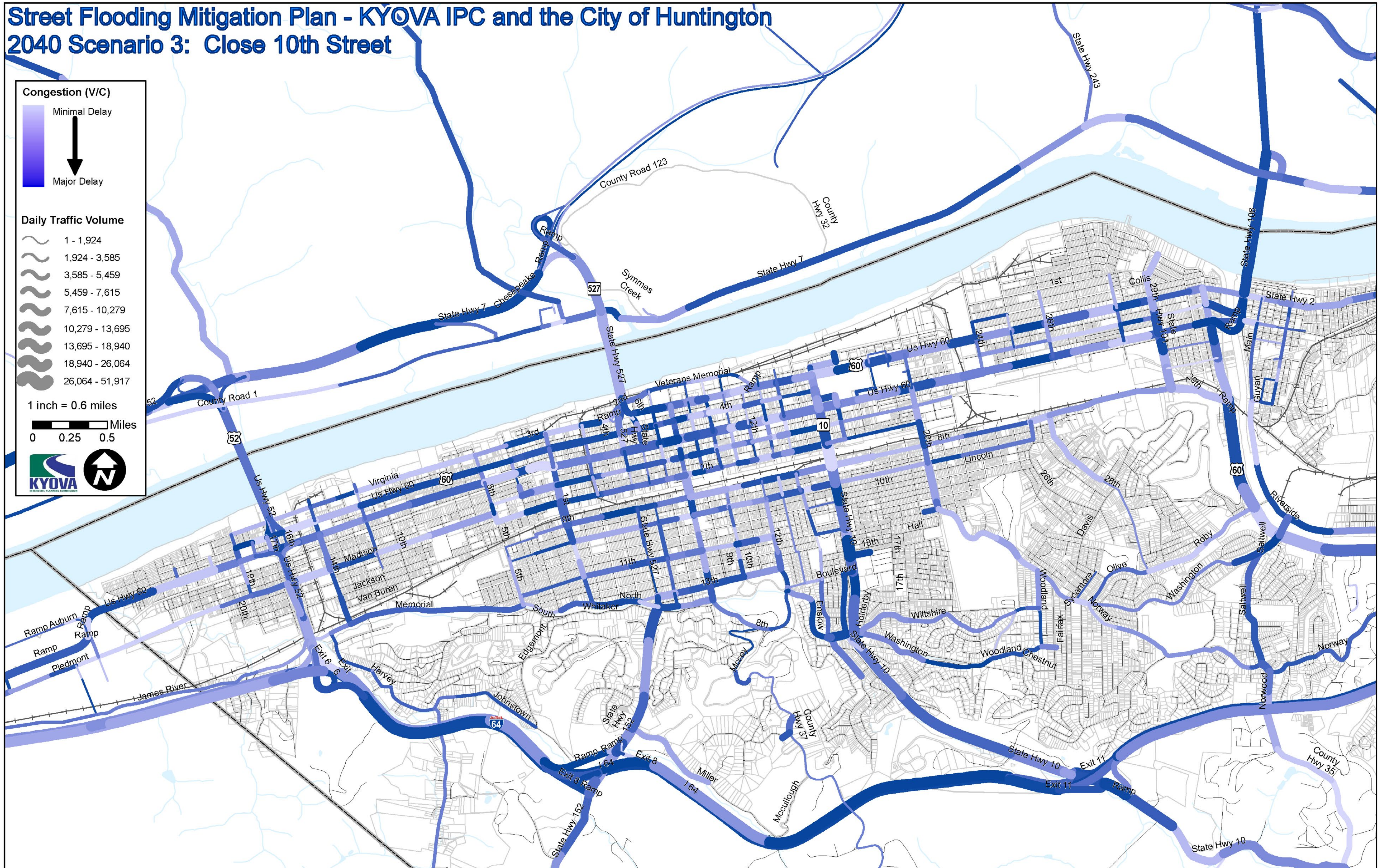


Figure 2-07: Scenario 3 Impacts

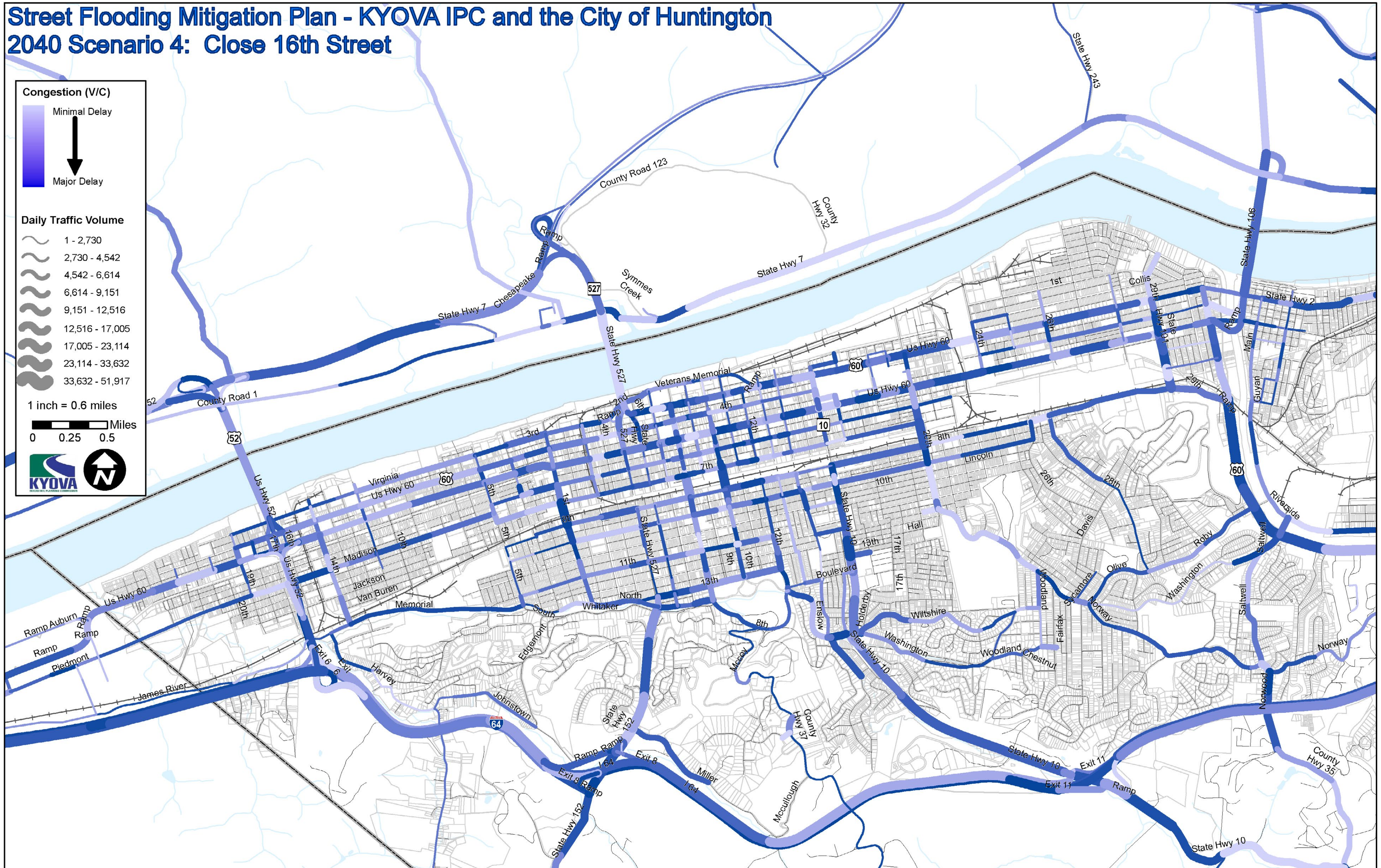


Figure 2-08: Scenario 4 Impacts

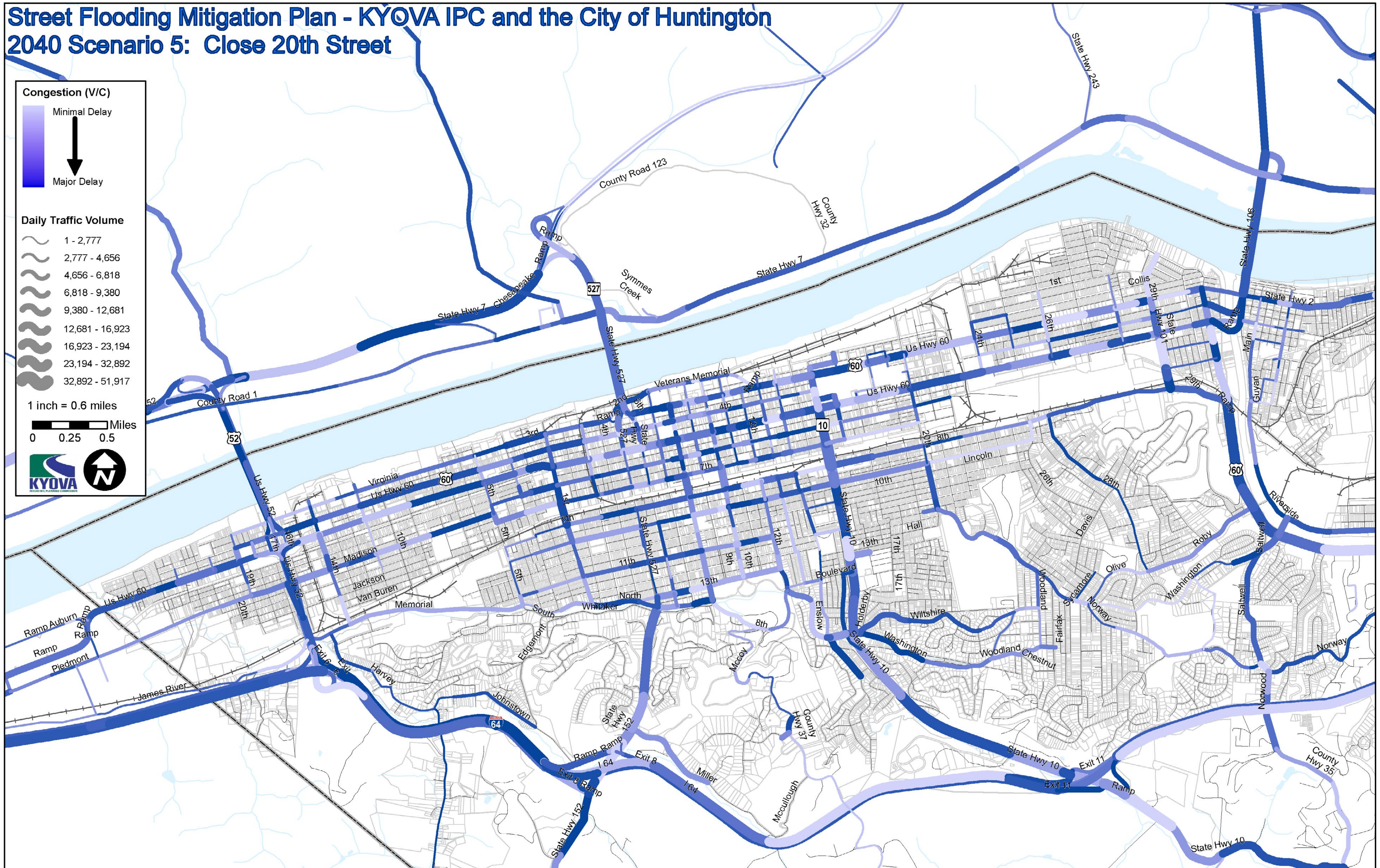


Figure 2-09: Scenario 5 Impacts

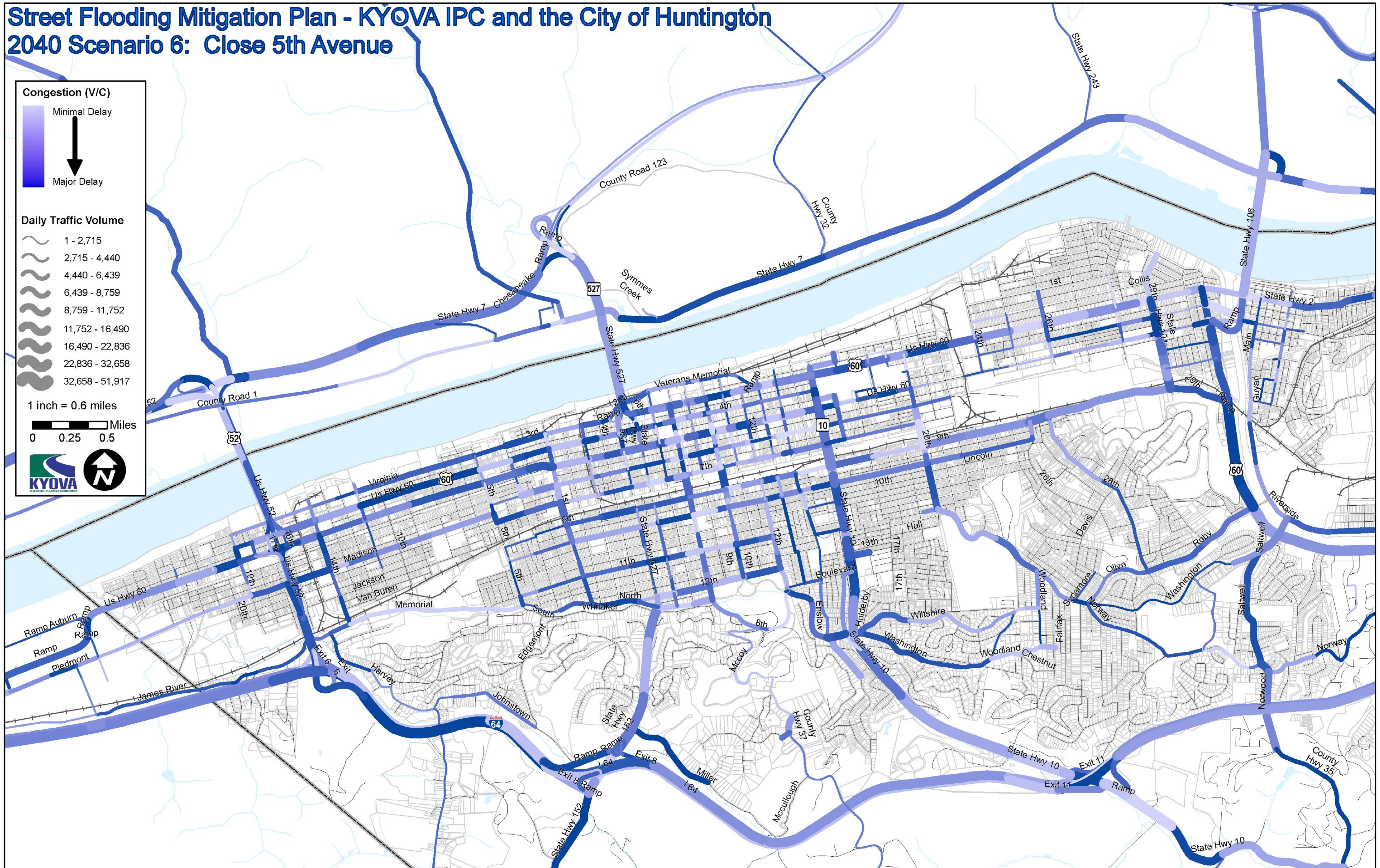


Figure 2-10: Scenario 6 Impacts

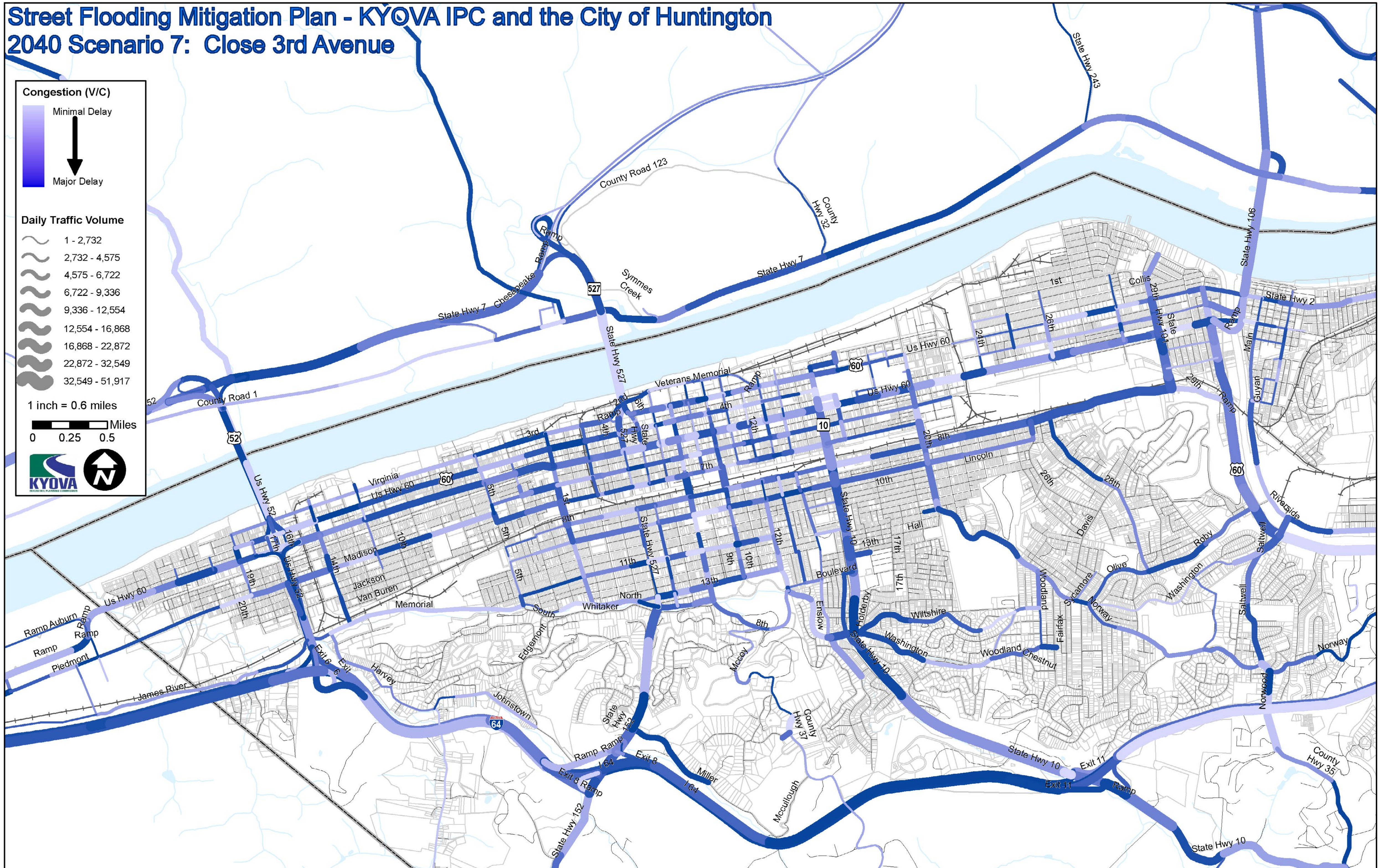


Figure 2-11: Scenario 7 Impacts

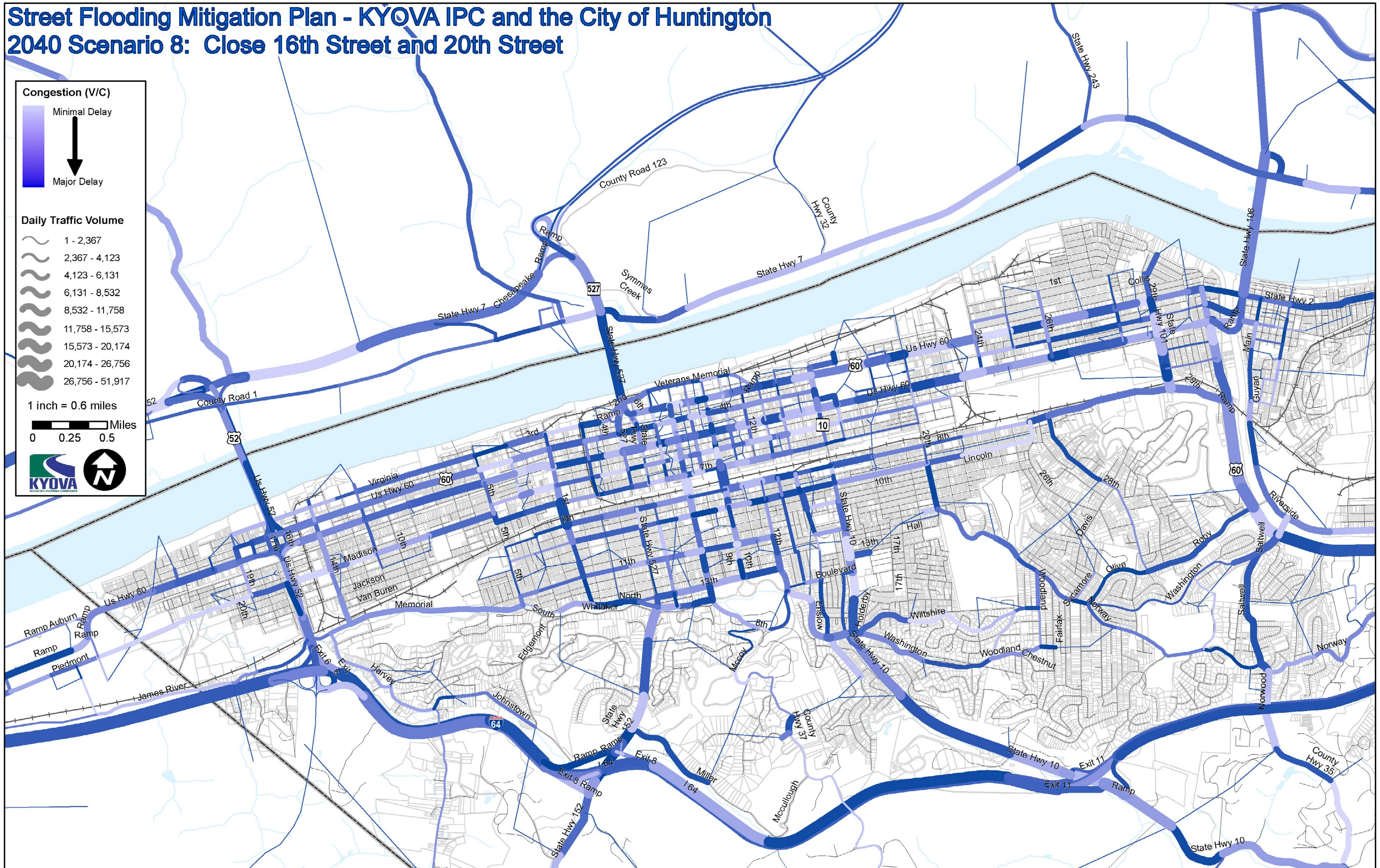


Figure 2-12: Scenario 8 Impacts

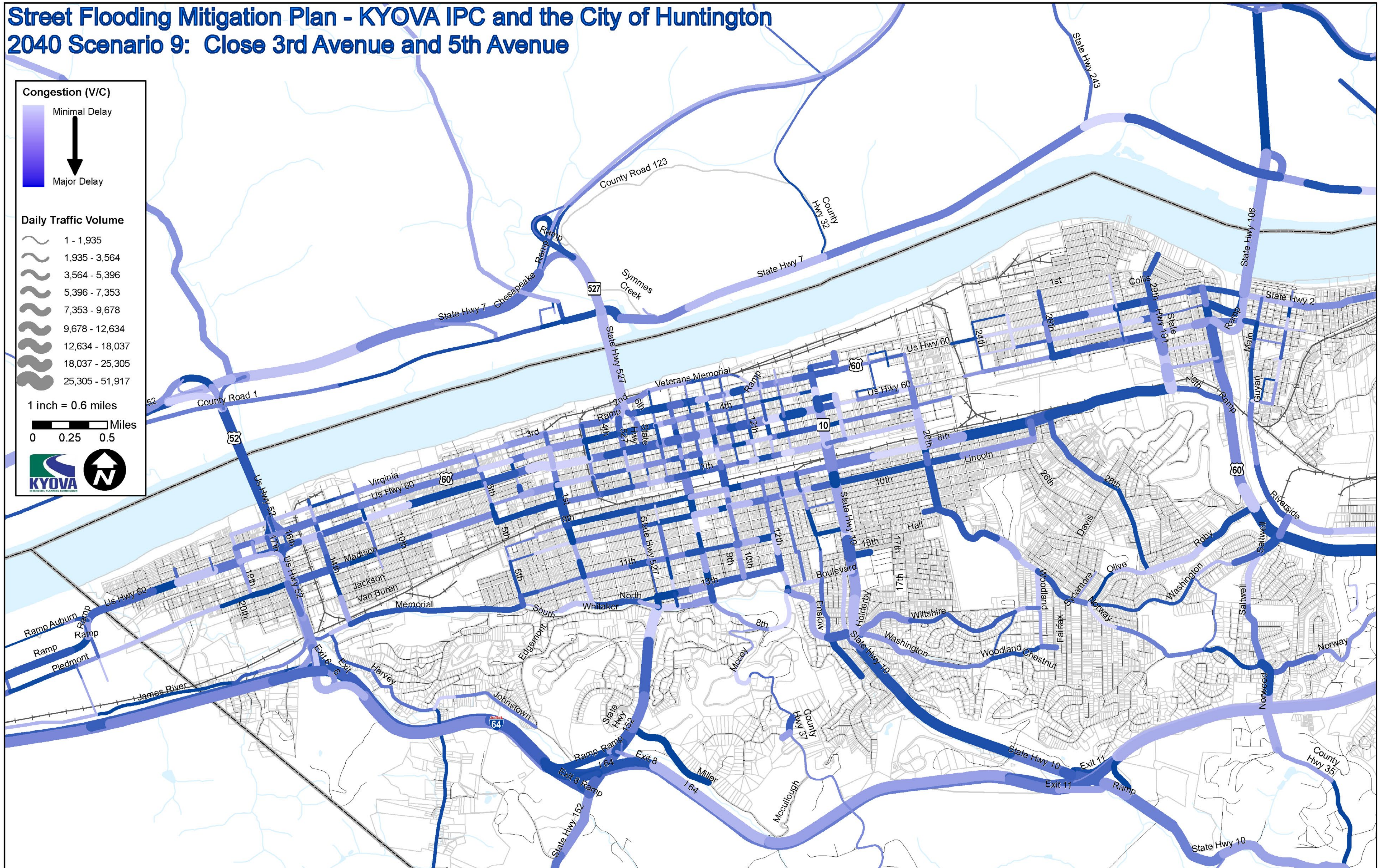


Figure 2-13: Scenario 9 Impacts

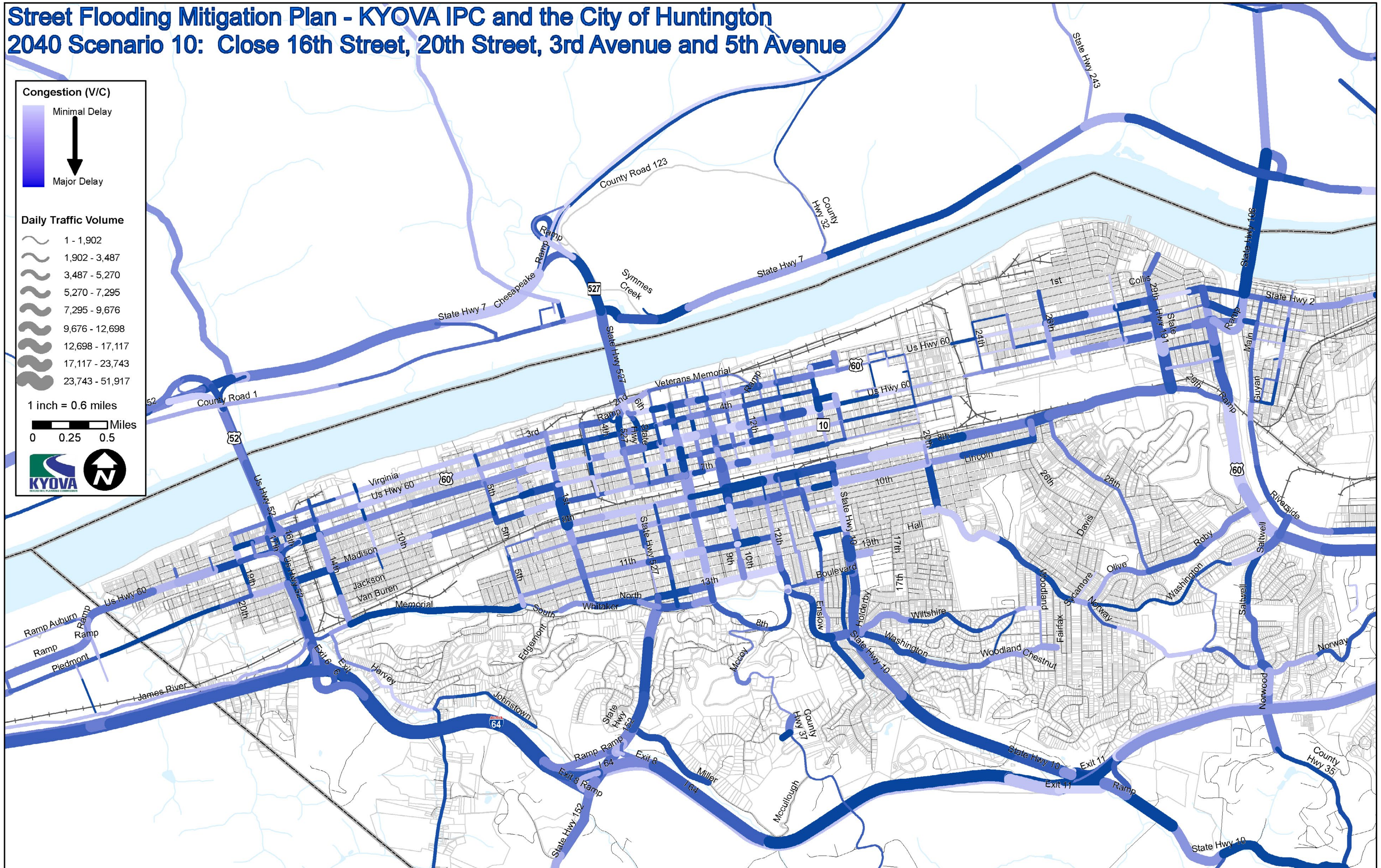


Figure 2-14: Scenario 10 Impacts

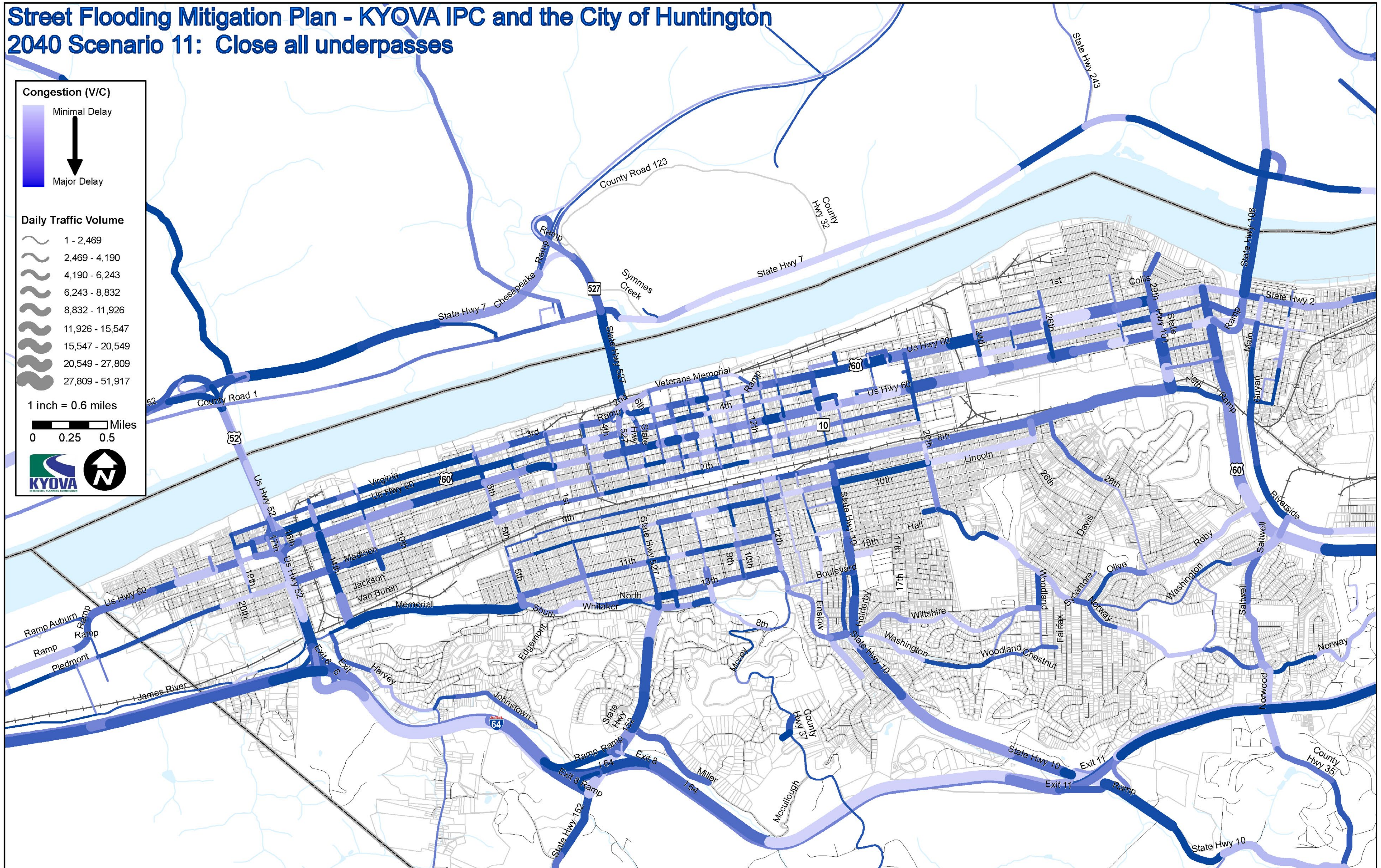


Figure 2-15: Scenario 11 Impacts

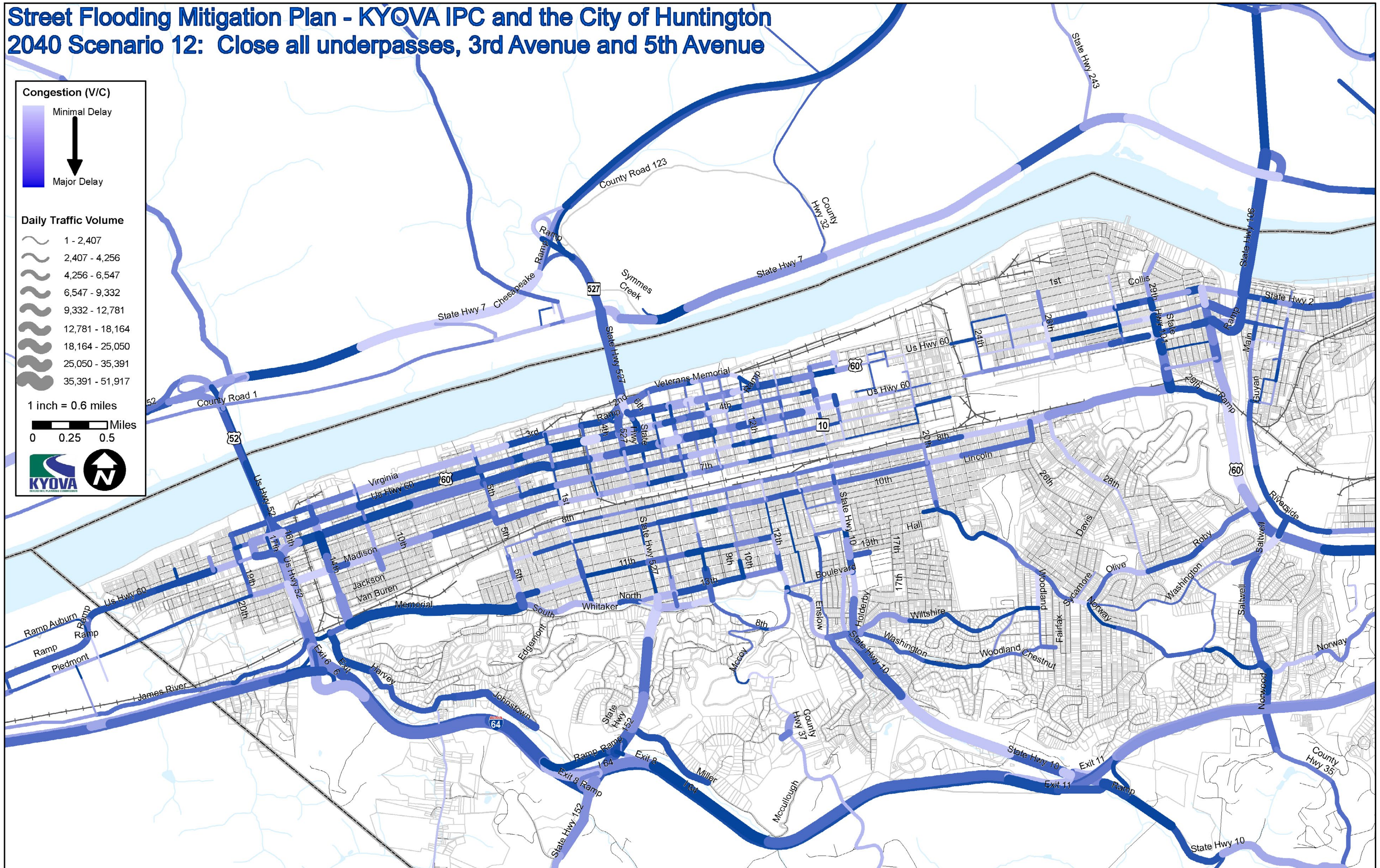


Figure 2-16: Scenario 12 Impacts

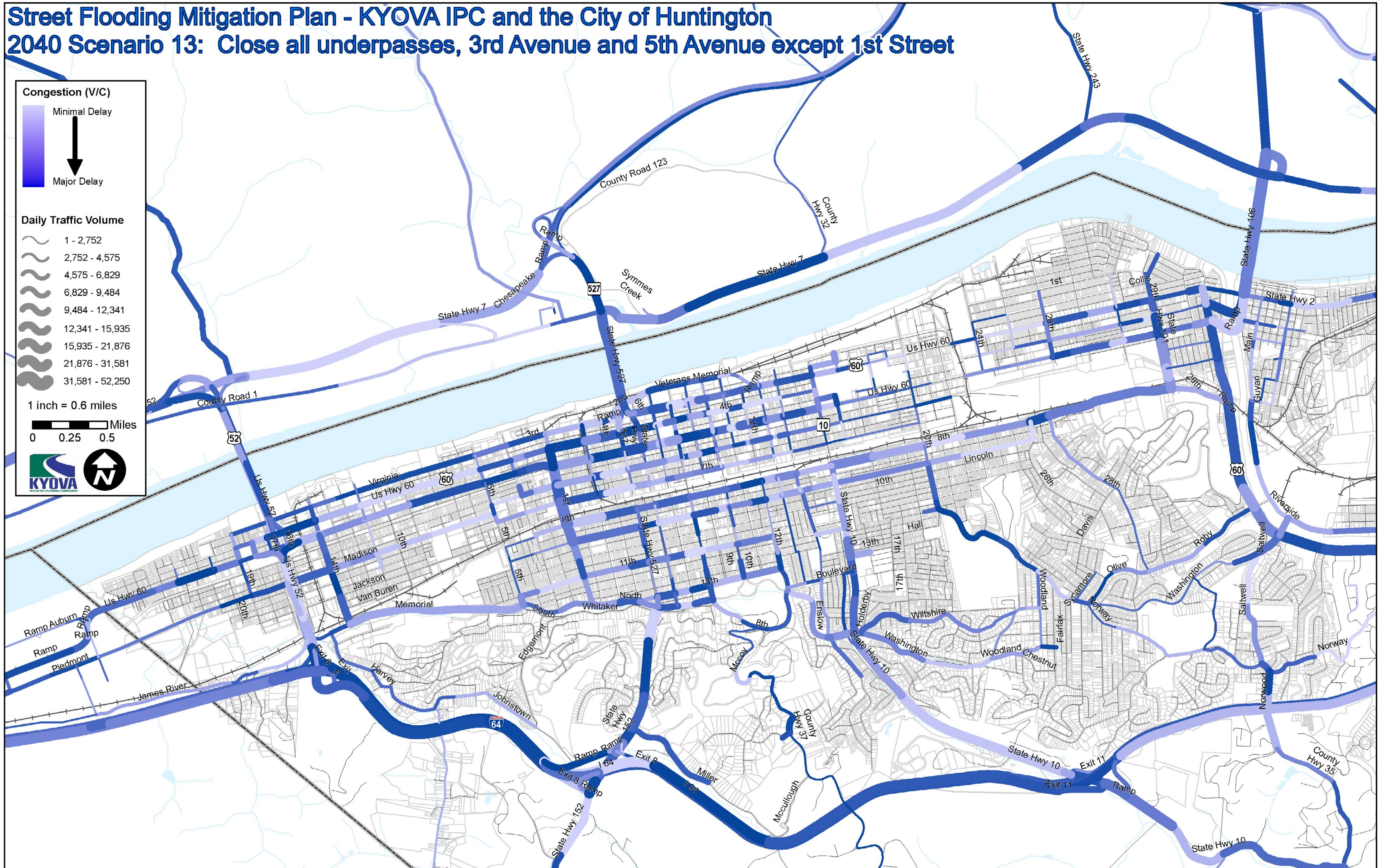


Figure 2-17: Scenario 13 Impacts

Summary of Traffic Impacts

The performance measures that were deemed to be appropriate to evaluate the traffic impacts of the street closures were traffic volumes, VMTs (vehicle-miles traveled) and VHTs (vehicle-hours traveled). These measures were generated for the various closure scenarios and compared to that for the No-Build scenario.

Table 2-01 shows the traffic volume impacts of the street closures by scenario. In each scenario, traffic diverts on to the roadways parallel to the street being closed. The magnitude of the diversions depends on the location of the closure and the traffic volumes on that roadway in the No-Build scenario. In general, if the roadway carried higher volumes, the impact is greater.

Table 2-01: Traffic Impacts of Street Closures

Scenario		Location						
		1st Street	8th Street	10th Street	16th Street	20th Street	5th Ave	3rd Ave
2040 No-Build	Volume	16,260	12,530	12,570	28,620	9,750	15,460	16,950
Scenario 1: Close 1st Street	Volume	0	19,690	15,590	30,860	10,120	15,410	17,000
	Impact	-16,260	7,160	3,020	2,240	370	-50	50
Scenario 2: Close 8th Street	Volume	20,020	0	16,960	31,160	10,050	15,360	16,990
	Impact	3,760	-12,530	4,390	2,540	300	-100	40
Scenario 3: Close 10th Street	Volume	18,510	17,600	0	32,090	10,170	15,360	16,950
	Impact	2,250	5,070	-12,570	3,470	420	-100	0
Scenario 4: Close 16th Street	Volume	18,920	17,680	17,730	0	20,100	15,440	17,360
	Impact	2,660	5,150	5,160	-28,620	10,350	-20	410
Scenario 5: Close 20th Street	Volume	16,450	13,390	13,420	34,910	0	15,510	16,920
	Impact	190	860	850	6,290	-9,750	50	-30
Scenario 6: Close 5th Ave	Volume	16,180	12,800	12,650	28,610	13,820	0	14,840
	Impact	-80	270	80	-10	4,070	-15,460	-2,110
Scenario 7: Close 3rd Ave	Volume	16,310	12,830	12,830	27,790	13,970	13,310	0
	Impact	50	300	260	-830	4,220	-2,150	-16,950
Scenario 8: Close 16th & 20th	Volume	21,700	21,260	22,610	0	0	16,470	17,940
	Impact	5,440	8,730	10,040	-28,620	-9,750	1,010	990
Scenario 9: Close 3rd and 5th Aves	Volume	16,230	12,970	12,630	28,170	17,570	0	0
	Impact	-30	440	60	-450	7,820	-15,460	-16,950
Scenario 10: Close 16th, 20th, 3rd and 5th	Volume	24,350	26,800	31,540	0	0	0	0
	Impact	8,090	14,270	18,970	-28,620	-9,750	-15,460	-16,950

Table 2-01: Traffic Impacts of Street Closures (cont.)

Scenario		Location						
		1st Street	8th Street	10th Street	16th Street	20th Street	5th Ave	3rd Ave
Scenario 11: Close all underpasses	Volume	0	0	0	0	0	28,930	29,140
	Impact	-16,260	-12,530	-12,570	-28,620	-9,750	13,470	12,190
Scenario 12: Close all underpasses, 3rd, 5th	Volume	0	0	0	0	0	0	0
	Impact	-16,260	-12,530	-12,570	-28,620	-9,750	-15,460	-16,950
Scenario 13: Close all except 1st	Volume	52,250	0	0	0	0	0	0
	Impact	35,990	-12,530	-12,570	-28,620	-9,750	-15,460	-16,950

Table 2-02 shows the daily VMT and VHT impacts of the closure scenarios within the study area boundary. The impact is a function of the location of the street closed and its volumes in the No-Build scenario. The impact is typically greater when multiple roadways are closed compared to when only one street is closed. Also, the impact of closing multiple roadways is greater than the sum of the individual closure impact, as the vehicles would have to divert much further away if multiple roads are closed.

Table 2-02: 2040 Daily VMT and VHT Impacts of Street Closures

Scenario	Measure		Impact	
	VMT	VHT	VMT	VHT
2040 No-Build	940,200	31,400		
2040 Scenario 1 (Close 1st Street)	947,600	32,100	7,400	700
2040 Scenario 2 (Close 8th Street)	940,900	31,600	700	200
2040 Scenario 3 (Close 10th Street)	940,900	31,600	700	200
2040 Scenario 4 (Close 16th Street)	943,200	32,000	3,000	600
2040 Scenario 5 (Close 20th Street)	942,000	31,600	1,800	200
2040 Scenario 6 (Close 5th Ave)	946,100	32,000	5,900	600
2040 Scenario 7 (Close 3rd Ave)	948,500	32,300	8,300	900
2040 Scenario 8 (Close 16th and 20th Streets)	953,700	32,800	13,500	1,400
2040 Scenario 9 (Close 3rd and 5th Aves)	956,700	32,500	16,500	1,100
2040 Scenario 10 (Close 16th, 20th, 3rd and 5th)	982,400	35,800	42,200	4,400
2040 Scenario 11 (Close all underpasses)	1,113,700	45,600	173,500	14,200
2040 Scenario 12 (Close all underpasses, 3rd, 5th)	1,209,600	62,600	269,400	31,200
2040 Scenario 13 (Close all underpasses except 1st, Close 3rd, 5th)	1,063,900	45,500	123,700	14,100

Bicycle and Pedestrian Circulation

According to the US Department of Transportation, a well-connected transportation network reduces the distances traveled to reach destinations, increases the options for routes of travel, and can facilitate walking and bicycling. Well-connected, multimodal networks are characterized by seamless bicycle and pedestrian infrastructure, direct routing, accessibility, few dead-ends, and few physical barriers. Increased levels of connectivity are associated with higher levels of physical activity from transportation. Connectivity via transportation networks can also improve health by increasing access to health care, goods and services, and other resources.

Strategies to improve pedestrian and bicycle connectivity include:

- Short block lengths
- Implementation of a Complete Streets policy
- Bicycle/pedestrian outlets for cul-de-sacs and dead ends
- Prioritization of multimodal access to public transportation
- Safe and visible bicycle and pedestrian facilities

The primary method by which pedestrians can make reasonable connections and increase walking activity in Huntington is to have multiple options to use the city transportation network. These options include providing sidewalks throughout the network. Identifying gaps in the existing system will help officials make choices to expend funds for repairs. In a similar manner, the best opportunities for encouraging bicycling include dedicated lanes (where possible) or wider shoulders, but at a minimum should include options for safe bicycle travel on the same road network that motorized vehicles use. Adequate sight lines and driver awareness advance bicycling safety in most cases.

The existing network of sidewalks is mostly complete for much of the study area (see **Figure 2-18**). Pedestrian circulation experiences very little disruption due to lack of proper facilities in all but a small number of locations. One goal for this project is to provide as many opportunities for pedestrian travel as possible; the best way to do that is to make connections between common destinations through repairs or new construction of sidewalks and other pedestrian pathways.

The following section highlights the main locations within the study area that require further attention and development. **Figures 2-19** through **2-25** identify unique locations that should receive additional scrutiny when future sidewalk funding opportunities arise.

Circulation Area #1

Figure 2-19 shows the Marshall University Main Campus and areas adjacent to the east and south. The bicycle and pedestrian facilities in this area are in very good condition compared to the rest of the study area and provide comprehensive coverage of the transportation network.

Sidewalks are consistent around campus and along 3rd Avenue and 5th Avenue. These two one-way corridors are very wide and allow adequate spacing for safe bicycle travel with traffic. The sidewalk coverage to the south along 7th Avenue begins to break down, with inconsistent lengths of sidewalk on the south side of 7th Avenue and around the Village on 6th Avenue.

In this area around campus, there is a consistent network of alleys that are mostly underutilized for point-to-point travel. These alleys are broken up by the non-traditional institutional structures at Marshall University, but have potential to serve as an additional avenue for non-motorized inner city travel.

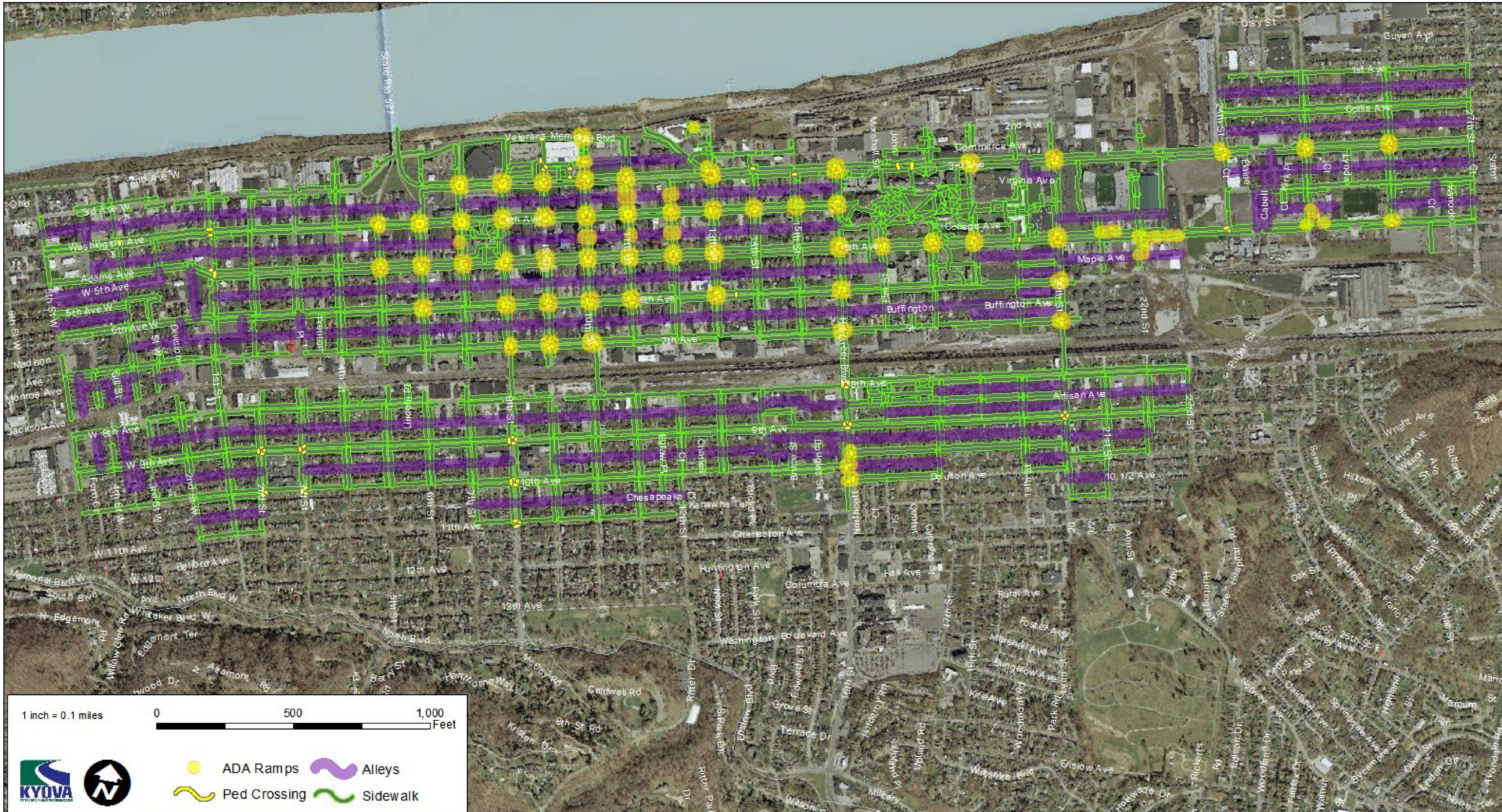


Figure 2-18: Existing Bicycle & Pedestrian Circulation

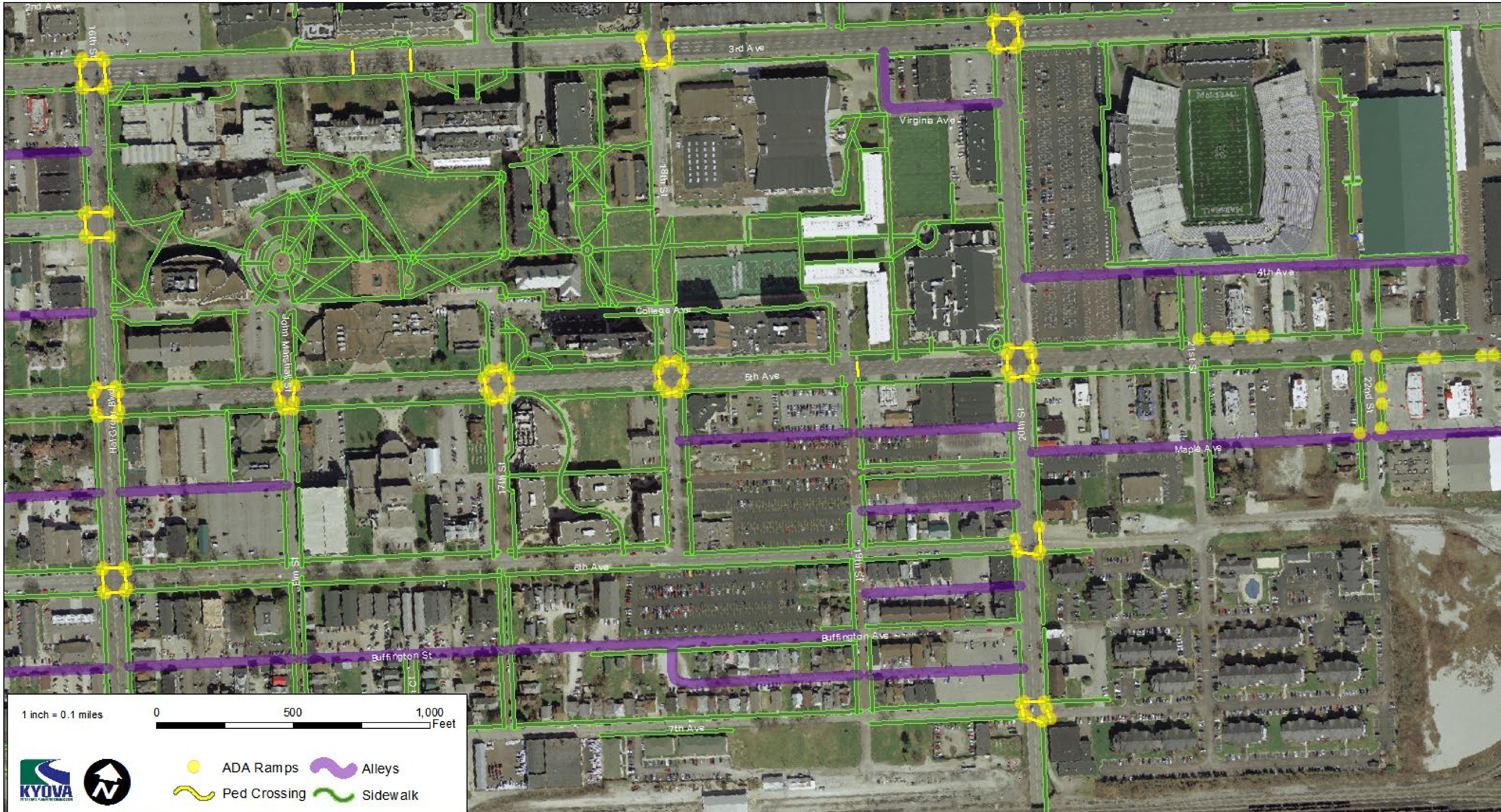


Figure 2-19: Circulation Area #1

ADA-compliant ramps and crosswalks are in place immediately around the Marshall campus, but are missing between 5th Avenue and 7th Avenue except for the intersections at Hal Greer Boulevard and 20th Street.

Circulation Area #2

The next area to consider is illustrated in **Figure 2-20** and shows the south side of the CSX railroad facility between Hal Greer Boulevard and 20th Street. The bicycle and pedestrian facilities in this area are in fair condition compared to the rest of the study area and provide focused coverage of the transportation network especially on the north side of this area.

Sidewalks are consistent between 8th Avenue and 10th Avenue. 8th Avenue is a highly travelled commuter corridor and has daily traffic volumes averaging 8,308 vehicles/day in the future No-Build scenario. Moving south from 8th Avenue, the streets are residential in nature and although they are not wide, low traffic volumes and speeds allow for safe bicycle travel with traffic.

In this area the network of alleys is very consistent and is mostly underutilized for point-to-point travel. These alleys have potential to serve as an additional avenue for non-motorized inner city travel.

No ADA-compliant ramps are present in this part of Huntington, except for a cluster of ramps on Hal Greer Boulevard between 10th Avenue and Doulton Avenue. Crosswalks are also missing for most of this area except along Hal Greer Boulevard and on 9th Avenue at 20th Street.

Circulation Area #3

Figure 2-21 shows the south side of the CSX railroad facility between Hal Greer Boulevard and 10th Street. The bicycle and pedestrian facilities in this area are in fair condition compared to the rest of the study area and provide inconsistent coverage of the transportation network.

Sidewalks are consistent along 9th Avenue and the south side of 8th Avenue. 8th Avenue is a highly travelled commuter corridor and has daily traffic volumes averaging 8,746 vehicles/day in the future No-Build scenario. The north side of 8th Avenue has a long stretch of missing sidewalk that would help to provide essential connections from this neighborhood to the underpasses. Other than the higher volume on 8th Avenue, the streets are residential in nature and although they are not wide, low traffic volumes and speeds allow for safe bicycle travel with traffic.

In this area the network of alleys is very consistent and is mostly underutilized for point-to-point travel. These alleys have potential to serve as an additional avenue for non-motorized inner city travel.

No ADA-compliant ramps are present in this part of Huntington, except for a cluster of ramps on Hal Greer Boulevard between 10th Avenue and Doulton Avenue. Crosswalks are also missing in this area.

Circulation Area #4

Figure 2-22 shows the south side of the CSX railroad facility between 10th Street and 1st Street. The bicycle and pedestrian facilities in this area are in good condition compared to the rest of the study area and provide consistent coverage of the transportation network, except for a few spots in critical locations.

Sidewalks are consistent along 8th Avenue and the other main corridors, except for a few very critical locations between 8th Street and 10th Street on 8th Avenue that would help to provide essential connections from this neighborhood to the underpasses. 8th Avenue is a highly travelled commuter corridor and has

Figure 2-20: Circulation Area #2

Figure 2-21: Circulation Area #3

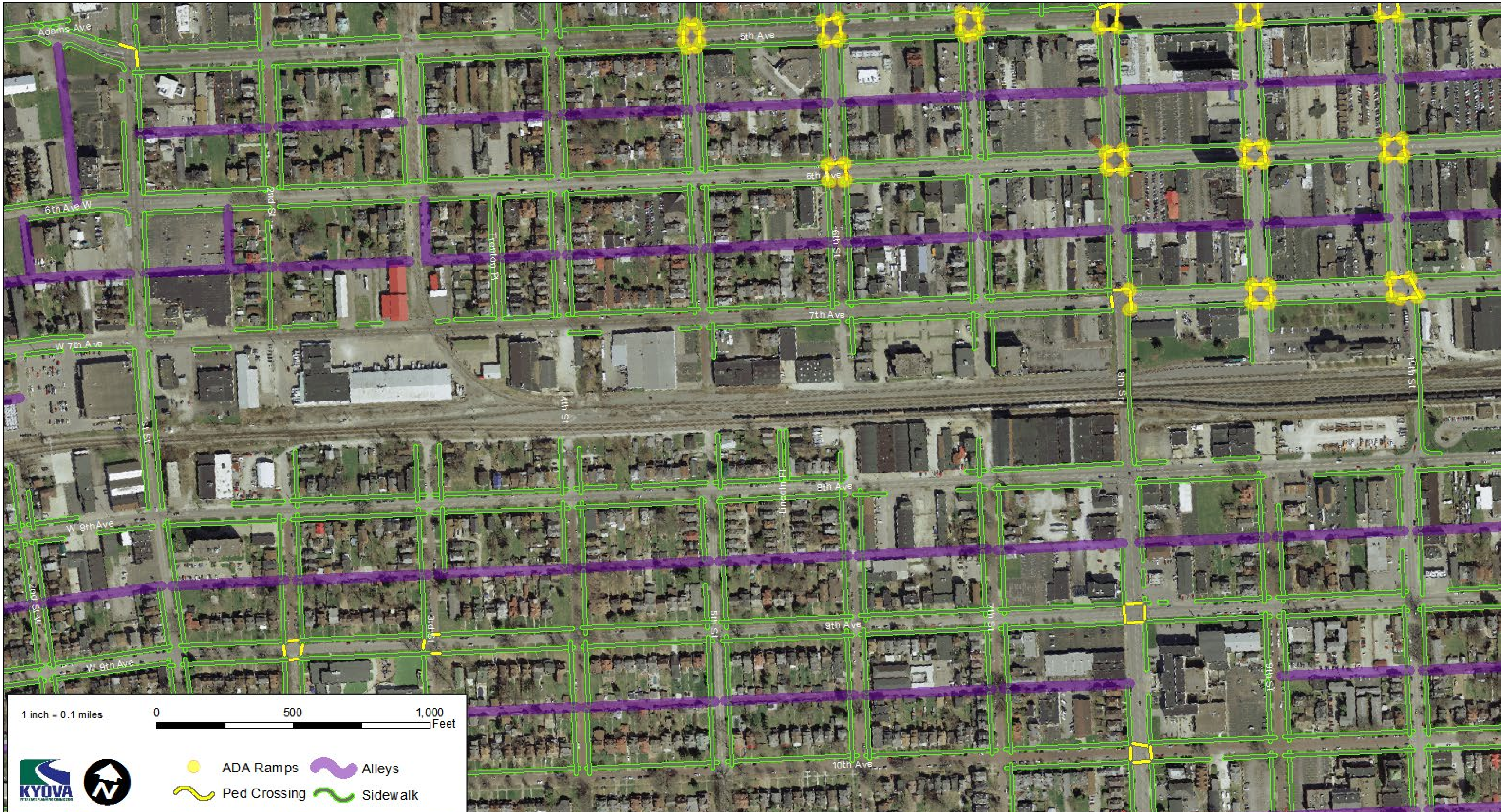


Figure 2-22: Circulation Area #4

daily traffic volumes averaging 6,967 vehicles/day in the future No-Build scenario. Other than the higher volume on 8th Avenue, the streets are residential in nature and although they are not wide, low traffic volumes and speeds allow for safe bicycle travel with traffic.

In this area, the network of alleys is very consistent with the exception of the block between 8th Street and 9th Street and is mostly underutilized for point-to-point travel. These alleys have a lot of potential to serve as an additional avenue for non-motorized inner city travel.

No ADA-compliant ramps are present in this part of Huntington. Crosswalks are also missing in this area, except at critical intersections on 8th Street at 9th Avenue and 10th Avenue.

Circulation Area #5

Figure 2-23 shows the transition area between the south and north of the CSX railroad facility centered at the 1st Street underpass. The bicycle and pedestrian facilities in this area are in fair condition compared to the rest of the study area, but provide inconsistent coverage of the transportation network, especially on 8th Avenue and 7th Avenue around the underpass.

Sidewalks are relatively consistent along the main corridors, except for a few very critical locations centered around 1st Street that would help to provide essential connections from both north and south to the underpasses. 8th Avenue is a highly travelled commuter corridor and has daily traffic volumes averaging 5,856 vehicles/day in the future No-Build scenario. The streets in this area are residential in nature and although they are not wide, low traffic volumes and speeds allow for safe bicycle travel with traffic.

In this area, the network of alleys is very consistent, with the exception of a few single-block locations where a larger building or cross-directional alley exists, and is mostly underutilized for point-to-point travel. These alleys have a lot of potential to serve as an additional avenue for non-motorized inner city travel.

No ADA-compliant ramps are present in this part of Huntington. Crosswalks are also missing in this area.

Circulation Area #6

Figure 2-24 illustrates the section north of the CSX underpasses between 1st Street and 9th Street. The bicycle and pedestrian facilities in this area are in fair condition compared to the rest of the study area and provide consistent coverage of the transportation network, especially from 5th Street east through the central business district.

Sidewalks are relatively consistent along the main corridors, except for previously referenced critical locations centered around 1st Street and along 7th Avenue that would help to provide additional connections from both north and south through the underpasses and east-west between underpasses. 5th Avenue is a highly travelled commuter corridor and has daily traffic volumes in the central business district averaging 15,195 vehicles/ day in the future No-Build scenario. The streets in this area serve commercial and service-oriented uses and offer wide, visually-clear vistas with regular breaks in traffic for safe travel for more experienced cyclists.

In this area, the network of alleys is very consistent north of 7th Avenue and is mostly underutilized for point-to-point travel. These alleys have a lot of potential to serve as an additional avenue for non-motorized inner city travel.

Figure 2-23: Circulation Area #5

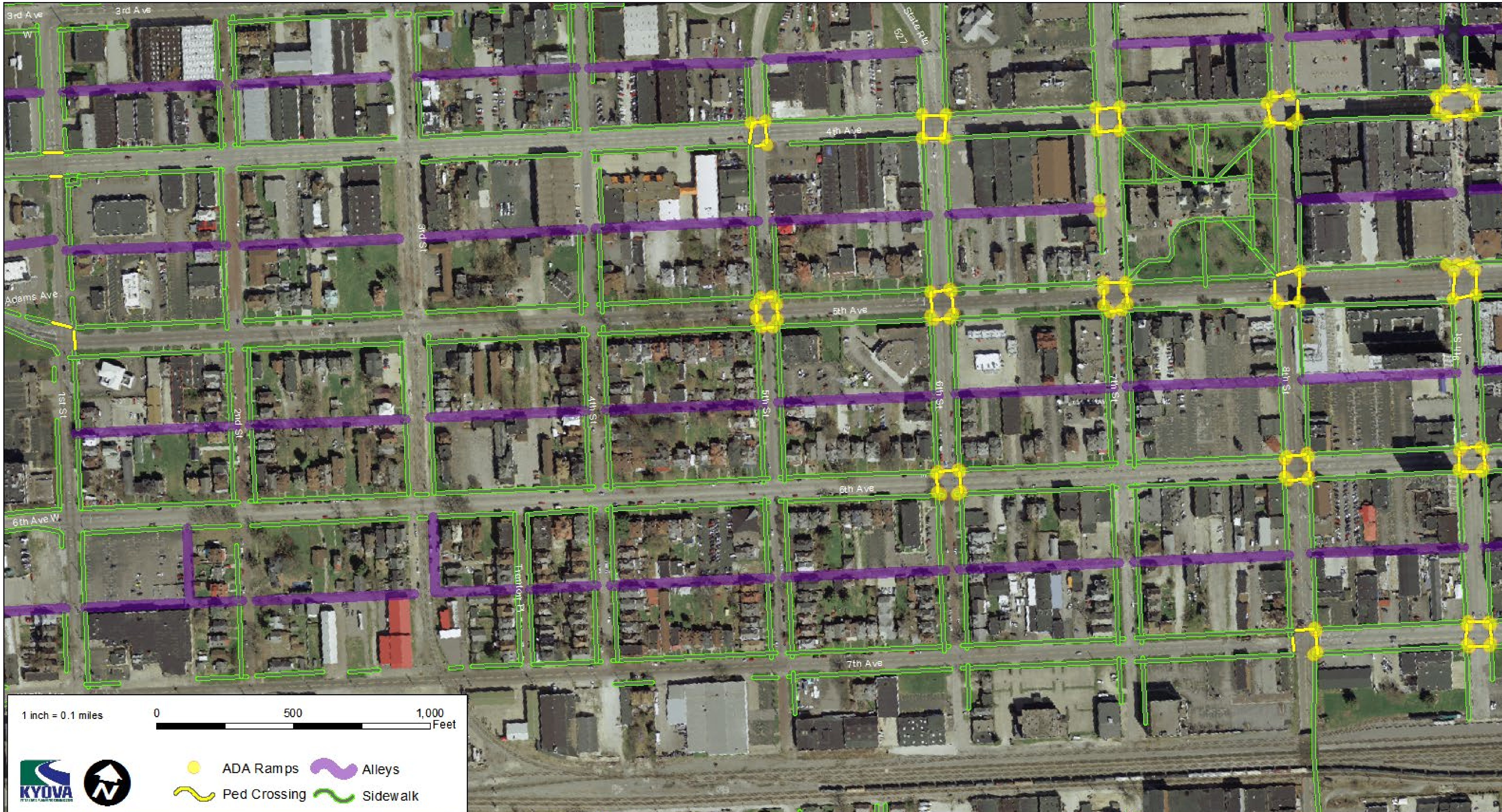


Figure 2-24: Circulation Area #6

ADA-compliant ramps are present east of 5th Street and north of 7th Avenue through the central business district. Crosswalks are consistently present with ADA-compliant ramps.

Circulation Area #7

Figure 2-25 illustrates the section north of the CSX underpasses between 9th Street and Hal Greer Boulevard. The bicycle and pedestrian facilities in this area are in good condition compared to the rest of the study area and provide consistent coverage of the transportation network north of 7th Avenue.

Sidewalks are consistent along the main corridors except 7th Avenue, which would help to provide additional connections from both north and south through the underpasses and east-west between underpasses. 5th Avenue is a highly travelled commuter corridor and has daily traffic volumes averaging 14,892 vehicles/day just west of Hal Greer Boulevard in the future No-Build scenario. The streets in this area serve commercial, service-oriented, institutional, and residential uses and offer wide, tree-lined vistas with regular breaks in traffic for safe travel for more experienced cyclists.

In this area, the network of alleys is very consistent north of 7th Avenue and is mostly underutilized for point-to-point travel. These alleys have a lot of potential to serve as an additional avenue for non-motorized inner city travel.

ADA-compliant ramps are consistently present between 9th Street and 13th Street through this area with additional need for delineation further east to Hal Greer Boulevard. Crosswalks are consistently present with ADA-compliant ramps.

Motorized System Assessment

The motorized system in Huntington is generally a very stable connection of roadways that offers a high level of service and low congestion for local residents and visitors to the area. There is an established grid network of streets and avenues that provide connectivity options for travelers.

In general, system volumes are low compared to the capacity of the roadways and traffic moves freely with coordination by the local signal system. There is a significant one-way pair composed of 3rd Avenue and 5th Avenue, traveling in an east-west direction through the campus of Marshall University and into the Huntington Central Business District. Although it has been the topic of debate for many years, the use of the one-way pair rather than a set of two-way streets has not been altered around the University. After thorough review of existing plans, including the 2013 Marshall University Campus Master Plan and the Downtown Huntington Access Study, the study team was directed to continue this analysis utilizing the one-way pair combination.

Some congestion occurs during major events or during rush hour on certain segments of the local traffic network. For general traffic volumes, Hal Greer Boulevard (16th Street) has higher volumes and some delay due to turning movements and high amounts of destinations along its route. Major traffic generators include Marshall University, Cabell-Huntington Hospital, St. Mary's Hospital, and general shopping and services in downtown Huntington.

Inter-network travel includes commuter and visitor traffic from Interstate 64 on the south, US 60 from the east, US 52 and Ohio 7 from the north, and US 60 from the west. The majority of vehicular traffic utilizes Hal Greer Boulevard from I-64.

Figure 2-25: Circulation Area #7

Bicycle / Pedestrian Crossings

Bicycle and pedestrian crossings occur mostly on an as-needed basis and sometimes in particularly dangerous locations. When not located at crosswalks or with the flow of traffic, the study team noted the majority of these crossings at locations all along the edge of the Marshall campus. Although not as highly traveled, these crossings also occurred on the north side of the underpasses, especially at Hal Greer and 20th Street.

Sharing the Road

The study team observed very few cyclists using the roadways to travel with the flow of traffic. The limited number of observed cyclists on roadways were generally located downtown or near the Marshall campus on 5th Avenue.

Speed of Roadway Traffic

During major sporting and entertainment events, the area surrounding Marshall University Campus becomes congested for short periods of time. In addition, the Big Sandy Arena occasionally hosts entertainment and business events that increase traffic. Most of this increase is easily accommodated by the existing street network and available structured parking. A typical condition at all other times, especially around the Marshall campus on wider streets, is to have free-flow traffic with higher speeds.

Non-Motorized System Assessment

Connections

Based on the results of the visual inspection and inventory of bicycle and pedestrian facilities, the study team has been able to identify geographic gaps in service for non-motorized system utilization. The following locations have been identified as gaps in the current system which, if improved, could restore or provide new opportunities for use. These connections can help to link neighborhoods, street divisions, businesses, recreation, or other destinations as identified.

The roadway corridors immediately adjacent to the north-south underpasses, 7th Avenue and 8th Avenue, exhibit severe gaps in coverage for sidewalks and safety improvements at crossing areas. The traffic volumes on 7th Avenue are suitable for bicycle travel, but the industrial nature of the businesses in this area suggests improvement to the safety conditions and sight distances for cross-streets to make it more suitable for bicycle traffic. 8th Avenue has higher traffic volumes, but would still be suitable for bicycle traffic if safety and rider education were prioritized.

There are also missed connections for non-motorized travel between the Marshall campus and student residential facilities south and east. Provision of additional non-motorized paths to these destinations would improve safety for students and staff, as well as incentivize demand for new housing in that area.

Safety

Safety is an important factor in people choosing to utilize a particular pathway or connection between two destinations. As the system analysis was performed, no unique locations were identified as possible safety concerns that could be highlighted for future improvements. There were not readily obtainable traffic reports to assist in determination of conflict points, so the safety observations were made using a combination of on-site review and stakeholder interviews. In general, safety needs to be a focus for all system improvements.

Aesthetics

The predominant features of the five underpasses in this study serve the traffic function of the individual corridor. As can be seen in **Figure 2-26** below, each underpass is very similar in appearance, with the exception being the 1st Street underpass, which incorporates more visually-pleasing materials and has spacing that allows the pedestrian walkways to be more useful for non-motorized travelers. The other underpasses are all very similar in their appearance and have narrow or non-existent unsafe pedestrian walkways, poor lighting, drab appearances, and generally unclean conditions. Safety concerns for the non-motorized user are detrimental to regular use by people who may not have other options. There are no vegetative features along the underpasses.

3rd and 5th Avenues are wide, open, and flat corridors built to accept a large amount of vehicles per hour. Visually, these avenues are plain, with a wide expanse of asphalt, and they achieve the goal of maximizing space for motorized vehicles to use. These corridors are built to accept a large amount of traffic, and safety may suffer because of that feature. There may be opportunities to improve safety along the corridor with additional features to emphasize awareness of the traveler's surroundings. Vegetation is not uniform along these two corridors; some blocks have a wide planted strip between the roadway and sidewalk and other blocks have no vegetation.

Figure 2-26: Underpasses

Compliance with Americans with Disabilities Act regulations

From a planning assessment, there are many crossings in the area adjacent to and including Marshall University that have striped crosswalks and ADA-compliant ramps. As the traveler moves away from the campus setting, these facilities become rarer.

Latent demand

Existing obstacles and barriers occasionally interfere with the true attractiveness of a certain system component. Through this analysis, the following areas have been identified as locations where existing obstacles, if removed or addressed in some other way, would allow for increased usage of the non-motorized system by a larger segment of the population.

Highlawn Brownfields

Through the development of the Highlawn Brownfields Area-Wide Plan, the City of Huntington is taking necessary steps to resolve major issues related to traffic and efficient movement of people and goods in the area around the Joan C. Edwards Stadium, north to the Ohio River, and south across 5th Avenue towards the CSX railyards.

The existing ACF facility and associated parking and storage yards hinder access through this section of Huntington and reduce both the likelihood of excess stormwater recharge and the highest and best use of the land for positive growth and development. Through the development of the Area-Wide Plan, the City has taken steps to establish a long-term vision that will deliver the goals of stakeholders and community leaders for this area.

Surface parking between 17th and 19th Streets

A natural route to campus for many students, faculty, and staff that live to the south is to use either the Hal Greer Boulevard or 20th Street underpasses to cross the CSX right-of-way and either walk or bike to their destination. One of the possible obstacles to that routing is the vast amount of paved parking between 17th Street and 19th Street between Buffington Avenue and 5th Avenue.

While it may not be an absolute barrier to bicycle and pedestrian travel, the opportunity exists to make some aesthetic and organizational changes to this surface parking. With low capital impacts, the parking could be laid out with incorporation of pathways to campus and green infrastructure, such as rain gardens and planted islands.

Storage yards / underutilized property

Barriers to travel do not always have to include physical impediments. In some instances, the appearance and induced feelings that are projected by a place may hinder the willingness of travelers to utilize the pathway.

The CSX railyards and associated industry contribute to such a traveler experience, especially related to the Hal Greer Boulevard and 10th Street underpasses. While the businesses in those areas are functional and contributing to the tax base, they do not facilitate non-motorized travel. The lack of consistent sidewalks along the south side of 8th Avenue and the industrial appearance of these properties does not entice people to make their trips via bicycle or on foot.

Possible improvements that would greatly improve appearances and invite people to use the underpasses on foot or by bicycle are relatively low-cost and easy to accomplish. These improvements start with infill of missing sidewalk sections along 8th Avenue and other streets that access the underpasses. The next component may involve working with businesses to add vegetative screening or buffers that soften the edge between the commuter route and the individual parcels.

Network Conditions Economic Assessment

Implementation of street flooding mitigation improvements in Huntington would provide for safer and more reliable transportation through the downtown area. This section presents an analysis of the benefits of avoiding closures of underpasses at 16th and 20th Streets and 3rd and 5th Avenues as described under Scenario 10 through the implementation of Combined Sewer Separation Alternative #1 + Green Infrastructure (Optimal Alternative). Based on inputs from local stakeholders, Scenario 10 would be the most likely impact on the transportation network from a major storm and prove the most impactful to the daily commuter. Accordingly, travel model data corresponding to Scenario 10 was used in estimating the project benefits. **Table 2-03** lists the various quantitative benefits due to the project. The remainder of this document describes the assumptions and benefits estimated in this analysis, as well as discussion of qualitative benefits from the project.

Table 2-03 – Benefits of KYOVA Street Flood Mitigation Plan under Scenario 10, $M 2017 Dollars over 20 Years

Category	Value, Discounted at 7%
Travel Time Savings	$661,500
Safety	$72,700
Travel Cost Savings	$74,900
Reduced Emissions	$33,200
Safety Response Costs Avoided	$6,000
Operating and Maintenance Costs Avoided	$28,800
Total Benefits	**$877,100**

Assumptions

An analysis of the benefits was conducted for the street flooding mitigation improvements to give a high-level estimate of the scale of benefits possible through the project improvements. The results of the analysis provide KYOVA IPC and the City of Huntington with information on how the project would affect traffic operations and the transportation network downtown under two routine flooding events every year.

Benefits included are related to increasing efficiency, avoiding costs, or enhancing productivity. The benefits were estimated using travel demand model data, which provided vehicle hours traveled (VHT) and vehicle miles traveled (VMT) under 2040 Scenario 10, which is representative of traffic network conditions during a flooding event (with closures of underpasses at 16th Street, 20th Street, 3rd Avenue, and 5th Avenue) compared to the 2040 No Build Scenario (no flooding event). VHT and VMT data were also provided for 2010 No Build Scenario (no flooding event). Metrics for years in-between 2010 and

2040 were estimated through straight-line interpolation.

For the purpose of this analysis, implementation of street flooding mitigation improvements is assumed to take place in 2025 and 2026. The benefit stream is converted to present values using real discount rates of 7 percent and 3 percent. Projects expecting to use federal funding are required to use a 7 percent discount rate (in real dollars, in this analysis 2017 dollars); however, to better reflect the interest rates of the last few years, the results were also discounted at 3 percent. Summary tables of estimated benefits using 7 percent and 3 percent are provided. All benefits were estimated over a 20-year analysis period, beginning in the first full year of operations (2027). Benefits were discounted to 2017 and results in the text were rounded to the nearest hundreds.

Benefits

The project improvements would provide transportation benefits for users, but non-users will also benefit in a number of ways. The users benefit primarily from avoiding longer trips due to underpass closures, saving travel time, travel costs, improving reliability, and safety. Non-users benefit from reduced emissions, as a result of traffic avoiding longer trips due to underpass closures, and improved property values, as a result of green infrastructure components that would enhance the aesthetics of the community and neighborhood.

In this analysis, the street flooding mitigation improvements are evaluated by assessing the benefits of avoiding closures of underpasses at 16th, 20th, 3rd, and 5th Streets in the event of a storm. For the purpose of this analysis, implementation of street flooding mitigation improvements is assumed to take place in 2025 and 2026. The benefits described in this section were estimated over a 20-year timeframe starting in 2027, the first full year after project implementation. The benefits are displayed at a 7 percent discount rate in 2017 dollars.

Safety Benefit due to VMT Avoided

Closing the underpasses during flooding events result in traffic diversion and drivers would have to travel longer distances to reach their destinations. These longer trips result in additional vehicle miles traveled (VMT). Implementing street flooding mitigation improvements reduce the frequency of flooding and result in VMT avoided. This reduces the likelihood of crashes and associated deaths, injuries, and property damage. Based on Bureau of Transportation Statistics (BTS) crash rates per 100 million VMT and the USDOT recommended value of a statistical life, auto VMT avoided results in $72,700 in reduced highway fatalities and crashes over the 20-year analysis period (**Table 2-04**).

Safety Benefit due to Improved Bike and Pedestrian Connectivity

The proposed project alternatives will incorporate road diets, green infrastructure buffers, and improved non-motorized right of way that will all support improved safety along the major corridors, especially 3rd and 5th Avenues. The project proposes the separation of bicycle lanes from vehicular lanes around Marshall University through the implementation of dedicated cycle tracks and directing non-motorized crossings to distinct crossing locations where motorists are more aware of other modes of travel and potential conflicts. The proposed project would also provide improved lighting and wider pedestrian paths in select locations to address current safety issues with non-motorized travel.

The bike-pedestrian connectivity elements of the proposed project would reduce the likelihood of crashes and associated deaths and injuries. Safety benefits due to improved bike-pedestrian connectivity are addressed qualitatively at this stage of the project assessment.

Travel Time Savings

When street flooding occurs, underpasses are closed, resulting in increased travel times for drivers and their passengers as they take a longer route to their destinations. The street flooding mitigation improvements would reduce the frequency of flooding, thereby reducing the travel time delays experienced by road users. Using results from the travel demand model and using the USDOT recommended value of time of $14.53 per hour (for local travel, all purposes), and applying the vehicle occupancy rate of 1.59 as derived from the travel demand model, the travel time savings of the project is $661,500 over the 20-year analysis period (**Table 2-05**).

Travel Cost Savings

The longer trips from road closures would result in additional VMT thereby increasing vehicle operating costs. Eliminating closures therefore avoids the costs associated with the additional vehicle operating and maintenance costs. The resulting savings is a benefit totaling $74,900 over the 20-year analysis period (**Table 2-06**).

Reduced Emissions

Eliminating road closures would reduce auto VMT and the associated emissions in the region. The project results in a benefit to the public by reducing the nitrogen oxide, particulate matter, volatile organic compounds, and carbon dioxide/Greenhouse Gas emissions in the region at a value of $33,200 over the 20-year analysis period (**Table 2-07**).

Reliability Benefit

The underpass improvements would provide a more reliable trip when weather delays can have an impact on travel times. Because of uncertainty, drivers must factor in a “buffer” time to auto travel in order to be on time to their destination. Drivers would save buffer time when the project is implemented. Travel time reliability is addressed qualitatively at this stage of the project assessment; as a result, the analysis is conservative.

Residual Value Benefit

The investments in infrastructure would have a useful life longer than the 20-year analysis period, resulting in residual value benefits. Capital costs for the individual infrastructure components are currently under development; therefore, residual value benefits are addressed qualitatively at this stage of the project assessment.

Benefit for Emergency Response Operations

The dispatch office for Cabell County Emergency Medical Services (EMS) is located at the intersection of 8th Avenue and 8th Street. When the underpasses are closed temporarily during flooding events, Cabell County EMS utilizes 8th Avenue exclusively to travel east-west and access underpasses that are not closed and to provide assistance at closure locations. To access the Cabell-Huntington Hospital (located near the intersection of Hal Greer Boulevard and 13th Avenue), vehicles primarily utilize Hal Greer Boulevard (16th Street). When the 16th Street underpass is closed temporarily during flooding events, traffic would choose among adjacent underpasses (20th Street or 10th Street). Alternatively, traffic would go around via I-64 to another access route such as US 60 or US 52. The time it takes to divert is valuable time that can result in further risk to a patient's health or possibly death. As a result, there is an emergency response benefit to Cabell County residents with the proposed project, which will allow faster and more reliable response times by emergency personnel. Emergency response benefits are addressed qualitatively at this stage of the project assessment; as a result, the analysis is conservative.

Property Premium Benefit

The implementation of street flooding mitigation improvements would enhance the aesthetics in the neighborhood and provide residents and businesses near the areas that typically flood with greater accessibility to downtown and a higher quality of life. As such, properties with higher accessibility would experience an increase in value, and adjacent businesses may experience an increase in retail sales. Property premium benefits are addressed qualitatively at this stage of the project assessment.

Costs

The costs of the project include capital construction costs and continuous operating and maintenance (O&M) costs over the 20-year analysis period.

Capital Costs

Capital costs for the individual infrastructure components are currently under development and not included at this stage of the project assessment.

Operating and Maintenance Costs Avoided

The new stormwater system will provide state of good repair benefits totaling $5,000 in Operating and Maintenance (O&M) savings per year. The O&M costs avoided are included as a benefit and total $28,800 over the 20-year analysis period at a 7 percent discount rate.

Other operating cost savings that are not quantifiable at this stage in the project assessment may include the maintenance costs of cleanup after flooding events. (**Table 2-08**).

Summary and Conclusions

The public benefits described and quantified in this memorandum are the result of capital and operating investments in the project. The street flooding mitigation improvements are evaluated by assessing the benefits of avoiding closures of underpasses at 16th Street, 20th Street, 3rd Avenue, and 5th Avenue, in the event of a flood. The project results in benefits to users and non-users in the form of safety, travel time and travel cost savings, emissions reductions, safety response costs avoided, operating and maintenance cost savings, benefits to emergency response operations, reliability for travelers, improved safety for cyclists and pedestrians, residual benefits, and property premium benefits. Benefits that are addressed quantitatively aggregate to $877,100 (in 2017 dollars), over the 20-year analysis period, at a 7 percent discount rate.

Table 2-04 - Safety Benefit

Calendar Year	Project Year	No Build		Scenario 10 (Flood Event)		Net Benefit	Discounted Net Benefits	
		Auto VMT	Accident Cost	Auto VMT	Accident Cost		7%	3%
2027	10	1,810,004	$487,533	1,816,043	$489,159	$1,626	$827	$1,210
2028	11	1,815,412	$488,989	1,827,489	$492,242	$3,253	$1,545	$2,350
2029	12	1,820,821	$490,446	1,838,936	$495,326	$4,879	$2,167	$3,422
2030	13	1,826,229	$491,903	1,850,382	$498,409	$6,506	$2,700	$4,430
2031	14	1,831,637	$493,360	1,861,829	$501,492	$8,132	$3,154	$5,376
2032	15	1,837,045	$494,816	1,873,276	$504,575	$9,759	$3,537	$6,264
2033	16	1,842,453	$496,273	1,884,722	$507,658	$11,385	$3,857	$7,095
2034	17	1,847,861	$497,730	1,896,169	$510,742	$13,012	$4,119	$7,872
2035	18	1,853,269	$499,186	1,907,615	$513,825	$14,638	$4,331	$8,598
2036	19	1,858,677	$500,643	1,919,062	$516,908	$16,265	$4,497	$9,276
2037	20	1,864,086	$502,100	1,930,508	$519,991	$17,891	$4,623	$9,906
2038	21	1,869,494	$503,557	1,941,955	$523,074	$19,518	$4,714	$10,492
2039	22	1,874,902	$505,013	1,953,401	$526,157	$21,144	$4,773	$11,035
2040	23	1,880,310	$506,470	1,964,848	$529,241	$22,771	$4,803	$11,538
2041	24	1,884,745	$507,664	1,969,482	$530,489	$22,824	$4,500	$11,228
2042	25	1,889,190	$508,862	1,974,127	$531,740	$22,878	$4,215	$10,927
2043	26	1,893,646	$510,062	1,978,783	$532,994	$22,932	$3,949	$10,634
2044	27	1,898,112	$511,265	1,983,450	$534,251	$22,986	$3,699	$10,348
2045	28	1,902,589	$512,471	1,988,128	$535,511	$23,040	$3,465	$10,070
2046	29	1,907,076	$513,679	1,992,817	$536,774	$23,095	$3,246	$9,800
TOTAL		**39,012,153**	**10,508,098**	**40,157,619**	**10,816,635**	**$308,537**	**$72,721**	**$161,872**

Table 2-05 - Travel Time Savings

Calendar Year	Project Year	No Build	Scenario 10 (Flood Event)	Net PHT Savings	PHT Benefit	Net Benefit	Discounted Net Benefits	
		Auto PHT	Auto PHT	Auto PHT	Auto PHT		7%	3%
2027	10	95,062	96,080	1,018	$14,796	$14,796	$7,521	$11,009
2028	11	95,419	97,456	2,037	$29,592	$29,592	$14,059	$21,378
2029	12	95,776	98,831	3,055	$44,387	$44,387	$19,709	$31,132
2030	13	96,134	100,207	4,073	$59,183	$59,183	$24,559	$40,301
2031	14	96,491	101,582	5,091	$73,979	$73,979	$28,690	$48,909
2032	15	96,848	102,958	6,110	$88,775	$88,775	$32,176	$56,981
2033	16	97,205	104,333	7,128	$103,570	$103,570	$35,083	$64,542
2034	17	97,562	105,709	8,146	$118,366	$118,366	$37,472	$71,614
2035	18	97,920	107,084	9,165	$133,162	$133,162	$39,398	$78,219
2036	19	98,277	108,460	10,183	$147,958	$147,958	$40,912	$84,378
2037	20	98,634	109,835	11,201	$162,754	$162,754	$42,059	$90,113
2038	21	98,991	111,211	12,219	$177,549	$177,549	$42,881	$95,442
2039	22	99,349	112,586	13,238	$192,345	$192,345	$43,415	$100,384
2040	23	99,706	113,962	14,256	$207,141	$207,141	$43,696	$104,957
2041	24	99,941	114,230	14,290	$207,630	$207,630	$40,933	$102,140
2042	25	100,177	114,500	14,323	$208,119	$208,119	$38,346	$99,399
2043	26	100,413	114,770	14,357	$208,610	$208,610	$35,922	$96,731
2044	27	100,650	115,041	14,391	$209,102	$209,102	$33,651	$94,135
2045	28	100,887	115,312	14,425	$209,595	$209,595	$31,524	$91,609
2046	29	101,125	115,584	14,459	$210,090	$210,090	$29,531	$89,151
TOTAL		**2,061,270**	**2,254,434**	**193,164**	**$2,806,703**	**$2,806,703**	**$661,534**	**$1,472,522**

Table 2-06 - Travel Cost Savings

Calendar Year	Project Year	No Build	No Build	Scenario 10 (Flood Event)	Scenario 10 (Flood Event)	Net Benefit	Discounted Net Benefits	
		Auto VMT	Auto Costs	Auto VMT	Total Costs		7%	3%
2027	10	1,810,004	$502,465	1,816,043	$504,142	$1,676	$852	$1,247
2028	11	1,815,412	$503,967	1,827,489	$507,319	$3,353	$1,593	$2,422
2029	12	1,820,821	$505,468	1,838,936	$510,497	$5,029	$2,233	$3,527
2030	13	1,826,229	$506,969	1,850,382	$513,675	$6,705	$2,782	$4,566
2031	14	1,831,637	$508,471	1,861,829	$516,852	$8,381	$3,250	$5,541
2032	15	1,837,045	$509,972	1,873,276	$520,030	$10,058	$3,645	$6,456
2033	16	1,842,453	$511,473	1,884,722	$523,207	$11,734	$3,975	$7,312
2034	17	1,847,861	$512,975	1,896,169	$526,385	$13,410	$4,245	$8,113
2035	18	1,853,269	$514,476	1,907,615	$529,563	$15,087	$4,464	$8,862
2036	19	1,858,677	$515,977	1,919,062	$532,740	$16,763	$4,635	$9,560
2037	20	1,864,086	$517,479	1,930,508	$535,918	$18,439	$4,765	$10,209
2038	21	1,869,494	$518,980	1,941,955	$539,095	$20,116	$4,858	$10,813
2039	22	1,874,902	$520,481	1,953,401	$542,273	$21,792	$4,919	$11,373
2040	23	1,880,310	$521,983	1,964,848	$545,451	$23,468	$4,951	$11,891
2041	24	1,884,745	$523,214	1,969,482	$546,737	$23,523	$4,638	$11,572
2042	25	1,889,190	$524,448	1,974,127	$548,027	$23,579	$4,344	$11,261
2043	26	1,893,646	$525,685	1,978,783	$549,319	$23,635	$4,070	$10,959
2044	27	1,898,112	$526,924	1,983,450	$550,615	$23,690	$3,812	$10,665
2045	28	1,902,589	$528,167	1,988,128	$551,913	$23,746	$3,571	$10,379
2046	29	1,907,076	$529,413	1,992,817	$553,215	$23,802	$3,346	$10,100
TOTAL		**39,012,153**	**10,829,950**	**40,157,619**	**$11,147,937**	**$317,987**	**$74,949**	**$166,830**

Table 2-07 - Emissions Savings

Calendar Year	Project Year	Auto VMT Saved	Net Reduction in Emissions				Social Cost of Carbon (SCC)	SCC Discounted @3%	Non-CO_2 Air Quality Benefits	Discounted Net Benefits	
			VOC (Metric Tons)	NOx (Metric Tons)	PM (Metric Tons)	CO_2 Reduced (Metric Tons)				7%	3%
2026	0	--	0.000	0.000	0.000000	0.000	$0	$0	$0	$0	$0
2027	1	6,038	0.002	0.002	0.000060	2.621	$146	$142	$40	$179	$181
2028	2	12,077	0.003	0.003	0.000121	5.241	$297	$297	$80	$367	$356
2029	3	18,115	0.005	0.005	0.000181	7.862	$446	$446	$121	$544	$518
2030	4	24,154	0.007	0.007	0.000242	10.483	$605	$605	$161	$728	$680
2031	5	30,192	0.008	0.008	0.000302	13.103	$783	$783	$201	$926	$849
2032	6	36,231	0.010	0.010	0.000362	15.724	$956	$956	$241	$1,117	$1,003
2033	7	42,269	0.011	0.012	0.000423	18.345	$1,134	$1,134	$281	$1,309	$1,151
2034	8	48,307	0.013	0.014	0.000483	20.965	$1,318	$1,318	$321	$1,505	$1,294
2035	9	54,346	0.011	0.011	0.000543	21.575	$1,378	$1,378	$319	$1,552	$1,301
2036	10	60,384	0.013	0.012	0.000604	23.973	$1,556	$1,556	$354	$1,736	$1,422
2037	11	66,423	0.014	0.013	0.000664	26.370	$1,739	$1,739	$390	$1,924	$1,538
2038	12	72,461	0.015	0.014	0.000725	28.767	$1,927	$1,927	$425	$2,116	$1,650
2039	13	78,500	0.016	0.016	0.000785	31.164	$2,152	$2,152	$461	$2,343	$1,779
2040	14	84,538	0.018	0.017	0.000845	33.562	$2,352	$2,352	$496	$2,544	$1,883
2041	15	84,737	0.018	0.017	0.000847	33.641	$2,392	$2,392	$497	$2,572	$1,854
2042	16	84,937	0.018	0.017	0.000849	33.720	$2,398	$2,398	$498	$2,566	$1,805
2043	17	85,138	0.018	0.017	0.000851	33.800	$2,438	$2,438	$499	$2,596	$1,777
2044	18	85,338	0.018	0.017	0.000853	33.879	$2,479	$2,479	$501	$2,627	$1,750
2045	19	85,540	0.018	0.017	0.000855	33.959	$2,520	$2,520	$502	$2,658	$1,723
2046	20	85,741	0.018	0.017	0.000857	34.039	$2,561	$2,561	$503	$2,691	$1,696
TOTAL		**1,145,467**	**0**	**0**	**0**	**463**	**$31,576**	**$31,572**	**$6,891**	**$34,601**	**$26,208**

Table 2-08 - Operating and Maintenance Costs Avoided

Calendar Year	Project Year	Operation, Maintenance & Replacement Costs Avoided	Discounted O&M Costs Avoided	
			7%	3%
2027	10	$5,000	$2,542	$3,720
2028	11	$5,000	$2,375	$3,612
2029	12	$5,000	$2,220	$3,507
2030	13	$5,000	$2,075	$3,405
2031	14	$5,000	$1,939	$3,306
2032	15	$5,000	$1,812	$3,209
2033	16	$5,000	$1,694	$3,116
2034	17	$5,000	$1,583	$3,025
2035	18	$5,000	$1,479	$2,937
2036	19	$5,000	$1,383	$2,851
2037	20	$5,000	$1,292	$2,768
2038	21	$5,000	$1,208	$2,688
2039	22	$5,000	$1,129	$2,609
2040	23	$5,000	$1,055	$2,533
2041	24	$5,000	$986	$2,460
2042	25	$5,000	$921	$2,388
2043	26	$5,000	$861	$2,318
2044	27	$5,000	$805	$2,251
2045	28	$5,000	$752	$2,185
2046	29	$5,000	$703	$2,122
TOTAL		**$100,000**	**$28,812**	**$57,012**

Emergency Services Response Assessment

Through detailed discussions with the Cabell County Emergency Medical Services (EMS) leadership, it was determined that the initial approach to developing travel time savings information was flawed and would not apply for this study. In our investigation, the study team determined that the length of closure for a typical storm event and the associated staff time dedicated to mitigating the impacts on the transportation network did not warrant major changes in service delivery and operation.

In a typical storm event, emergency service providers reported that their staff time would include roughly two hours of service to the particular event and placement and removal of barriers on the affected roads. Huntington City Police are in charge during these events and reported that there is no one usually stationed at the underpasses for the storm events because of staffing deficiencies. There is no one employee charged with doing this, so it could range from a junior patrol officer to the chief.

When the underpasses are closed for storm events, Cabell County EMS uses 8th Avenue exclusively to travel east-west and access underpasses that are not closed and to provide assistance at closure locations. Their dispatch office is at 8th Avenue and 8th Street. Cabell-Huntington Hospital uses Hal Greer Boulevard (16th Street) primarily, and if that underpass is closed they choose accordingly among adjacent underpasses (20th Street or 10th Street) or going around via I-64 to another City access route such as US 60 or US 52.

Stormwater Model Development Process

Introduction

A major component of this project was to develop an existing conditions Hydrologic and Hydraulic (H&H) model for a pilot area identified as CSO #12 by the City of Huntington.

The primary objectives of the H&H modeling effort are to develop a predictive tool for use in characterizing the CSO collection system under existing conditions to be used to evaluate stormwater improvements to mitigate flooding.

This section provides discussion on the approach employed to develop, validate, and implement the existing conditions model.

Existing System Description

The overall size of the CSO #12 basin area is approximately 622 acres. The CSO #12 basin contains one diversion chamber, a pump station, floodwall, and flood gates. The model extents includes pipes that flow to the CSO #12 outfall from the Ohio River to the north, Wiltshire Blvd to the south, Marshall Memorial Blvd (20th St) on the east, and 13th St on the west.

<u>Impervious and Pervious Areas</u>

Overall, the CSO #12 basin is comprised of approximately 422 acres of impervious surfaces and 200 acres of pervious surface. This represents a 68 percent to 32 percent split. The National Land Cover Database (NLCD) 2011 Land Cover was used to determine pervious and impervious areas.

<u>Current Land Use</u>

The CSO #12 basin is characterized by the following land uses: High Intensity Developed, Medium

Intensity, Low Intensity Developed, Developed Open Space, Bare Land, Hay/Pasture, Herbaceous/ Grassland, and Open Water.

Population

Estimates establish the population within the CSO #12 basin at nearly 5,519 persons. This was used in estimation dry weather flow.

Model Development Process

This section summarizes the general modeling approach, inventories the data sources necessary to develop and validate the model, and then describes the specific approach for hydrologic development in combined versus separate sanitary sub-catchments.

The EPA Storm Water Management Model (SWMM) 5 was the selected computational engine for the H&H model. SWMM is a dynamic rainfall-runoff simulation model used for single event or long-term (continuous) simulation of runoff quantity and quality from primarily urban areas. It is widely used throughout the world for planning, analysis, and design related to storm water runoff, combined sewers, sanitary sewers, and other drainage systems in urban areas, with many applications in non-urban areas as well.

To provide input data to the H&H model, the study team collected different types of data which included drawings, Geographic Information Systems (GIS) shapefile information, and past reports from other projects. To organize and analyze the data, the study team utilized various support tools, such as Microsoft Excel spreadsheets, Microsoft Access databases and ESRI ArcGIS. GIS tools and scripts were used to develop hydrologic parameters like area, slope and soil characterization to create and update the H&H model.

Data Collection and Sources

The study team received various information and GIS data from the Huntington Sanitary Board and from Cabell County for conveyance system assets like shapefiles for manholes, pipes, inlets/catch basins, pumps/pump stations, diversion chambers, regulators, outfalls.

A breakdown of the data included:

- Shapefiles containing existing pipe sizes, lengths, type, and materials obtained from Huntington Water Quality Board
- Shapefiles containing existing manhole and catch basin invert and rim elevations from Huntington Water Quality Board
- Parcel shapefiles from Huntington Water Quality Board
- Flood gate assembly, flood pump station, floodwall sections, regulator, and river outfall shapefiles from Huntington Water Quality Board
- Shapefiles containing Cabell roads, Cabell streams and water data
- Cabell Block Groups shapefile with population information
- Pump station map
- 16th Street regulator chamber map
- Previous reports

The study team also obtained the following data:

- Light Detection and Ranging (LiDAR) data from GeoSpatial Data Gateway
- National Land Cover Database (NLCD) 2011 Land Cover (2011 Edition)
- Orthophoto High Resolution Mosaic for Cabell County
- United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) Soil data

GIS shapefiles and other data were preprocessed using geoprocessing tools in ArcMap and Excel spreadsheets. The processed data were then imported into PCSWMM to create the initial skeletal model framework.

Data quality was reviewed using a comparative process for each data source. Many data gaps and missing data were discovered, along with conflicting information in the GIS shapefiles. In most cases, auditing tools and best engineering judgment was used to infer and estimate missing data and data gaps.

Previous reports were also reviewed to get a better idea of the background and various stormwater issues in the basin.

<u>Subcatchment Delineations</u>

Subcatchments are hydrologic units of land whose topography and drainage system elements direct surface runoff to a single discharge point. Subcatchments represent the basic building block for the H&H model hydrologic framework. For modeling purposes, basins/sewersheds are defined as those sewered areas tributary to a diversion chamber/regulator structure. Each subcatchment effectively represents a surface over which the hydrologic portion of the model will simulate precipitation falling and then running off into the collection system. Accordingly, each subcatchment possesses its own hydrologic properties including imperviousness, basin width factors that affect the "time of concentration," soil infiltration factors, overland roughness, etc.

LiDAR data was downloaded from GeoSpatial Data Gateway website. This was used to generate a Digital Elevation Model (DEM) file, which is a raster file that contains elevation data. A watershed delineation tool was then used to delineate subcatchments.

<u>Combined and Separate Sewer Systems</u>

The CSO #12 basin is comprised of two sewer systems, a separate sanitary system and a combined sewer system, with the combined system accounting for a majority of the system. Two different approaches were implemented for the separate sanitary subcatchments versus combined sewer subcatchments.

In separate sanitary subcatchments, the rain-dependent inflow and infiltration (RDII) hydrologic response was simulated within PCSWMM using a unit hydrograph curve fitting methodology referred to as the RTK unit-hydrograph approach. This unit hydrograph is represented by R, T, and K as follows: R is the fraction of precipitation over the sewershed that enters the collection system; T is the time to the hydrograph peak in hours, and K is the ratio of the event recession limb to the time to peak. Values of R, T, and K used for the unit hydrograph in the model were assumed. For the separate sanitary sewers, inflows (RDII using triangular hydrographs) were entered at junctions, considering the contributing area for each junction.

Conversely, in combined subcatchments, the rainfall-runoff response was simulated by synthesizing runoff surfaces for each combined model subcatchments.

Dry Weather Flow

Dry weather flow determination involves the sewershed population multiplied by the average daily wastewater generation rate. The spatial distribution of the population detailed in the Cabell Block Groups ACS data and an assumed average wastewater generation rate of 65 gallons per capita per day (GPCD) provided the basis for the estimation and apportioning of the population-driven dry weather flow into the model subcatchments.

Pervious and Impervious Cover

Subcatchments are divided into pervious and impervious subareas. Surface runoff can infiltrate into the pervious subarea, but not through the impervious subarea. Impervious areas are themselves divided into two subareas: one that contains depression storage and another that does not. The distribution of pervious and impervious cover within the CSO #12 basin is an important factor in establishing the hydrologic response from each of the combined system subcatchments.

Slope and Flow Length

The average slope and flow lengths govern the rate of runoff during model simulation. The average slope and flow lengths for the different combined subcatchments were obtained from a DEM file using Spatial Analyst Zonal Statistics tool. This was done by averaging the slope or flow length of each DEM grid cell within each subcatchment.

Soil Data

Soil data was downloaded from the USDA-NRCS web soil survey website. The soil data was preprocessed using Microsoft Excel, Microsoft Access, and ArcMap. A soils shapefile was then generated and imported into the model.

Soil Infiltration Parameters

The H&H model for the combined subcatchments also needed to account for rainfall abstractions associated with soil infiltration. Soils layers commonly consist of the spatial distribution of soil types for a specific area. Soil infiltration processes were simulated using Green-Ampt soil infiltration routines. Typical standard values for hydraulic conductivity, capillary suction, and initial moisture deficit for a range of soil textures were area-weighted and assigned to soils in combined subcatchments.

Rainfall Data

Rainfall data is used to generate runoff during model simulations. Rain gages were created for the 1-year (2.38 in), 2-year (2.68 in), and 5-year (3.42 in) storm events based on SCS 24h Type II design storms. These rain gages are then assigned to the individual subcatchments.

Boundary Condition

For the H&H model to adequately represent the hydraulic performance of the collection system and, more specifically, the interception of flows at the diversion structure, external factors that represent boundary conditions to the model were considered. This boundary condition is assigned to the outfall, which is the terminal node of the sewer system. A free boundary condition (i.e. outfall stage determined by minimum of critical flow depth and normal flow depth in the connecting conduit) was used as boundary condition in the outfall downstream of the CSO #12 regulator structure.

Other Information

Typical standard values were used for various model inputs which include: 0.015 for Manning's n for overland flow over the impervious portion of the subcatchment; 0.24 for Manning's n for overland flow over the pervious portion of the subcatchment; 0.06 inches for depth of depression storage on the impervious portion of the subcatchment; 0.3 inches for depth of depression storage on the pervious portion of the subcatchment; and 25 percent for percent of the impervious area with no depression storage.

Existing Conditions Model

Once all the preprocessing was completed, the various elements of the model were imported into PCSWMM. Missing information and data gaps were addressed. Pipe connectivity issues were in the model resolved. The model was run with the Dynamic Wave routing method which utilizes the full Saint Venant equations. The duration of the model simulation was 24 hours with a routing time step of one second. All flow rate results are to be presented in the units of million gallons per day (MGD). The hydraulic grade line (HGL) results are to be provided in terms of absolute elevation in feet. Assumptions, changes, and other documentation are documented in the SWMM5 input file using the "Description" field in the "properties" window.

Auditing and troubleshooting the model involved validating model attributes, identifying and correcting negative conduit slopes, reviewing dry pipes, identifying disconnected entities, checking subcatchment connectivity, and checking for warnings and error messages in the model output file and resolving all major warnings and errors.

During a model simulation, the model simulated precipitation over the subcatchments, using various subroutines for varying processes (i.e. soil infiltration, routing etc.), and evaluated the fate of the precipitation on the subcatchment surface as it ran off into the collection system.

When the model simulation was completed, it produced some continuity errors. A low continuity error demonstrates that the model is numerically correct because the model is converging to a solution in a stable manner based on the inputs provided. The mass continuity errors for runoff and flow routing represent the percent difference between initial storage plus total inflow and final storage plus total outflow for the entire model. Runoff Quantity Continuity Error is an indication of the uncertainty within the hydrology portion of the model. If the hydrology water balance is off, the error will be higher. The Flow Routing Continuity Error is an indication of the uncertainty with the hydraulics portion of the model. If the hydraulic routing water balance is off, the error will be greater than 0%. The Runoff Quantity Continuity Error and the Flow Routing Continuity Error for the existing conditions model was -0.044% and -0.015% respectively.

The model was developed using best information available. After evaluating the model, it was determined that additional adjustments needed to be made to conduct an appropriate alternative evaluation. The following has been updated in the model after further evaluation:

- The Hal Greer Boulevard (16th Street) underpass was modeled as a dual drainage system composed of a major and minor system. The underpass is the major system and the 36 inches wide by 48 inches high combined sewer below is the minor system (see **Figure 2-27**).
- Added a major system along Hal Greer Boulevard to accommodate the underpass, as well as surface flooding to the south. Surface flooding is expected to cause a redirection of flows to other tributaries to the west outside of the CSO basin (see **Figure 2-28**).

- Removed 20th Street from the CSO Basin.
- Added the capability within the model to account for ponding. This reduced system losses and quantifies redirected surface flows.
- Removed a large 48 inch storm line on the south end of the basin from the system that does not currently drain to CSO 12. GIS info received clipped the boundaries of the CSO and provided voids of info needed to create a representative model.
- Removed a portion of the campus flows that have been identified as draining to CSO 12.
- Added additional catchments to the system as needed for improved accuracy.

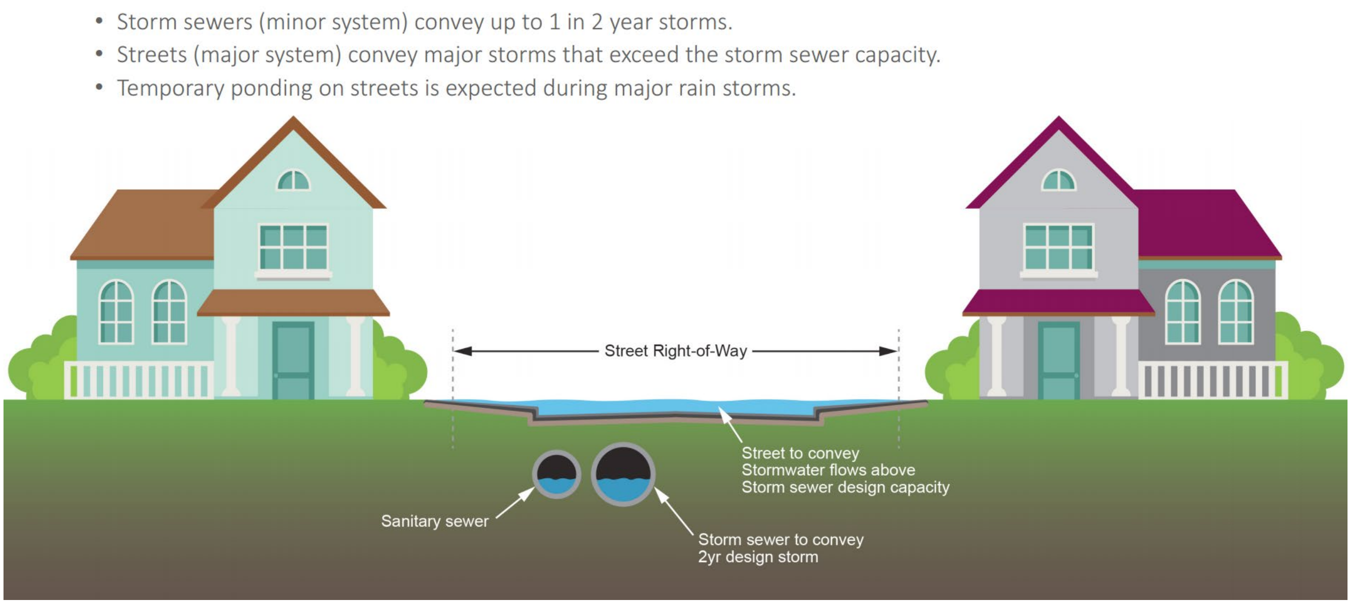


Figure 2-27: Major / Minor Systems
(Source: City of Toronto)

These adjustments were needed to have a more representative model. While the construction of the model is at a higher level of accuracy at this point, it remains relatively imprecise.

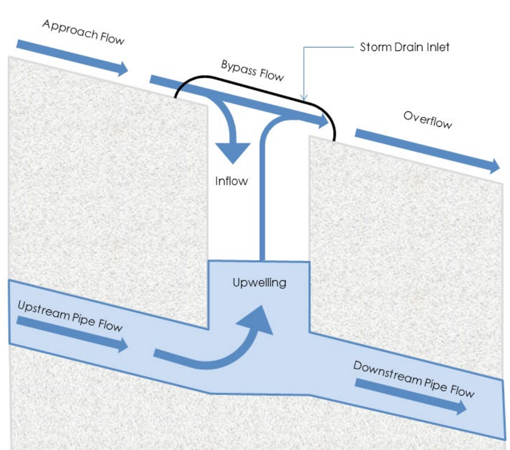


Figure 2-28: Hal Greer Major System

Figure 2-29 shows the configuration of the existing model. The improvements that are listed above are incorporated in the model as blue and grey lines and represent the separate storm lines and surface streets, respectively. The inclusion of these systems adds an element to the evaluation process and was used in the alternative selection process.

Model Verification

CSO #12 basin was not flow monitored. The H&H model for the CSO #12 was verified using an August 27, 2005 flood data based on an April 2010 report by GAI Consultants. The report states that the aforementioned storm dropped 2.94 inches of rain in 24 hours with an estimated maximum elevation of impounded water in the Hal Greer Boulevard underpass near 8th Street of 552.67 ft. In an attempt to calibrate the model, the time series from the 2.94 inch rainfall was investigated. A nearby rain gauge located at the Tri-State Airport (gauge number COOP:465418) was evaluated. The gauge was shown to have good recordings for all of 2005 and revealed no rainfall during the August 27 date. Because this event could not be substantiated, calibration was not performed.

Without knowing the true distribution of the rainfall for the 2.94 inch event, a SCS-Type II storm event was simulated through the model. SCS-Type II storms are 24-hour events, designed to have the largest concentration in the middle of the event. This leads to a very high peak rainfall concentration over a short period. Unless the 2.94 inch rainfall had a similar peak concentration, it would be expected that the SCS-Type II simulation would result in a higher peak surcharge throughout the system. Using the 2.94 inches rainfall on the existing conditions model, the maximum HGL in the underpass was estimated to be 554.6 feet, which is 2 feet above the estimated 2005 elevation. This level of uncertainty can be expected with the level of unknowns at this time. Because of this, it is recommended that flow monitoring and model calibration be performed before detail design.

Collection System Characterization

Once the H&H model was validated, simulations were conducted to characterize the conveyance performance relative to the 1-year, 2-year, and 5-year synthetic design storms. Most of the pipes hydraulic capabilities were exceeded during the 1-year, 2-year, and 5-year events.

Model analysis and observations

The Hal Greer Boulevard (16^{th} Street) underpass was modeled as a dual drainage system, which is composed of a major and minor system. The underpass is the major system and the 36 inches wide by 48 inches high combined sewer below is the minor system. The existing conditions model was run using the 1-year (2.38 inches), 2-year (2.68 inches), 5-year (3.42 inches) and 10-year (3.65 inches) design storms. **Figure 2-30** shows the profile of the four design storm simulations. As the design storm intensity increase, so does the HGL, with a 1-year (green) on the bottom and a 10-year (red) on the top.

In the 1-year design storm simulation, all of the manholes and pipes in the vicinity of the underpass were surcharged with some surface flooding upstream, indicating that the system capacity was exceeded, with surcharging present in the underpass. The elevation was 553.4 feet, at 1.6 feet deep. In the 2-year design storm simulation, the system capacity is also exceeded with slightly more underpass and surface flooding. The elevation was 554.1 feet (2.4 feet). Again in the 5-year and 10-year design storm simulations surface flooding is experienced. The elevations were 555.1 feet (3.3 feet) and 555.9 feet (4.1 feet), respectively. The model indicates that the inundation of the Hal Greer Boulevard (16^{th} Street) underpass was mostly caused by upward outflow (upwelling) from the surcharged combined sewers.

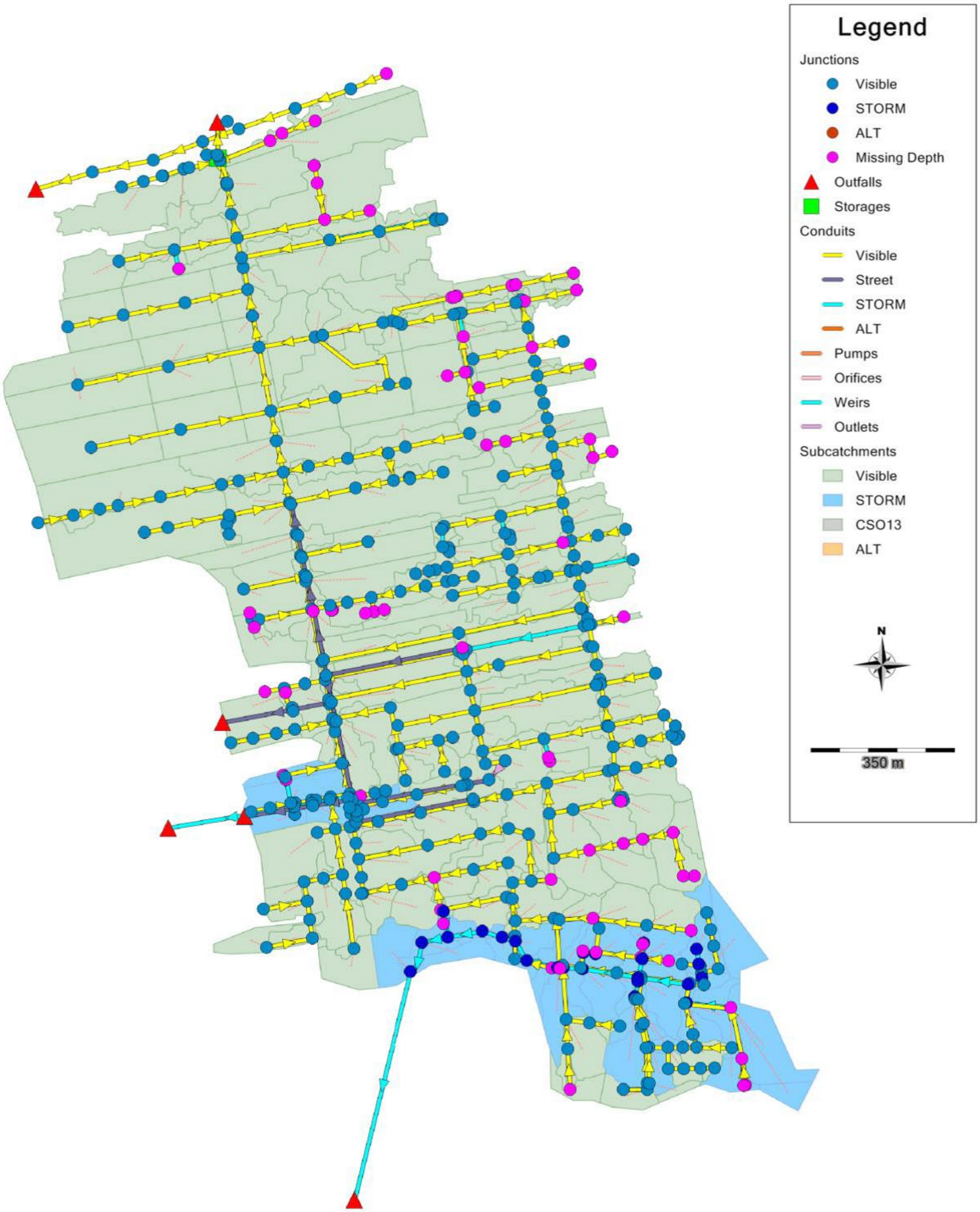


Figure 2-29: Existing Model Configuration

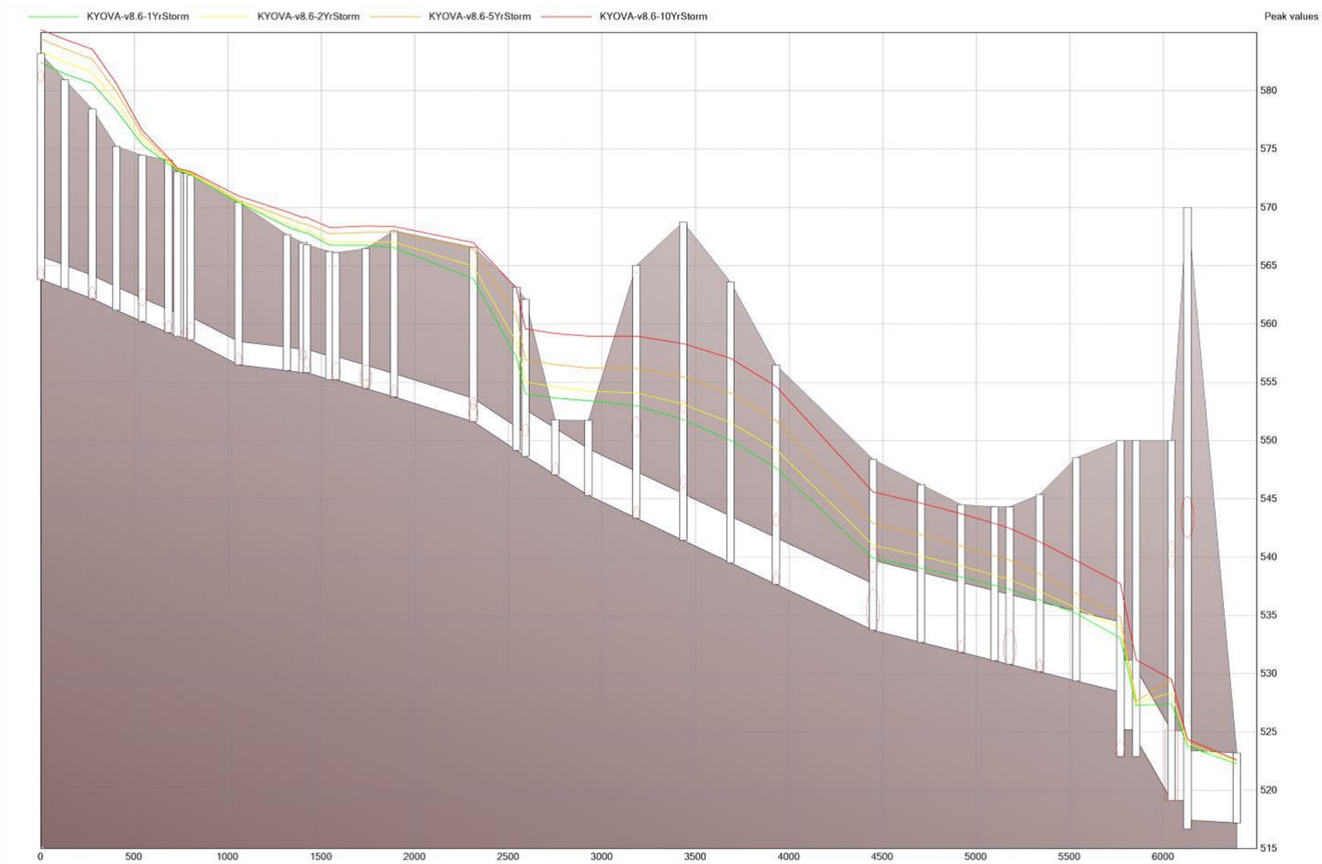


Figure 2-30: Design Storm Profiles

Flooding and Green Infrastructure Alternatives

Existing System Evaluation

From reviewing the existing conditions hydraulic model, four system limitations were identified as being challenges to flooding issues within the system. Each one of these system limitations need to be properly identified within the model to appropriately select an alternative. **Figure 2-29** from the previous section shows the configuration of the existing system model. **Figure 2-31** is a profile of the sewer running along Hal Greer Boulevard from the south to the north toward the CSO and pump station. Each of the four limitations are represented on the profile. The blue hydraulic grade line represents the maximum level that is observed during a SCS Type II storm for a 5 year - 24 hours event (3.2-inch rainfall).

Ohio River Level - The system hydraulics are directly impacted from the level at the Ohio River. As the level of the river increases a proportional rise will be experienced in the hydraulic gradeline of the sewer along the north side. This is due to a reduction in the downstream capacity at the outfall.

Pump Station- Similar to the first limitation, a peak capacity at the pump station reduces the system capacity. As a result, an increase in the hydraulic grade line will be experienced. This reduction in system

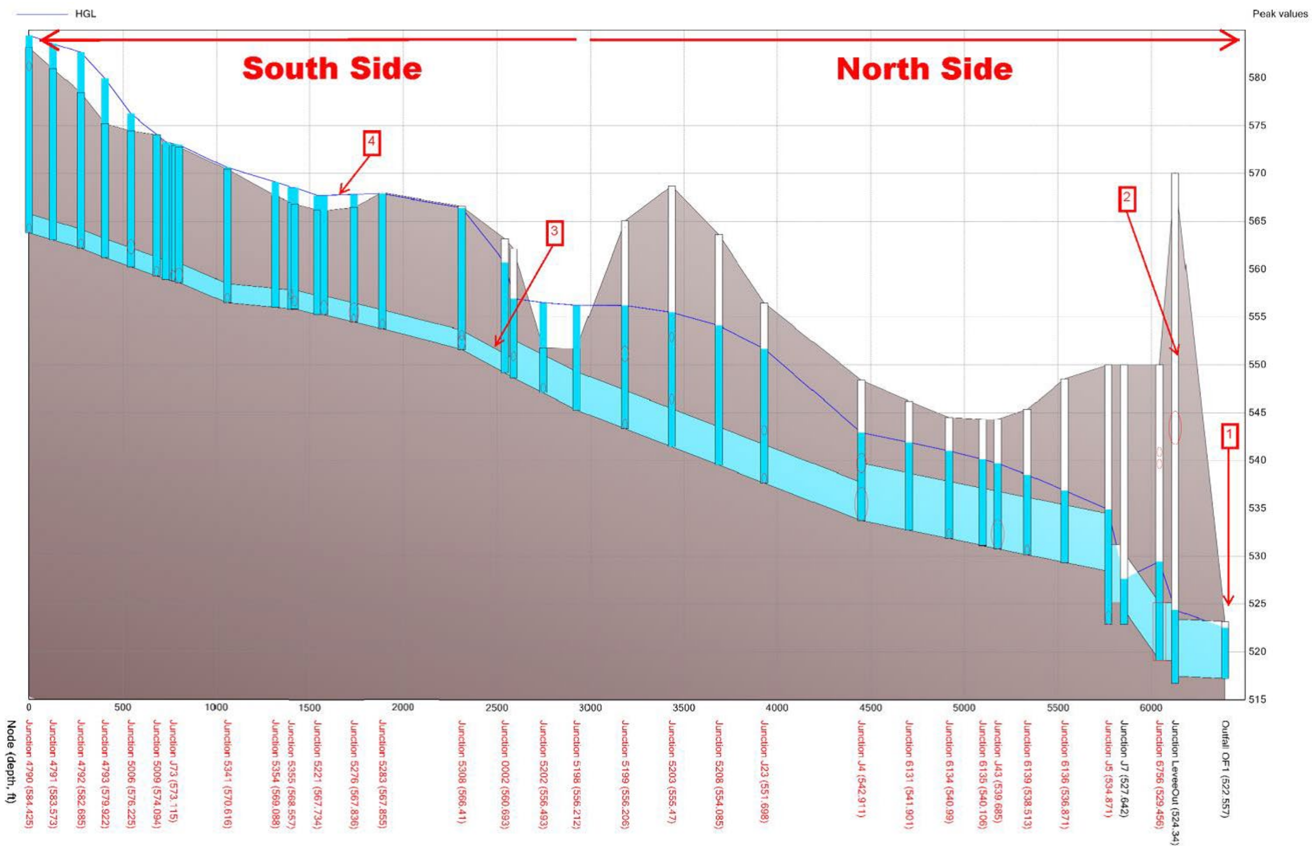


Figure 2-31: Hal Greer Sewer Profile

capacity will then result in a potential flooding issue near 3rd Avenue, the lowest section on the north side. Based off the pump curves, a peak station capacity of over 200MGD can be observed during surcharging conditions. The system is capable of supplying over 250MGD when the pump station gate is up.

Undersized Sewer - Just south of the Hal Greer Boulevard underpass, the sewer increases from a 24-inch diameter sewer to a 3-feet by 4-feet ellipse sewer. The 24-inch sewer has a fraction of the capacity the downstream sewer has and is creating an upstream surcharging issue. Without addressing other downstream system limitations first, increasing the capacity of the 24-inch will only send more flow downstream and exacerbate the flooding at the underpass.

Surface Overflow - Surcharging along the south side on Hal Greer Boulevard will create an effect that forces flow up to the surface that will overflow downhill into other basins. This flow is considered a loss from the system, but will need to be accounted for when alternatives are selected, as this flow will eventually drain into the system.

Other observations of the existing model were also observed to establish base points for alternative performance:

- The Hal Greer Boulevard underpass will begin flooding at a 1.5-inch SCS Type II storm event.
- Over a 24 hour period, the dry weather flow (DWF) conduit and wet weather flow (WWF) conduit at CSO-12 will experience the following conditions during a 1-year design storm and 5-yeardesign storm (see **Table 2-09**).
- Over a 24 hour period, the following conditions during 1-year and 5-year design storms are expected for flows leaving the basin from storm system and surface street runoff. Charleston Avenue was modeled to include the 24 inch storm line that is present, as well as the surface to monitor surface drainage from surcharging conditions. 10th Avenue was also included to represent the surface drainage expected from Hal Greer Boulevard because 10th Avenue is a low point. The Fourpole storm sewer represents the 48 inch sewer that flows south on Hal Greer Boulevard and discharges to Fourpole Creek (see **Table 2-10**).

Table 2-09: DWF / WWF Conditions

	1-Year Storm (2.22-inch)		5-Year Storm (3.20-inch)	
	CSO12-DWF	CSO12-WWF	CSO12-DWF	CSO12-WWF
Maximum Flow (MGD)	11.6	213.1	11.9	263.1
Total Flow (MG)	6.5	15.3	7.2	25.5

Table 2-10: Design Storm Conditions

	1-Year Storm (2.22-inch)				5-Year Storm (3.20-inch)			
	Charleston Storm	Charleston Surface	Fourpole Storm	10th Surface	Charleston Storm	Charleston Surface	Fourpole Storm	10th Surface
Maximum Flow (MGD)	15.1	3.2	67.9	36.6	21.4	10.4	102.3	61.9
Total Flow (MG)	0.73	0.04	2.14	1.31	1.31	0.26	3.37	2.82

* Flows represented in these tables are representative of the CSO 12 Basin, outside flows from storm or surface systems may not be indicative of holistic flows.

Alternative Considerations

The Alternative Analysis for stormwater and flooding considered four broad options during the evaluations process:

1. Conveyance
2. Combined Sewer Separation
3. Storage
4. Green Infrastructure

A process of selecting detailed alternatives was done for each one of these broad options. The process of selecting alternatives was constrained to the physical characteristics of the collection system basin, keeping in mind constructability implications. The following constraints were considered when evaluating the proposed alternative:

- The railroad running east and west through the middle of town splits the CSO Basin 12 in half with a north and south section. This creates a physical barrier that directs surface flow on the north side to the north and the south side to the west.
- The Ohio River and levee system have to be considered when normal gravity sewers are selected. In the process of directing flow to the Ohio River, mechanical means maybe needed to overcome elevated hydraulic conditions on the Ohio River.
- Hal Greer Boulevard is a main thoroughfare to the community and limiting the amount of construction located along it will help reduce any burden on the community.
- Heavy development along the northern reaches of the north side limit the ability to have any storm connections in some areas to the Ohio River.
- The CSO Basin 12 is not adjacent to any other drainage system. Fourpole Creek is the nearest waterway to the south side of the basin and is about a half mile from the nearest portion of the basin.

Due to a substantial number of missing invert information, depths for separate storm lines and alternative routing options were not able to be checked for constructability and were assumed to be functional. Further analysis will need to be considered to confirm sewer conflicts and the adjustments needed to evaluate the true feasibility and costs associated with each alternative.

Project Goals

While the primary goal of this project it to mitigate flooding in Hal Greer Boulevard underpass. The proposed alternatives will be evaluated for the following goals for this project:

1. Eliminate underpass flooding up to a 5-year design storm.
2. Eliminate the localized flooding issues within the basin.
3. Reduce the number of CSO events per City of Huntington, WV Long Term Control Plan (LTCP).
4. Improve water quality.

In the process of evaluating each alternative, a table was provided for each alternative as a quick and simple way to identify the benefits that each alternative will provide. Each goal will be represented with a symbol that indicates whether the alternative solves, improves, or provides no benefit. An example table (**Table 2-11**) is shown below. Since localized flooding is a widespread issue, it was broken into two identifiers: one for the trunk sewer along Hal Greer Boulevard and one for the trunk sewer along 19th Avenue.

Table 2-11: Example of Alternative Benefits

Alternative	Underpass	Local H.G.	Local 19th	Events	Quality
Example	⚠	✓	✗	✗	⚠

This example would indicate that the alternative solved localized flooding on Hal Greer Boulevard, but did not address localized flooding on 19th Avenue or reduce the number of expected events for the LTCP. In addition, this alternative did provide some benefit to the flooding in the underpass and improved water quality. When an improvement to a goal is shown, much like underpass flooding, the occurrence interval generally increases or the alternative only addresses a portion of the goal.

Alternative Development

The roughly 600 acres that consist of CSO Basin 12 are modeled to contribute approximately 51 MG of total precipitation during the simulated 3.20-inch SCS Type-II rainfall event (5-year design event). During this event approximately 11 MG is infiltrated, while the rest, 40 MG, enters the sewer system in the form of surface runoff. With the current model configuration, 7.2 MG goes to the plant through the interceptor, 4.7 MG is discharged into a storm system, 3.1 MG is street flow into other basins, and 25.5 MG is discharged out of the CSO. Due to the volume of discharge out the CSO over 24 hours, the best way to account for this CSO quantity is to redirect it to a separate storm system before entering the combined system.

Of the four alternative considerations, combined sewer separation and green infrastructure have the ability to meet all of the project goals while having the potential for additional external benefits. Combined sewer separation is the only alternative that can reasonably handle the volumes that are being observed within CSO Basin 12. However, due to the fact that there are multiple system limitations, a multiple solution approach may ultimately be the best alternative, since limiting factors may prevent individual preferred options.

Conveyance

Conveyance Alternative

When evaluating the conveyance option, a likely approach would be upsizing the sewer along all of Hal Greer Boulevard as an alternative because this section of sewer is the main truck line for the CSO basin. However, this alternative may involve significant construction on Hal Greer Boulevard.

Upsizing small sections of the combined sewer may make sense when coupled with another alternative. Upsizing may increase a small section of sewer when larger capacity is needed and available capacity is available downstream. Upsizing a sewer should only be done when downstream capacity is available and the increased sewer size helps an alternative meet a project goal that it would otherwise not meet without substantial resources. See **Table 2-12** for table of alternative benefits.

Table 2-12: Conveyance Alternative Benefits

Alternative	Underpass	Local H.G.	Local 19th	Events	Quality
Conveyance	✓	✓	✗	✗	✗

Figure 2-32 shows the parallel trunk sewer on Hal Greer Boulevard that is used to increase conveyance for CSO 12. To supply the needed conveyance capacity along Hal Greer Boulevard, a 3-foot to 6-foot diameter sewer would be placed alongside the existing combined sewer. Due to this additional flow being sent to the river, an additional pump station will be needed to handle the flows. The type of construction for this alternative is similar to the other separation alternatives, without the benefit of reduced CSO events or water quality improvements and therefore eliminated from consideration.

The model results for Conveyance Alternative are shown in **Table 2-13**. The table shows that the alternative removes the surface street flow, but redirects the flow to the CSO. This would have a slightly detrimental effect on water quality, by sending more flow quickly to the river, which allows for less time to enter the interceptor. It would also have the potential to increase the occurrences of flooding by allowing more flow to get to the CSO sooner, but this might be insignificant because the current dry weather flow to the interceptor is relatively small compared to the wet weather flow to the CSO.

Table 2-13: Conveyance Model Results

	Existing (MG)	Conveyance #1 (MG)
Interceptor	7.2	7.1
Storm Sewer	4.7	4.1
Street Surface	3.1	0.0
CSO	25.5	29.3

Combined Sewer Separation

Combined Sewer Separation Alternative #1

With the CSO basin divided into a north and south side, a dedicated separate storm sewer that services the entire CSO basin would be extremely difficult to build due to capacity requirements and the topography. Therefore, dividing the basin into sections that are easily separated can make separation more advantageous. The north side is naturally drained to the Ohio River, but is limited by the development along the northern end, which makes 15th Street the most likely corridor to route a storm sewer. See **Table 2-14** for table of alternative benefits.

Combined Sewer Separation Alternative 1.A would consist of a large diameter storm that would separate the combined system west of Hal Greer Boulevard and any storm system that would be easily redirected from the east side of Hal Greer Boulevard on the north side. The outlet could be routed back to the existing levee pump station or through a new dedicated storm levee pump station. Due to the capacity of this system, a separate wet weather pump station would be recommended. The size of this pump station

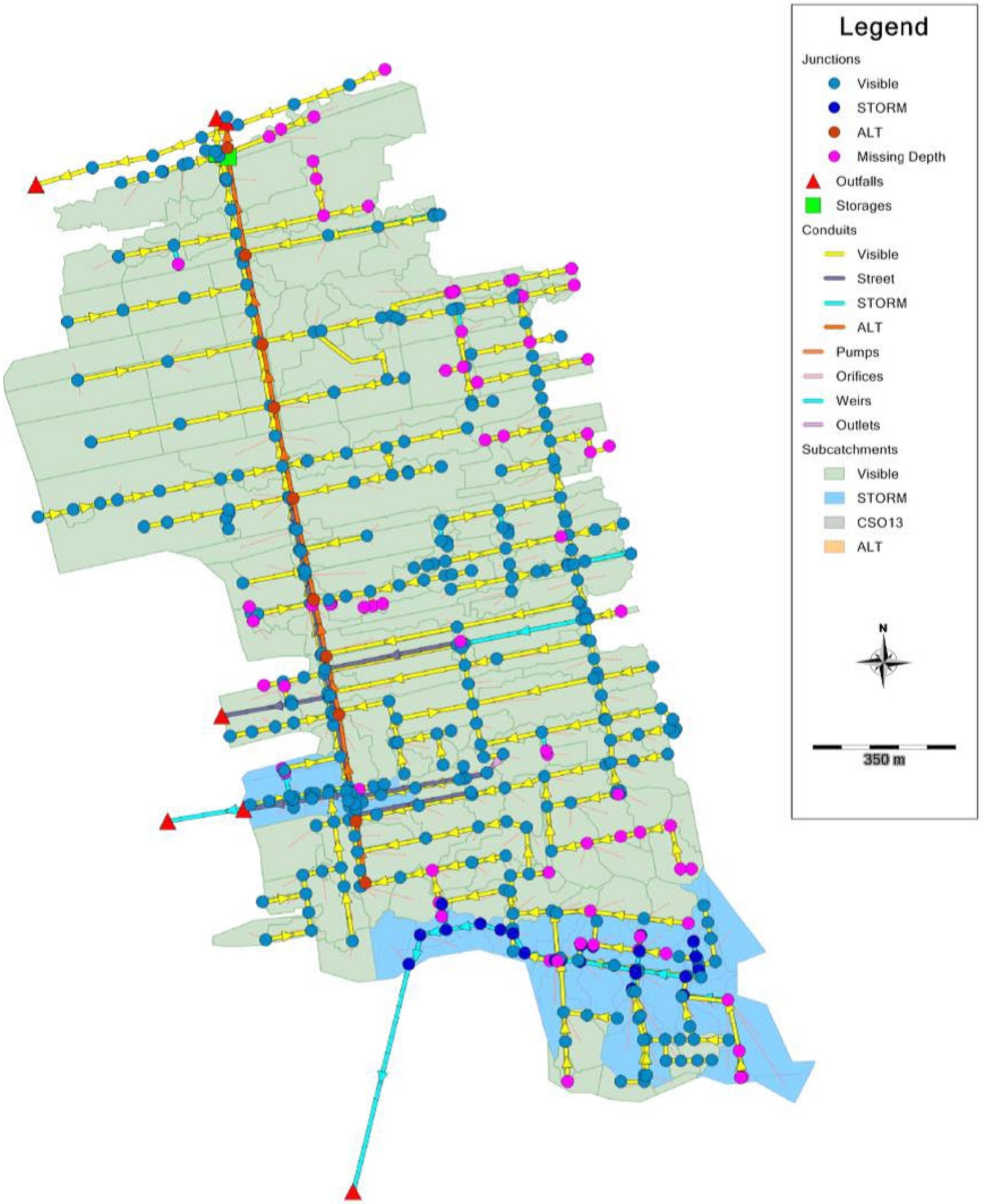


Figure 2-32: Conveyance System

would be expected to be around 300 MGD and would vary greatly by the tributary able to be redirected to the separate system. This portion of the alternative will contribute to all of the project goals, but will not fulfill any goal entirely.

Combined Sewer Separation Alternative 1.B would focus on separation opportunities on the south side of the CSO basin. The south side is more land locked with storm routing options and would require routing storm flows though adjacent basins. To the south and southwest, three separate storm systems currently border CSO Basin 12. In an effort to maximize existing systems, those three systems can be evaluated to see if there is any existing capacity left for the potential of redirecting portions of flow from CSO Basin 12. If no capacity is left, a large separate storm sewer will be required to redirect flows from the combined sewer.

Combined Sewer Separation Alternative 1.C would be beneficial to both CSO Basin 12 and CSO Basin 13. This portion of the alternative places a separate storm sewer along 20th Street and will redirect storm from both the west and east of 20th Street. This system would be similar in size as Alternative 1.A and would require a similar wet weather pump station.

Table 2-14: Sewer Separation #1 Alternative Benefits

Alternative	Underpass	Local H.G.	Local 19th	Events	Quality
Sewer Separation #1	✓	⚠	⚠	✓	✓

The combination of all three sub-alternatives is shown in **Figure 2-33**. The separate storm sewers are shown in orange, as well as the tributaries that they service. The trunk storm sewers on the north side range from 4-foot to 6.5-foot diameter, with the south storm sewer as large as 3.5-foot diameter.

The model results for Sewer Separation Alternative #1 are shown in **Table 2-15**. The table shows that a large majority of flows are redirected to storm sewers, but surface flows from the major system still exist. These surface flows are due to the inability to supply separation throughout the central region of the basin. Water quality would significantly improve with this alternative by greatly reducing the CSO volume and even the total flow into the interceptor. This drastic reduction of volume is expected to reduce the occurrences of CSOs by reducing the demand on the system.

Table 2-15: Sewer Separation Alternative #1 Model Results

	Existing (MG)	Conveyance #1 (MG)
Interceptor	7.2	5.7
Storm Sewer	4.7	23.2
Street Surface	3.1	2.0
CSO	25.5	9.0

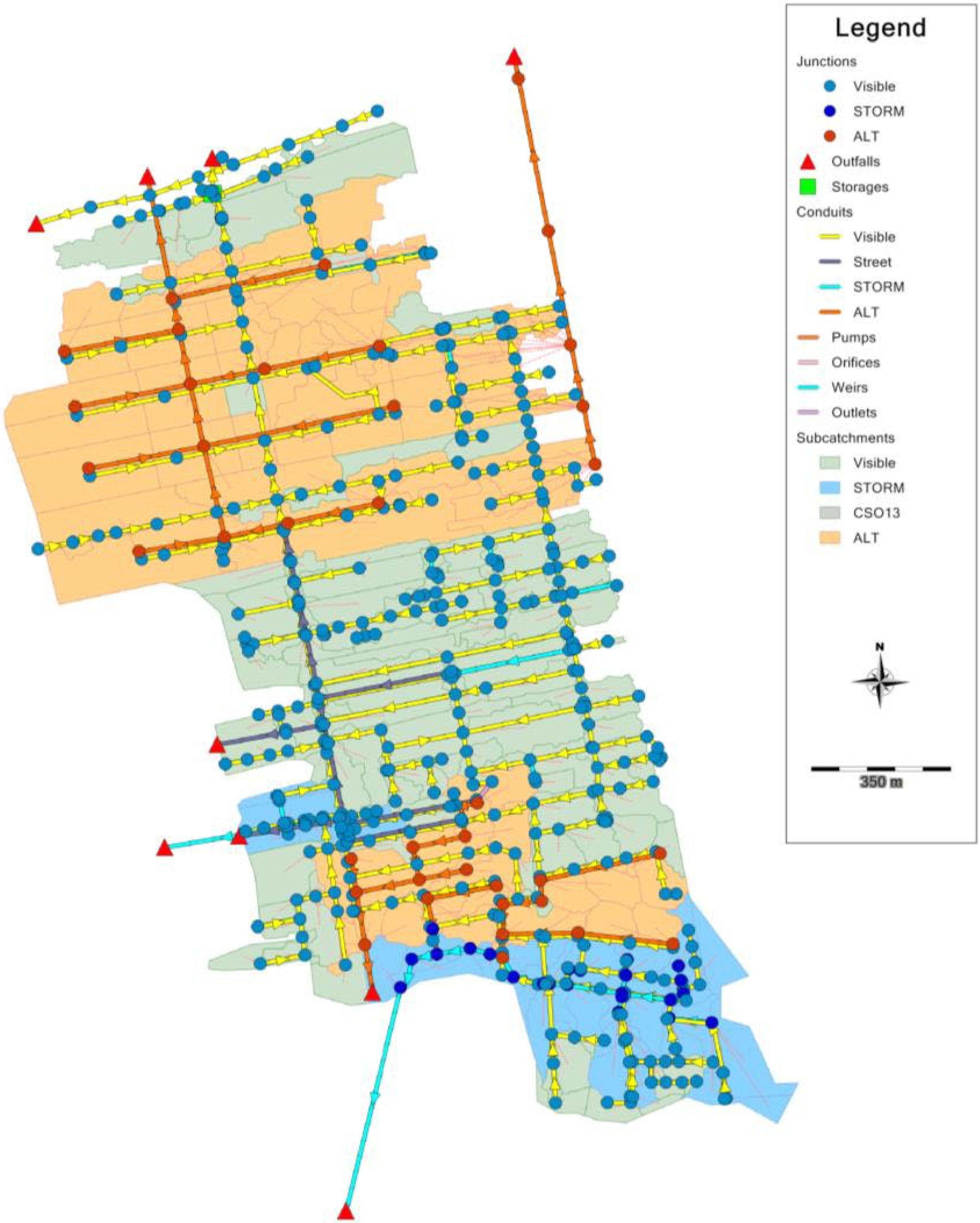


Figure 2-33: Combined Sewer Separation Alternative #1 System

Combined Sewer Separation Alternative #2

Another alternative that can be paired with other solutions is the addition of a wet weather pump station at the underpass. The wet weather pump station would only be a viable option when a deep storm sewer is not cost beneficial or a dedicated separate storm is not available. This alternative consists of separating the CSO from the catch basins located within the underpass. Sealing the combined system and bolting down the manhole lids would also be required to prevent the upwelling condition that is responsible for flooding the underpass. The pump station can either discharge to a separate storm system or downstream to the combined system. Connecting it to a separate storm system will have many benefits and will fulfill or contribute to each of the project goals. However, connecting the pump station to the combined line only would address the underpass flooding goal. Pairing this alternative with other solutions may be the most advantageous for solving the underpass flooding issue. See **Table 2-16** for table of alternative benefits.

Table 2-16: Sewer Separation #2 Alternative Benefits

Alternative	Underpass	Local H.G.	Local 19th	Events	Quality
Sewer Separation #2	✓	⚠	✗	⚠	⚠

For comparison purposed this alternative will be paired with only a single storm system to the north (Separation Alternative #1.A). **Figure 2-34** illustrates the combination of a wet weather pump station at the Hal Greer Boulevard underpass and a separate storm sewer on 15th Street. The underpass wet weather pump station is used to keep the storm system shallow reducing cost and utility conflicts. If higher up utility conflicts are present, a lower storm system could be used to eliminate the need for a pump station.

The model results for Sewer Separation Alternative #2 are shown in **Table 2-17**. The table shows that a portion of flows are redirected to storm sewers, but due to the limit of improvements for this alternative surface flows from the major system still exist. Surface flows will still be present during larger storms. Water quality would improve with this alternative by reducing the CSO volume and even the total flow into the interceptor. This reduction of CSO volume is expected to moderate reduction of CSO occurrences by reducing the demand on the system.

Table 2-17: Sewer Separation Alternative #2 Model Results

	Existing (MG)	Conveyance #1 (MG)
Interceptor	7.2	6.4
Storm Sewer	4.7	18.7
Street Surface	3.1	3.0
CSO	25.5	11.9

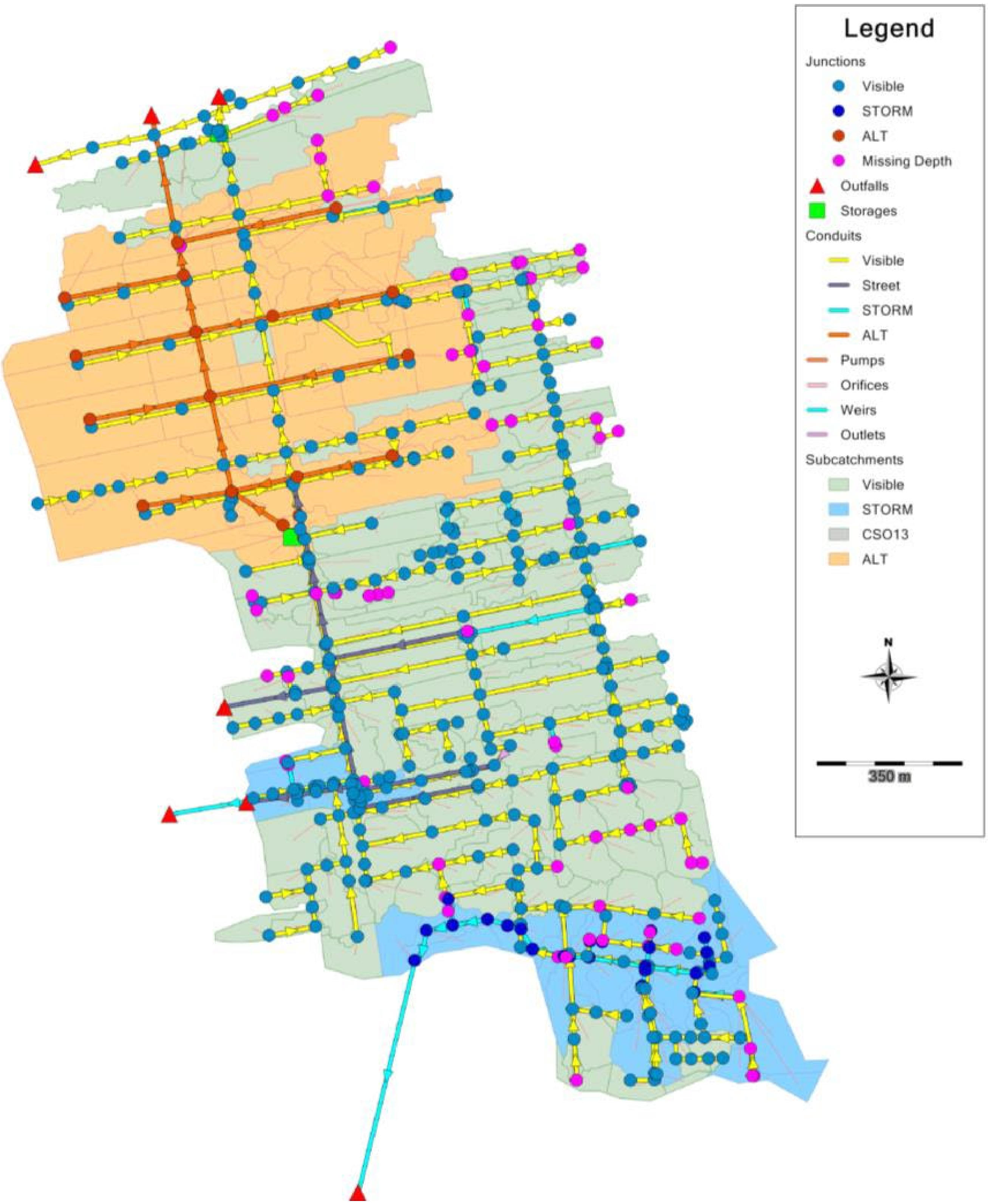


Figure 2-34: Combined Sewer Separation Alternative #2 System

Separation Alternative #3

This separation alternative would be an ideal situation, where a two storm systems can be discharged to the Ohio River and collect the upper reaches of the system with minimal utility and combined sewer conflicts. The separate storm system would cover the same area as Separation Alternative #1, as well as reach further to the south to cover a larger majority of the basin. The storm sewers in this alternative would be up to seven feet in diameter and would require a wet weather pump station of over 400 MGD when river levels limit gravity flow. Separation Alternative #3 accomplishes all of the goals established for this project. However, this alternative assumes utility conflicts would be minimal and that CSX would allow jack and boring of the proposed storm system under the railroad. Figure 35 shows how far the alternative extends to the south. Not all of the sub-catchments need to the separated to meet the set goals. As long as the majority of the sub-catchments are separated, the combined system is able to handle the remaining flows. See **Table 2-18** for table of alternative benefits.

Table 2-18: Separation Alternative #3 Alternative Benefits

Alternative	Underpass	Local H.G.	Local 19th	Events	Quality
Separation Alternative #3	✓	✓	✓	✓	✓

The flow results from Sewer Separation Alternative #3 are shown in **Table 2-19**. Out of all the separation alternatives, this one has the greatest overall improvement to surface flooding and water quality. Surface flooding is completely eliminated and the CSO volume is reduced by 80 percent for a 5-year design storm.

Table 2-19: Sewer Separation Alternative #3 Model Results

	Existing (MG)	Conveyance #1 (MG)
Interceptor	7.2	3.9
Storm Sewer	4.7	29.7
Street Surface	3.1	0.0
CSO	25.5	5.7

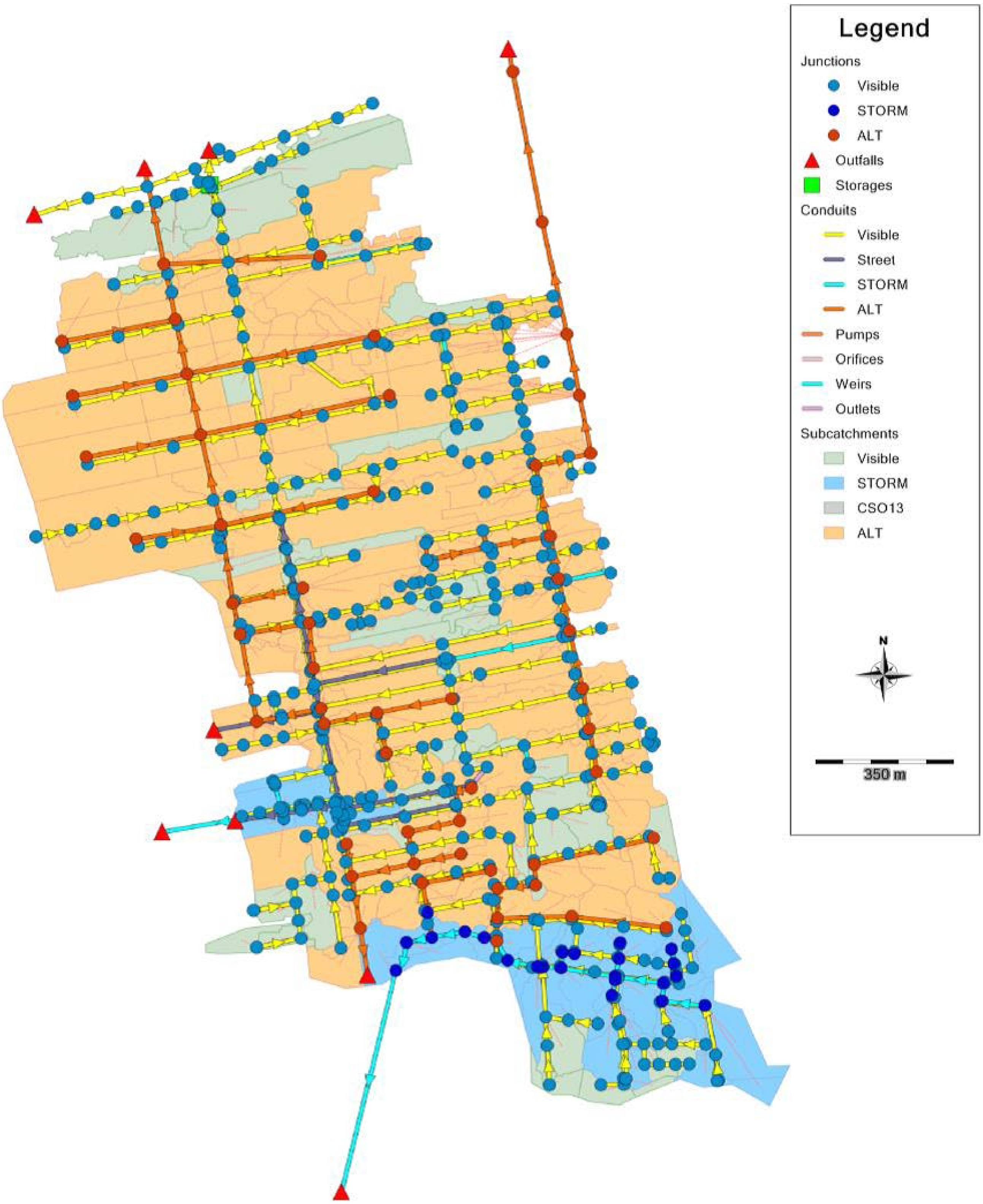


Figure 2-35: Combined Sewer Separation Alternative #3 System

Storage

Storage Alternative #1

Storage is best utilized in a system during peak conditions when system conveyance has reached its maximum potential and additional system capacity is needed to meet the demand. Storage can increase the system design limit while not having to increase downstream system components. As part of this alternative, storage can be considered to be located adjacent to Hal Greer Boulevard to supplement system capacity deficiencies. Multiple storage tanks with pump stations would be required to supplement capacity along Hal Greer Boulevard to meet the system demand during a specified design storm. Due to the multiple system limitations, having one massive storage tank in an optimal location would still not be able to account to the system limitations a cross the whole system. The model predicts that four storage tanks along Hal Greer Boulevard with a total storage capacity of 7 MG would be needed to prevent surface flooding and any other system improvements. While this addresses surface and underpass flooding issues, the other project goals are not addressed. See **Table 2-20** for table of alternative benefits.

Table 2-20: Storage Alternative Benefits

Alternative	Underpass	Local H.G.	Local 19th	Events	Quality
Storage	✓	✓	✗	✗	✗

Table 2-21 shows the results of the Storage Alternative compared to the existing system. Surface flows are removed by this alternative, but water quality and CSO flows are not addressed.

Due to the size requirements for both storage and pumping, this alternative is not recommended. The size and location of the required tanks makes the alternative impractical and likely unfavorable in the eyes of the public.

Table 2-21: Storage Alternative Model Results

	Existing (MG)	Conveyance #1 (MG)
Interceptor	7.2	7.1
Storm Sewer	4.7	4.1
Street Surface	3.1	0.0
CSO	25.5	23.3

Green Infrastructure

Similar to the storage option, green infrastructure option will require a large amount of storage to meet the goals of the project. While green infrastructure has the added ability to allow for infiltration compared to storage, green infrastructure does require a much larger footprint.

Green Alternative #1

As an independent alternative, green infrastructure would be required along nearly every street to meet the necessary storage requirements. Approximately 400,000 sq.ft. of green infrastructure would need to be installed to account for the required storage need to supplement the combined sewers. This would equate to installing green infrastructure components, such as bioswales or permeable pavement, to 12 streets that were 2,500 feet long and 15 feet wide. A substantial investment in green infrastructure would have to be made to meet all of the project goals and even then space maybe limited to fulfill each of the goals. The proposed Green #1 Alternative with 400,000 sq.ft. of green infrastructure would improve water quality, while substantially improving the system to come close to meeting all of the other goals during a 5-year design storm. For a 2-year design storm underpass and surface flooding along Hal Greer Boulevard are not expected. See **Table 2-22** for table of alternative benefits.

Table 2-22: Green #1 Alternative Benefits

Alternative	Underpass	Local H.G.	Local 19th	Events	Quality
Green #1	⚠	⚠	⚠	⚠	✔

Table 2-23 illustrates that by incorporating green infrastructure across the basin a reduction of CSO volume would occur. Green infrastructure slows down the flow and provides storage which reduces surface flooding and decreases the CSO volume by approximately a third. Types of green infrastructure that could be considered are describer following the table.

Table 2-23: Green Infrastructure Alternative Model Results

	Existing (MG)	Conveyance #1 (MG)
Interceptor	7.2	6.2
Storm Sewer	4.7	4.3
Street Surface	3.1	1.0
CSO	25.5	17.2

- Permeable Pavement/Pervious Sidewalks: A special type of paving material that is typically used in parking areas and sidewalks and that allows stormwater runoff to infiltrate through the surface course into an aggregate base. Once in the base course, the stormwater is stored in the aggregate void space until infiltrating into the soil or discharging into a receiving sewer through an underdrain. Maintenance requirements include street sweeping and vacuuming the surface course to restore permeability. Frequency of maintenance will depend on pollutant contributions from the surrounding area. When siting porous pavement, consideration will be given to existing streets trees and other sources of fine materials that may clog the surface.

- Bioretention: Vegetated practices that collect stormwater runoff for filtering, infiltration, and evapotranspiration. Bioretention may be utilized on vacant/abandoned parcels, within the curb lawn, or incorporated into traffic calming devices (stormwater bumpouts) as an alternative to speed bumps. An underdrain is typically provided for discharge into a receiving sewer system. Maintenance of bioretention cells includes weeding and pruning of vegetation and occasional replacement of the engineered soil mix. Frequency of weeding and pruning is consistent with standard landscape maintenance practices, while frequency of replacing the engineered soil mix is dependent on pollutant buildup from the surrounding land uses. When the engineered soil mix is replaced, the vegetation will also require replacement.

- Bio-Tree Trench: This innovative green infrastructure technique evolved after understanding the challenges of existing tree box design. Tree boxes are limited in their ability to capture and clean stormwater. In addition, the cost/benefit analysis for tree boxes demonstrated that stand-alone tree boxes were cost prohibitive. The Bio-Tree Trench can be used as a best management practice along the entire street and can take advantage of vertical and horizontal infiltration. The Bio- Tree Trench includes 18-24 inches of engineered soil mix to enhance water quality pollutant removal. The Bio-Tree Trench is so named because along with being a bioinfiltration practice, it also provides the resiliency needed in many corridors by using permeable pavers that still allow stormwater to be captured as part of the practice. In fact, recent studies have shown that the use of trees is extremely beneficial for water quality benefits within bioinfiltration practices.

- Green Alleys: Although alleys constitute a significant portion of impervious surface, most do not have stormwater drainage. Green alleys use permeable pavement (pervious concrete, asphalt or brick paver materials) in the cross section to increase runoff infiltration and treatment on site. An impermeable liner (geomembrane) could prevent infiltration into underlying sanitary sewers while still providing a filtering benefit, but no volume reduction would be achieved.

Rendering concepts for green infrastructure are included in **Appendix A**.

Optimal Alternative

<u>Optimized Alternative #1</u>

This alternative will include Separation Alternative #1 along with green infrastructure in sub-catchments not serviced by separate storm sewers. **Figure 2-36** illustrates the balance of GI and storm sewers throughout the CSO basin. Storm sewers, shown in orange, will be located on the north side and south end of the basin where access to outlets are available. Along the south side, green infrastructure, shown in green, can be installed to act as storage and reduce the flow to the combined sewers. Green infrastructure is used in this alternative to supplement the storm system when storm sewer extension would be expensive or infeasible. The size of the storm sewer would be up to 7 feet in diameter and would extend south to the railroad. This was a break point due to the expected cost that would be added to crossing under the railroad. The storm sewer depth would be dependent on other utilities and the combined sewer in the area, but is expected to be reasonably shallow due to not needing to continue further south to pick up additional sub-catchments. If planned for, an extension of the storm sewers south of the railroad is an option that could be used to supplement additional EPA requirements. Considerations for this alternative would include the ability to connect into existing storm sewers on the south side or whether new sewers will need to be installed. Further analysis of this alternative needs to be conducted to confirm the optimum routing of all storm flows. In this alternative, green infrastructure is used to help the existing combined sewers meet the flow capacities. A total of 200,000 sq.ft. of green infrastructure would be required thin this alternative. All project goals except for local flooding are met with this alternative. However, localized flooding is drastically reduced with this alternative and would only be present during storm at or greater than 5-year recurrence. Localized flooding that is greatly reduced from existing conditions would only be present south of the railroad where green infrastructure is proposed and the combined sewers are extremely undersized. See **Table 2-24** for table of alternative benefits.

Table 2-24: Optimized #1 Alternative Benefits

Alternative	Underpass	Local H.G.	Local 19th	Events	Quality
Optimized #1	✔	⚠	⚠	✔	✔

The model results for Optimized Alternative #1 are shown in **Table 2-25**. The table shows that the alternative reduces the surface street flow, while greatly reducing the total flow to the CSO. These surface flows are due to the inability to supply full separation throughout the central region of the basin. Water quality would significantly improve with this alternative by greatly reducing the CSO volume and even the total flow into the interceptor. This drastic reduction of CSO volume is expected to reduce the occurrences of CSOs by reducing the demand on the system.

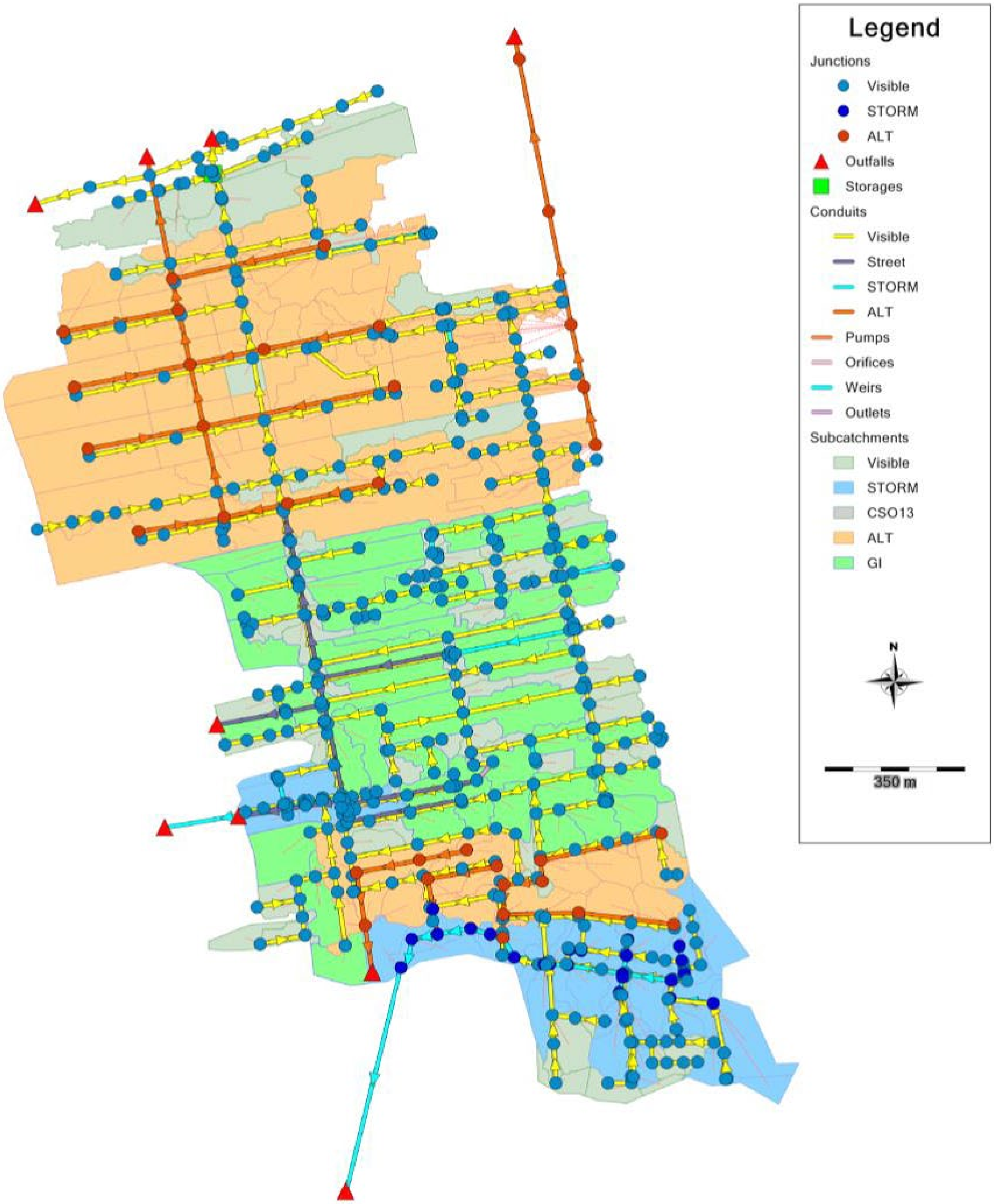


Figure 2-36: Optimized Alternative System

Table 2-25: Optimized Alternative Model Results

	Existing (MG)	Conveyance #1 (MG)
Interceptor	7.2	4.4
Storm Sewer	4.7	22.0
Street Surface	3.1	0.7
CSO	25.5	6.5

Alternatives Summary

In an effort to further compare these three preferred alternatives, **Table 2-26** illustrates the alternative benefits throughout increasing design storms. The table shows the total flow from a 24-hour period going to the interceptor, existing storm sewers, street surface runoff, and CSO with varying design year storms for each model. The level of benefit each alternative has is relatively proportional for all flow parameters. As flow decreases at the CSO, so does the street surface flows and flows going into the interceptor. By comparing the flow volume allocations for the three alternatives, it is evident that Separation #3 has the greatest holistic benefits. Optimized #1 has slightly less benefits compared to Separation #3 and Separation #1 have slightly less benefits compared to Optimized #1. This correlation is indicative of the amount of work each alternative inherently has. Table 12 also shows the depth at the Hal Greer Boulevard underpass. For evaluation purposes, any depth less than 0.4 feet is measurable drainage flows (roadway drainage). All measurements above 0.5 feet will correspond to an upwelling effect and would be considered flooding. Dependent of the model and design storm, the intensity of flooding can change greatly. While Optimized #3 has a lesser measurable depth at the underpass compared to Separation #3, each correspond to normal drainage and should be thought of as having virtually no flooding.

Table 2-26: Preferred Alternative Comparisons

1-year Design Storm (2.22 inch)				
	Existing (MG)	Separation #1 (MG)	Separation #3 (MG)	Optimized #1 (MG)
Interceptor	6.5	4.6	2.8	3.4
Storm Sewer	2.9	2.7	3.9	3.6
Street Surface	1.4	0.8	0.0	0.1
CSO	16.3	5.7	2.8	3.6
Proposed Storm	N/A	12.2	17.3	11.7
Depth at Underpass (ft)	**1.7**	**0.3**	**0.3**	**0.1**

Table 2-26: Preferred Alternative Comparisons (cont.)

2-year Design Storm (2.64 inch)				
	Existing (MG)	Separation #1 (MG)	Separation #3 (MG)	Optimized #1 (MG)
Interceptor	6.8	5.1	3.2	3.8
Storm Sewer	3.7	3.4	4.8	4.4
Street Surface	1.9	1.2	0.0	0.2
CSO	20.2	6.9	3.5	4.7
Proposed Storm	N/A	14.7	20.7	14.1
Depth at Underpass (ft)	**2.4**	**0.3**	**0.3**	**0.1**

5-year Design Storm (3.20 inch)				
	Existing (MG)	Separation #1 (MG)	Separation #3 (MG)	Optimized #1 (MG)
Interceptor	7.2	5.7	3.7	4.4
Storm Sewer	4.7	4.3	6.0	5.4
Street Surface	3.1	2.0	0.0	0.7
CSO	25.5	9.0	4.6	6.5
Proposed Storm	N/A	18.1	25.1	16.6
Depth at Underpass (ft)	**3.3**	**0.5**	**0.4**	**0.2**

10-year Design Storm (3.65 inch)				
	Existing (MG)	Separation #1 (MG)	Separation #3 (MG)	Optimized #1 (MG)
Interceptor	7.5	6.4	4.0	4.9
Storm Sewer	5.5	5.1	7.0	6.2
Street Surface	4.2	2.6	0.0	1.3
CSO	30.0	10.7	5.6	8.1
Proposed Storm	N/A	21.0	28.7	19.4
Depth at Underpass (ft)	**4.1**	**0.7**	**0.4**	**0.2**

Depending on the financial investment or the potential for phasing, the City may choose to lessen the level of service provided for this alternative. If this decision is made, implementing Separation Alternative #1A would provide the largest impact to underpass flooding. **Table 2-27** shows the model results of a 5-year design storm for Separation #1A. Street surface runoff and localized flooding would still be present for the south side of the basin, but the CSO volume would be reduced by half.

Table 2-27: 5-Year Model Results for Separation #1A

	Existing (MG)	Separation #1A (MG)
Interceptor	7.2	6.4
Storm Sewer	4.7	4.7
Street Surface	3.1	3.0
CSO	25.5	12.4
Proposed Storm	N/A	13.7
Depth at Underpass (ft)	**3.3**	**0.5**

The advantage alternative Separation #1A has is that it removes a large portion of flow, reducing the hydraulic grade line in the northern section of the Hal Greer Boulevard trunk sewer, which increases the level of service expected before underpass flooding will occur. The level of service would be near a 5-year design storm.

Figure 2-37 shows the profile of the Hal Greer Boulevard trunk sewer and the hydraulic grade line of the existing and alternative models. The black line is the existing conditions during a 5-year design storm. The pink, green, blue, and red lines correspond to the alternatives Separation #1A, Separation #1, Separation #3, and Optimized #1, respectively.

Alternative Separation #1A removes enough flow from the large diameter sewer to allow more upstream flows to come through the pipe, in turn reducing the hydraulic grade line at the underpass. However, due to the capacity of the 24-inch sewer upstream of the underpass, the hydraulic grade line quickly returns to existing system conditions a few links upstream of the underpass, which results in upstream surface flooding.

Similar to Separation #1A, Separation #1 would reduce the hydraulic grade line downstream of the underpass, resulting in less flooding at the underpass. However, Separation #1 would also greatly reduce the surface flooding on the upstream side as well. While flooding has not been completely removed, there is a noticeable reduction.

Alternative Optimized #1 is similar to Separation #1, but it would result in a significant impact to surface flooding compared to Separation #1.

Alternative Separation #3 has the greatest benefit to all of the alternatives; however, it may cost the most to construct due to multiple utility conflicts requiring the relocation of those systems. An additional SSES type evaluation would be beneficial to identifying whether this alternative would be a viable candidate. Due to some unknown combined sewer depths, evaluating the constructability of the proposed storm sewers in this alternative is not feasible.

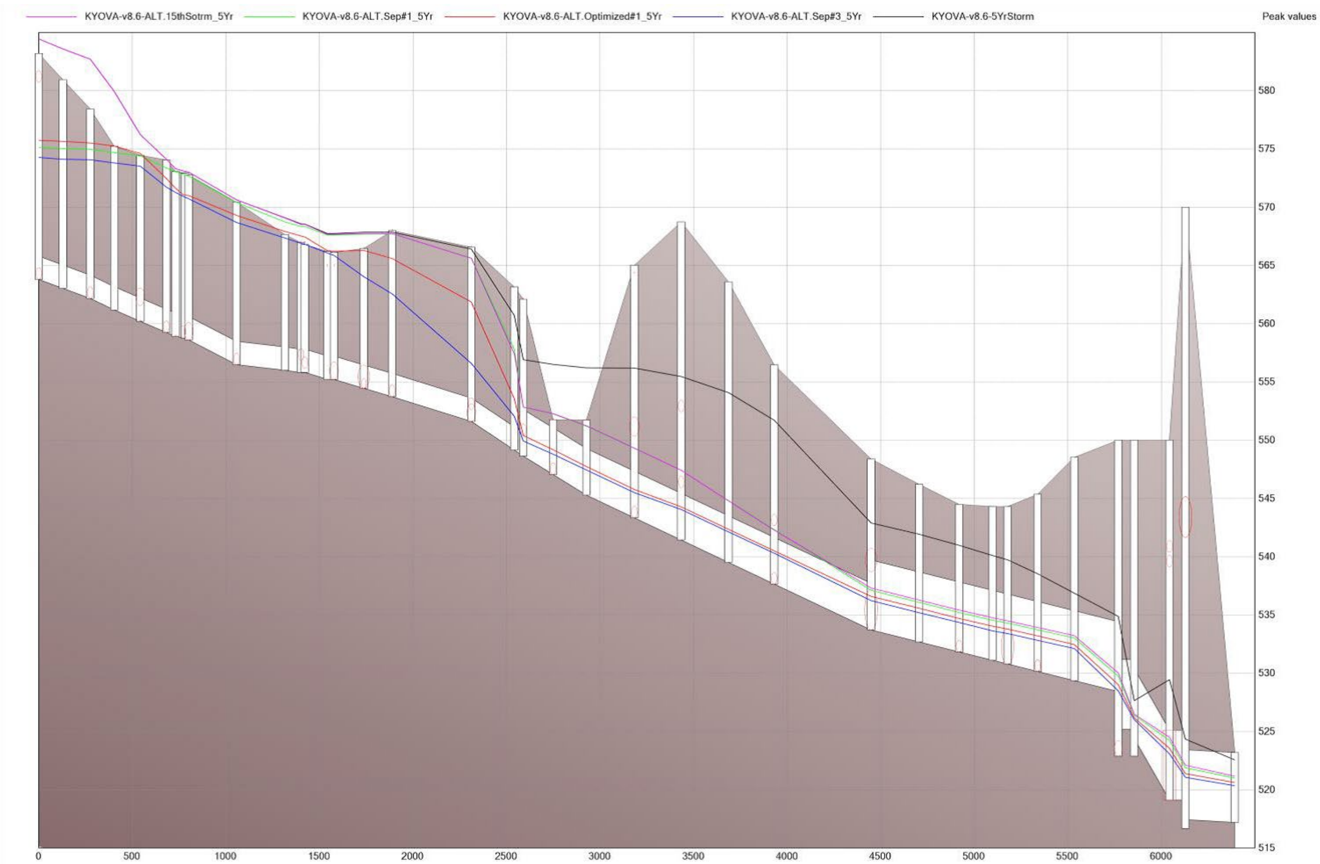


Figure 2-37: Profiles of Existing vs. Alternative Models

Chapter 3. Final Alternatives

Foundations

Based on the research and analysis discussed in Chapter Two, the study team and steering committee were able to develop a set of recommendations that comprehensively address street flooding in the study area and simultaneously contribute to the urban form and character of Huntington to positively affect future growth and development.

With an initial understanding of the immediate and long-term issues with the storm water system, the study team was able to then focus on transportation options that would complement the storm water recommendations and also provide multi-modal transportation improvements for the city.

The study team found that there were competing current recommendations from plans and studies developed by various organizations and agencies in Huntington. With an understanding of these (sometimes) differing opinions, the study team developed a set of recommendations that should complement existing plans and processes. Those plans include the 2040 KYOVA Metropolitan Transportation Plan, the Downtown Huntington Access Study, the Highlawn Brownfields Area-Wide Plan, and the 2013 Marshall University Master Plan. There were many other plans and documents reviewed in addition to these listed primary sources.

Alternatives Testing

The 2040 KYOVA Travel Demand Model was utilized to test closure scenarios for each of the identified locations where nuisance flooding has occurred. These locations included 1st Street, 8th Street, 10th Street, Hal Greer Boulevard, and 20th Street underpasses, as well as 3rd Avenue and 5th Avenue in the vicinity of Joan C. Edwards Stadium. In addition to the single closures, additional model runs were developed that assessed impacts from combinations of closures that could theoretically occur. In total, there were 13 different closure scenarios that were assessed through the model.

The raw data from each of these modeled scenarios was used to capture a ‘snapshot in time’ of the conditions that may be expected during a storm event that would impact these particular closure locations. As is the case with any travel demand model, specific numbers are not reliable to solely base decisions upon, but the overall trends give a good perspective on the consequences of the closure scenarios.

Comparing these trends to the results of the stormwater analysis allowed the study team to develop a range of solutions that best fit the needs of each area.

Recommendations

Recommended improvements are featured on the following pages and include a combination of stormwater improvements and transportation network improvements.

Stormwater Improvements

With the set system goals in mind, the selected alternative should be a combination of optimal performance compared to cost. While only one alternative, Separation #3, was able to fully accomplish the system goals, two other alternatives, Separation #1 and Optimized #1, were able to come close to a desired performance. Due to the current model calibration and level of confidence, any of these three alternatives could be viable with additional refinement. Flow monitoring and survey of the system should be conducted to increase the level of confidence in the selected alternative, before preliminary design.

Applying cost factors to each of these alternatives clarifies the recommended option, Optimized #1, for this study. A level of uncertainty applies to the recommendation based on the level of detail to which the cost estimate is developed; further investigation is necessary for the following reasons:

1. Additional study needs to be developed specifically for the area in need of improvement. This project only assessed needs and impacts for CSO #12. Each CSO area may have differing impacts and benefits that would not be realized until further study is complete.
2. Further clarification of engineering detail must be realized through preliminary and final engineering design of any improvements.
3. Cost estimates must be updated according to the outcome of the engineering design.

Table 3-01 below breaks down the costs for each of the components in the recommended alternative. The following assumptions should be noted as future plans are considered based upon these calculations:

- Pipeline linear footage is based on estimates for the Optimized #1 alternative.
- Pipe and culvert costs (including excavation, stone bedding, backfill, paving, curb/gutter, sidewalk, and SD structures) are from RS Means.
- All pipes are RCP, and culvert is precast concrete.
- Pipes 12 inches to 24 inches in diameter are assumed with an average depth of 8 feet (to invert).
- Pipes 30 inches to 72 inches in diameter and culvert are assumed with an average depth of 16 feet (to invert).
- All pipes are bedded in # 57 stone 1 foot below, 1 foot above, and 1.5 feet to each side of the springline.
- Earth backfill is to be used above stone bedding.
- Construction is in an urban environment.
- Sheeting/shoring all trenches, according to costs from AECOM engineering judgement and experience.
- Asphalt cover over all trenches includes 6-inch stone subbase and 6-inch asphalt paving.
- Curb and gutter and sidewalk (on one side of street) reconstruction assumed for all pipelines and culvert.
- Storm drain structure count is based on nodes in the model.
- Box culvert is 6 feet by 7 feet, excavation at 5 feet on each side with sheeting/shoring and 1 foot of stone bedding underneath.
- Pump station unit costs derived from www.costwater.com which cites a 1999 USEPA study. Costs were doubled to account for inflation over 20 years.
- Green infrastructure costs were derived from a presentation entitled “Maintenance and Costs of Green Infrastructure” by Rutgers University Water Resources Program, which cites a Washington, D.C. water cost evaluation.
- Engineering cost is not included.
- A contingency is not included.

Table 3-01: Recommended Stormwater Improvement Cost Estimates

Component	Cost Estimate
Pipelines	$41,111,779
SD Structures	$320,000
Culvert	$5,385,561
320 MGD Pump Station	$64,000,000
385 MGD Pump Station	$77,000,000
Green Infrastructure	$4,000,000
Total	**$191,817,340**

Complete Streets Improvements

Huntington has all the right factors in place to make its transportation network an extremely efficient, safe, and attractive system of options for all modes of travel. Many of the characteristics of the city street system are prime components of the best cities in America. The right-of-way widths are wide, traffic volumes are manageable, and the demand for multiple modal options exists with traffic generators such as the central business district and Marshall University. Huntington does not have the same constraints as many other West Virginia cities in its topography – there are not safety concerns with sight lines, steep grades to navigate, or only having one option to travel from Point A to Point B.

In many cases, the issues that affect the City of Huntington are related to its ability to provide the transportation service to residents and visitors at the level they demand, while realizing the full potential of the street network. Development of complete streets, or rightsizing, is the process of reallocating a street's space to better serve its full range of users. In many instances, the demands for roads in Huntington have changed over time. For example, a corridor that was built to initially serve a large industrial employment sector may now focus on the college population or neighborhood services. The needs of the community surrounding that road have changed over time and the design of that road may need to change to meet those needs as well. It may need less capacity to serve the driving population, an expanded sidewalk or a median to help people cross safely, or on-street parking for patrons who want to frequent local shops. Rightsizing a road can encompass a broad array of redesign measures and should always be sensitive to context and the vision of the local community

Typical goals for rightsizing include increasing safety and access for all users, encouraging walking, biking, and transit use, supporting the local economy, and creating places that foster community livability

Strategies for rightsizing include converting vehicle travel lanes to other uses, narrowing vehicle lanes, adding bike lanes, improving pedestrian infrastructure, changing parking configuration, and adding roundabouts and medians as needed.

The Project for Public Spaces (PPS) says that rightsizing a street is often a prerequisite to the street becoming a place where people want to be, instead of just a corridor to pass through. Rightsizing reconfigures a street to best serve the people who need to use it, whether they're drivers, pedestrians, or bicyclists. By improving safety, especially for people walking or biking, and by increasing space devoted to people, rightsizing projects cause vehicles to slow down and people to spend more time outside on the street.

PPS case studies highlight these projects' positive impacts, and FHWA research confirms that vehicle lanes can be converted to other purposes to achieve safety goals without negative transportation impacts. Rightsizing enables mobility for all users, increases safety for all users, and can contribute to the vitality of communities.

Safety of roadways is improved for all users by reducing dangerous driving speeds and movements. Speeding vehicles are exponentially more dangerous than vehicles traveling at appropriate speeds. FHWA road diet research found that over 80 percent of pedestrians hit by vehicles are killed when the vehicle is traveling 40 miles per hour, compared to less than 10 percent that are hit by vehicles traveling 20 miles per hour. Dedicated pedestrian and bicycle infrastructure also improves street safety.

Street access for pedestrians is improved through rightsizing by increasing safety and appeal. All transportation trips start and end as pedestrian trips, regardless of the intermediate mode, and making these trips safer and more enjoyable for people is crucial for communities' physical health, the cultivation of public spaces, and the success of street-fronted businesses. When redesigning a street, it is vital to prioritize designs that enable safe mobility for particularly vulnerable users, such as children and elderly pedestrians.

The following section discusses nine projects in Huntington where CSO improvements, roadway improvements, and rightsizing, coupled with installation of green infrastructure, can achieve these goals:

1. Reduce impervious surfaces throughout the city and increase groundwater recharge and retention of stormwater
2. Reduce vehicle speeds and make drivers more aware of their surroundings
3. Create community identity and provide a sense of place for each corridor
4. Improve safety for all travel modes
5. Provide opportunities for users, regardless of economic status, and reduce dependence on single-driver trips
6. Encourage redevelopment and community investment

Project 1

Project Name: 3rd Avenue Complete Street

Project Location: 3rd Avenue between 25th Street and 13th Street

Project Description: Retrofit 3rd Avenue as a complete, livable street, incorporating green infrastructure, complete streets principles, and placemaking to develop a sense of identity and maximize function of the corridor. Goals include reduction of impervious surface, increased rate of groundwater recharge, and increased functionality of the corridor for bicycles, pedestrians, and motorized vehicles.

Project Details: Acknowledging alternative parking and circulation along the corridor, develop a consistent road diet starting at 25th Street, through the Marshall campus, crossing Hal Greer Boulevard, and ending at 13th Street where US 60 diverts from 3rd Street. This project will establish the 3rd Avenue corridor as a complete street that serves all modes of travel and identify two distinct places – the Marshall campus (stadium complex and academic grounds) and the Huntington Central Business District. These two unique areas are bisected by Hal Greer Boulevard, which is undergoing a WVDOH Planning Study in 2017-2018 and will deliver close to 30,000 vehicles per day to the 3rd Avenue corridor.

The distinct roadway sections include:

Stadium Area (25th Street to 16th Street)

Current configuration: Four travel lanes (one way - west) with street parking on both sides

Planned configuration: Three 11-foot travel lanes with one lane of street parking, a dedicated two-way cycle track, and bioretention swales adjacent to sidewalks. Pavement updated with porous asphalt or pervious pavers under parking areas and the cycle track (**Figure 3-01**).

CBD Area (16th Street to 13th Street)

Current configuration: Four travel lanes (one way - west) with street parking on both sides

Planned configuration: Two 11-foot travel lanes with one lane of street parking, a center median with bioretention swale, a dedicated two-way cycle track, and bioretention swales adjacent to sidewalks. Pavement updated with porous asphalt or pervious pavers under parking areas and the cycle track (**Figure 3-02**).

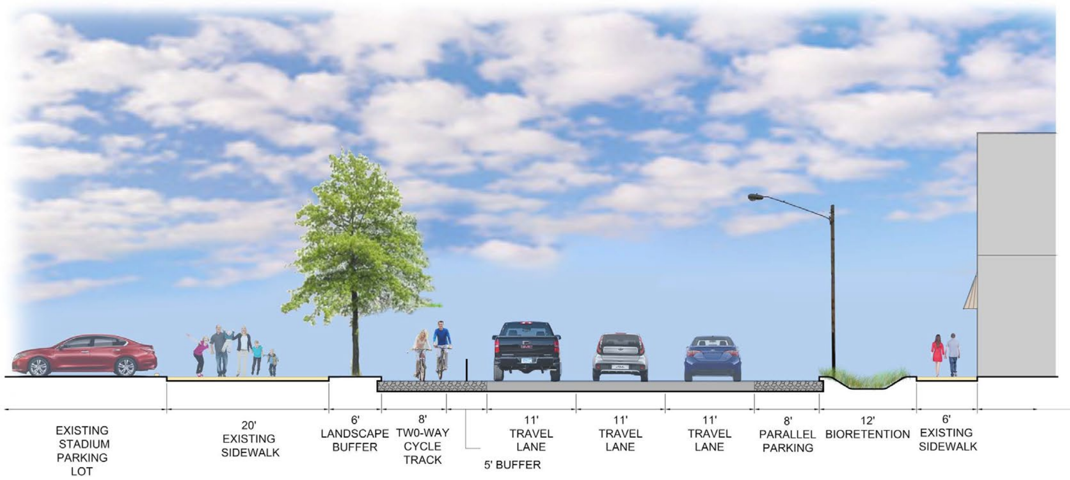


Figure 3-01: 3rd Avenue Complete Street (25th Street to 16th Street)

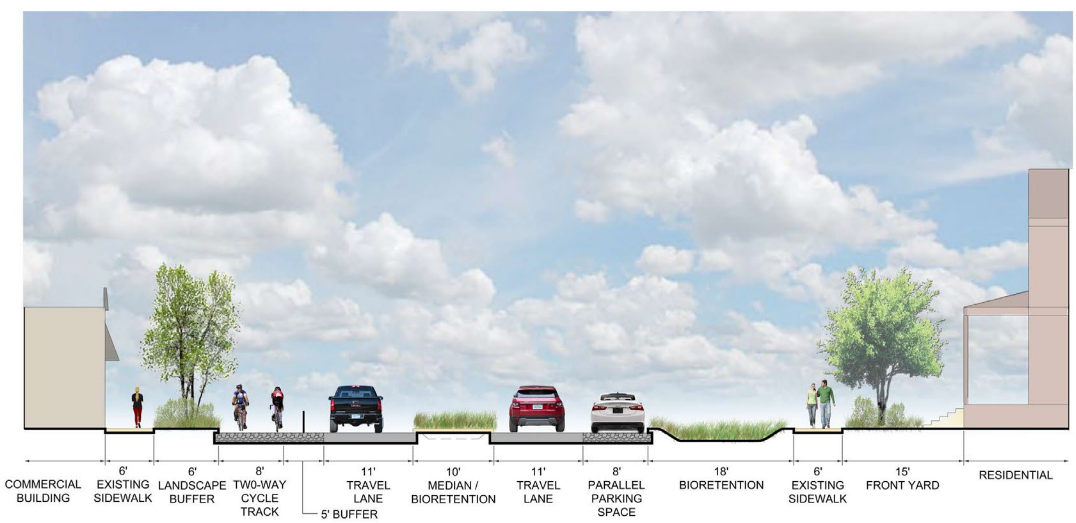


Figure 3-02: 3rd Avenue Complete Street (16th Street to 13th Street)

Project 2

Project Name: 5th Avenue Complete Street Part 1

Project Location: 5th Avenue between 29th Street and 13th Street

Project Description: Retrofit 5th Avenue as a complete, livable street, incorporating green infrastructure, complete streets principles, and placemaking to develop a sense of identity and maximize function of the corridor. Goals include reduction of impervious surface, increased rate of groundwater recharge, and increased functionality of the corridor for bicycles, pedestrians, and motorized vehicles.

Project Details: Acknowledging alternative parking and circulation along the corridor, develop a consistent road diet starting at 29th Street, through the Marshall campus, crossing Hal Greer Boulevard, and ending at 13th Street where the residential district transitions to office and institutional uses. This project will distinguish three distinct sections of the 5th Avenue corridor and help to calm traffic through the Marshall campus, as well as provide multi-modal travel options for residents and student commuters. In addition to Hal Greer Boulevard, the 5th Avenue corridor is envisioned as a major commuter route for commuters to Marshall University.

The distinct roadway sections include:

Business Area (29th Street to 20th Street)

Current configuration: Four travel lanes (one way - east)

Planned configuration: Three 11-foot travel lanes with a dedicated two-way cycle track, and bioretention swales adjacent to sidewalks. Pavement updated with porous asphalt or pervious pavers under the cycle track (**Figure 3-03**) .

University Area (20th Street to 16th Street)

Current configuration: Four travel lanes (one way - east)

Planned configuration: Two 11-foot travel lanes and an 8-foot two-way cycle track on the north side. Include a 10-foot center pedestrian refuge with bioretention bulbs. Install parallel parking on both sides. On the north side, install 6-foot sidewalk and a 6-foot green buffer. On the south side, install 6-foot sidewalk and 6-foot green buffer. Pavement updated with porous asphalt under the cycle track. At either end of this section of corridor, there would be an opportunity to establish gateway wayfinding to the Marshall University academic campus (**Figure 3-04**).

Residential Area (16th Street to 13th Street)

Current configuration: Four travel lanes (one way - east)

Planned configuration: Two 11-foot travel lanes and an 8-foot two-way cycle track on the north side. Include a 10-foot center pedestrian refuge with bioretention bulbs. Install parallel parking on both sides. On the north side, install 6-foot sidewalk and a 6-foot green buffer. On the south side, install 6-foot sidewalk and 6-foot green buffer. Pavement updated with porous asphalt under the cycle track (**Figure 3-05**).

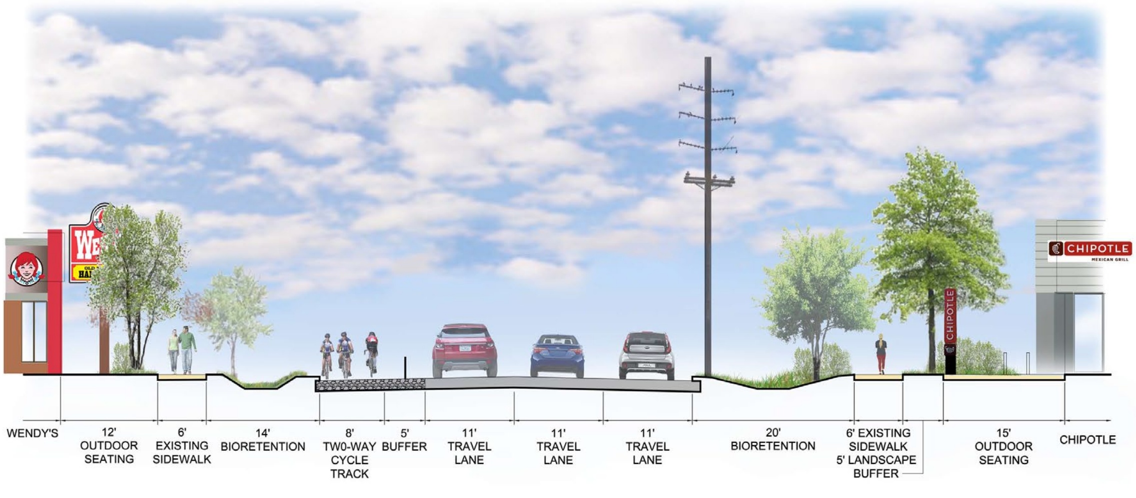


Figure 3-03: 5th Avenue Complete Street (29th Street to 20th Street)

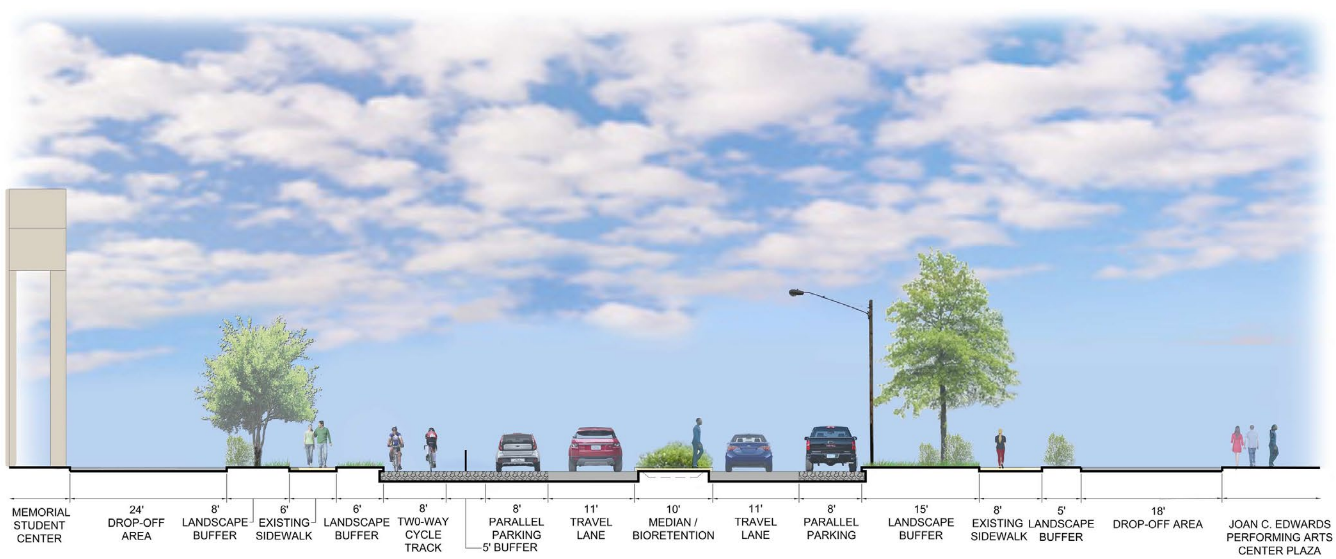


Figure 3-04: 5th Avenue Complete Street (20th Street to 16th Street)

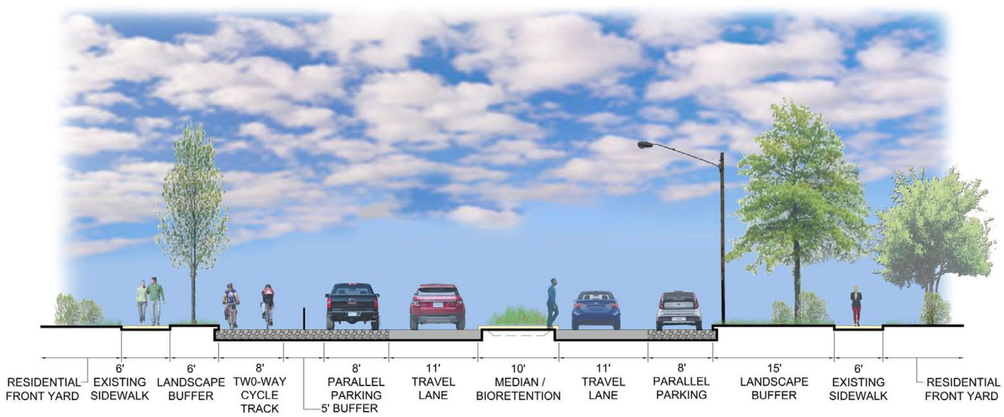


Figure 3-05: 5th Avenue Complete Street (16th Street to 13th Street)

Project 3

Project Name: 20th Street Underpass

Project Location: 20th Street between 8th Avenue and 5th Avenue

Project Description: Retrofit 20th Street as a complete, livable street, incorporating green infrastructure, complete streets principles, and placemaking to develop a sense of identity and maximize function of the corridor. Goals include reduction of impervious surface, increased rate of groundwater recharge, and increased functionality of the corridor for bicycles, pedestrians, and motorized vehicles. The corridor is a major arterial across the CSX underpass and must provide reliable multimodal connectivity between 8th Avenue and the north during significant storm events.

Project Details: With a focus on access and safety, develop multimodal roadway improvements between 8th Avenue and 5th Avenue. This project will develop a reliable, safe connection between the Fairfield neighborhood and 5th Avenue that is primarily a local traffic route, but can be utilized as needed by a larger volume of commuters and re-routed traffic from adjacent underpasses. In addition to Hal Greer Boulevard, the 20th Street corridor is envisioned as a major south-north route for commuters to Marshall University.

The distinct roadway sections include:

Underpass Area (8th Avenue to 7th Avenue)

Current configuration: 2+2 travel lanes (bi-directional) with 4-foot sidewalk on east side

Planned configuration: Two 11-foot travel lanes, a center turn lane with bioretention islands, and a dedicated two-way cycle track. Pavement updated with porous asphalt or pervious pavers under the non-motorized path (**Figure 3-06**).

University Area (7th Avenue to 5th Avenue)

Current configuration: 2+2 travel lanes (bi-directional) with 12-foot sidewalk and street parking on both sides

Planned configuration: Two 11-foot travel lanes with a 6-foot center pedestrian refuge, street parking on one side, a dedicated two-way cycle track, and bioretention swales adjacent to sidewalks. Pavement updated with porous asphalt or pervious pavers under parking areas and cycle track. The northbound 20th Street and 5th Avenue intersection presents an opportunity to establish gateway wayfinding to the Marshall University academic campus and the stadium (**Figure 3-07**).

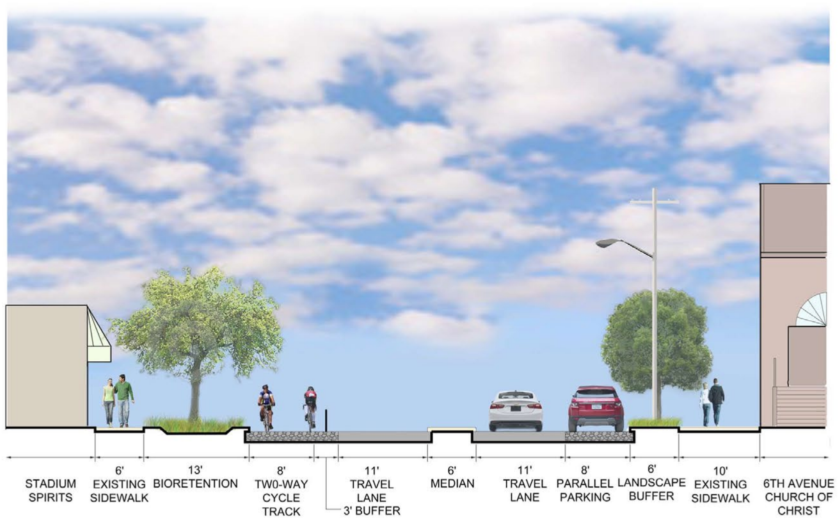


Figure 3-06: 20th Street Underpass (7th Avenue to 5th Avenue)

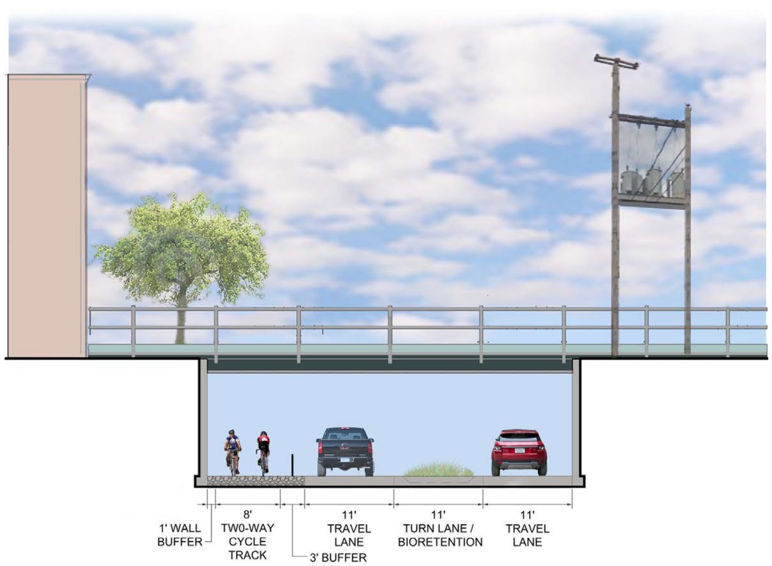


Figure 3-07: 20th Street Underpass (8th Avenue to 7th Avenue)

Project 4

Project Name: 16th Street Underpass

Project Location: 16th Street between 8th Avenue and 5th Avenue

Project Description: Retrofit Hal Greer Boulevard as a complete, livable street, incorporating green infrastructure, complete streets principles, and placemaking to develop a sense of identity and maximize function of the corridor. Goals include reduction of impervious surface, increased rate of groundwater recharge, and increased functionality of the corridor for bicycles, pedestrians, and motorized vehicles. The corridor is the primary travel route for commuters and visitors across the CSX underpass and must provide reliable multimodal connectivity between 8th Avenue and the north during significant storm events.

Project Details: With a focus on access and safety, develop multimodal roadway improvements between 8th Avenue and 5th Avenue. This corridor is a major gateway to the City of Huntington and the project will develop a reliable, safe connection between I-64 and 5th Avenue that is a regional arterial route with the flexibility to accommodate a large volume of vehicles and re-routed traffic from adjacent underpasses. In addition to 20th Street, the Hal Greer Boulevard corridor is envisioned as a major south-north route for commuters to Marshall University.

The distinct roadway sections include:

Underpass Area (8th Avenue to 7th Avenue)

Current configuration: 2+2 travel lanes (bi-directional) with 4-foot sidewalk on west side and 2-foot sidewalk on east side

Planned configuration: Two 11-foot travel lanes, a center turn lane with bioretention islands, and an elevated bicycle / multiuse path on the east side. Pavement updated with porous asphalt or pervious pavers under the multi-use path (**Figure 3-08**).

University Area (7th Avenue to 5th Avenue)

Current configuration: 2+2 travel lanes (bi-directional) with 12-foot sidewalk and street parking on both sides from 7th Avenue north to the alley and then 2+2 travel lanes (bi-directional) with center striped turn lanes and 12-foot sidewalk on both sides from the alley north to 5th Avenue.

Planned configuration: Two 11-foot travel lanes with a 6-foot center pedestrian refuge, street parking on one side, a dedicated two-way cycle track, and bioretention swales adjacent to sidewalks. Pavement updated with porous asphalt or pervious pavers under parking areas and cycle track. The northbound Hal Greer Boulevard and 5th Avenue intersection presents an opportunity to establish gateway wayfinding to the Marshall University academic campus and the stadium (**Figure 3-09**).

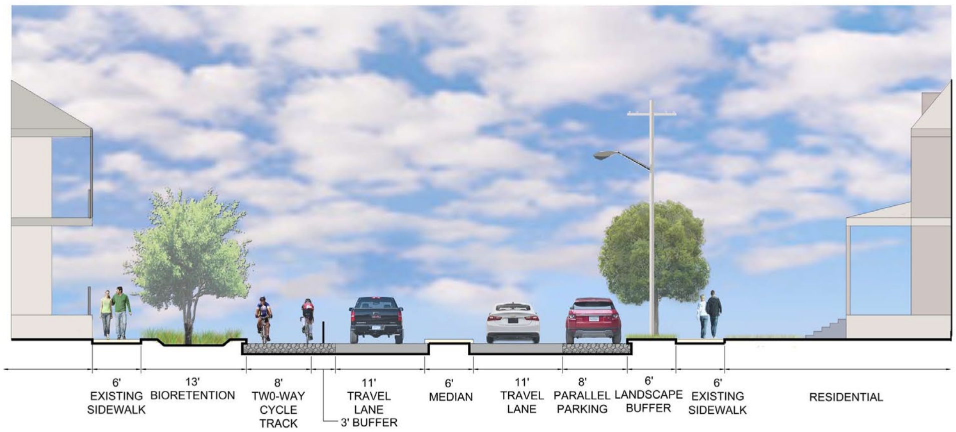


Figure 3-08: 16th Street Underpass (7th Avenue to 5th Avenue)

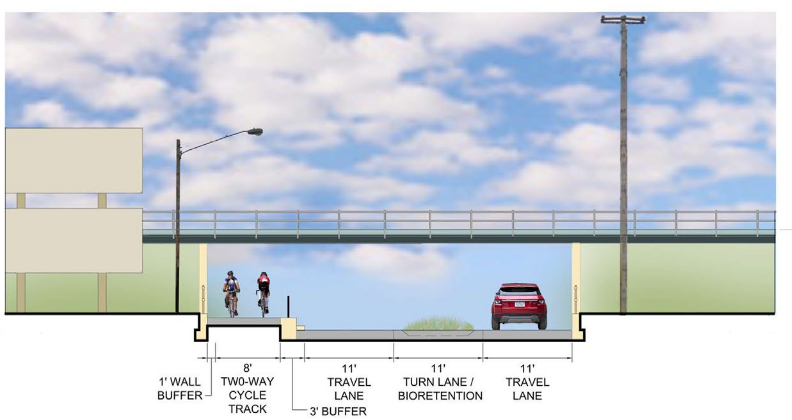


Figure 3-09: 16th Street Underpass (8th Avenue to 7th Avenue)

Project 5

Project Name: Hal Greer Storm Separation

Project Location: CSO #12

Project Description: With the CSO basin divided into a north and south side by the rail facility, a dedicated separate storm sewer that services the entire CSO basin would be extremely difficult to build due to utilities, capacity requirements and the topography. Therefore, dividing the basin into sections can make separation more advantageous. The north side is naturally drained to the Ohio River, but is limited by the development along the northern end, which makes 15th Street the most likely corridor to route a storm sewer. This project needs to be supplemented by green infrastructure to act as storage and reduce flow to combined sewers.

Project Details: *Combined Sewer Separation Part 1.A* would consist of a large diameter storm that would separate the combined system west of Hal Greer Boulevard and any storm system that would be easily redirected from the east side of Hal Greer Boulevard on the north side. The outlet could be routed back to the existing levee pump station or through a new dedicated storm levee pump station. Due to the capacity of this system a separate wet weather pump station is necessary, sized at 300 MGD and would vary greatly by the tributary able to be redirected to the separate system.

Combined Sewer Separation Part 1.B would focus on separation opportunities on the south side of the CSO basin. The south side is more land locked with storm routing options and would require routing storm flows though adjacent basins. To the south and southwest, three separate storm systems currently border CSO Basin 12. In an effort to maximize existing systems, those three systems can be evaluated to see if there is any existing capacity left to redirect portions of flow from CSO Basin 12. If no capacity is left a large separate storm sewer will be required to redirect flows from the combined sewer.

Combined Sewer Separation Part 1.C would be beneficial to both CSO Basin 12 and CSO Basin 13. This portion of the alternative places a separate storm sewer along 20th Street and will redirect storm from both the west and east of 20th Street. This system would be similar in size as Part 1.A and would require a similar wet weather pump station.

The trunk storm sewers on the north side range from 4-foot to 6.5-foot diameter, with the south storm sewer as large as 3.5-foot diameter. **Table 3-02** shows that a large majority of flows are redirected to storm sewers, but surface flows from the major system still exist. These surface flows are due to the inability to supply separation throughout the central region of the basin. Water quality would significantly improve with this alternative by greatly reducing the CSO volume and even the total flow into the interceptor. This drastic reduction of volume is expected to reduce the occurrences of CSOs by reducing the demand on the system.

Localized flooding is drastically reduced with this alternative and would only be present during storm at or greater than 5-year recurrence. Localized flooding that is greatly reduced from existing conditions would only be present south of the railroad where green infrastructure is proposed and the combined sewers are extremely undersized.

Table 3-02: Trunk Storm Sewers

Type	Existing (MG)	Storm Separation (MG)
Interceptor	7.2	4.4
Storm Sewer	4.7	22.0
Street Surface	3.1	0.7
CSO	25.5	6.5

Project 6

Project Name: 10th Street Underpass

Project Location: 10th Street between 8th Avenue and 5th Avenue

Project Description: Retrofit 10th Street as a complete, livable street, incorporating green infrastructure, complete streets principles, and placemaking to develop a sense of identity and maximize function of the corridor. Goals include reduction of impervious surface, increased rate of groundwater recharge, and increased functionality of the corridor for bicycles, pedestrians, and motorized vehicles. The corridor is a major travel route for commuters and local residents across the CSX underpass, primarily accessing social services and the central business district, and must provide reliable multimodal connectivity between 8th Avenue and the north during significant storm events.

Project Details: With a focus on access and safety, develop multimodal roadway improvements between 8th Avenue and 5th Avenue. This corridor is a primary central access point to the City of Huntington and the project will develop a reliable, safe connection between south side residential areas, commuters from I-64, and 5th Avenue that is a local arterial route with the flexibility to accommodate a large volume of vehicles and re-routed traffic from adjacent underpasses. The 10th Street corridor is envisioned as a major south-north route for commuters to downtown Huntington.

The distinct roadway sections include:

Underpass Area (8th Avenue to 7th Avenue)

Current configuration: 1+1 travel lanes (bi-directional) with 8-foot sidewalk on east side

Planned configuration: Two 11-foot travel lanes and a green bicycle / multiuse path on the east side. Pavement updated with porous concrete under the multiuse path (**Figure 3-10**).

Central Business District Area (7th Avenue to 5th Avenue)

Current configuration: 2+2 travel lanes (bi-directional) with 10-foot sidewalk and street parking on the west side and 12-foot sidewalk and street parking on the east side from 7th Avenue north to 5th Avenue.

Planned configuration: Two 11-foot travel lanes, street parking on both sides, an 8-foot dedicated two-way cycle track, and bioretention swales in bulb outs at each intersection. Pavement updated with porous asphalt or pervious pavers under parking areas and cycle track. Paired with 8th Street, this corridor can be established as a preferred commuter route (**Figure 3-11**).

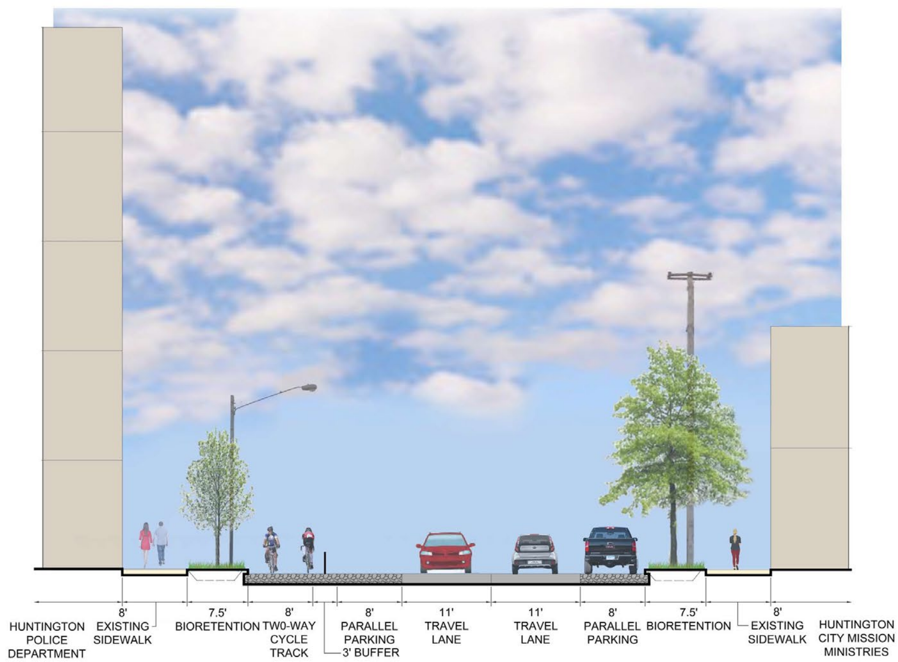


Figure 3-10: 10th Street Underpass (7th Avenue to 5th Avenue)

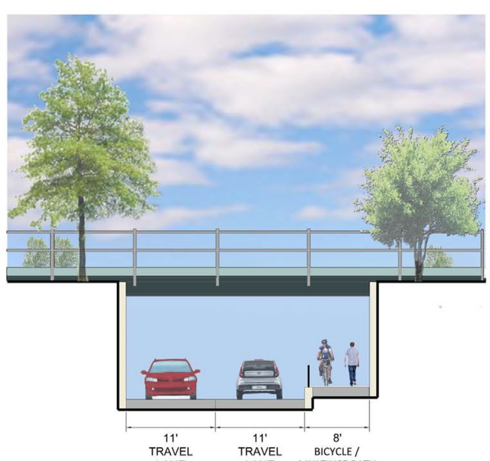


Figure 3-11: 10th Street Underpass (8th Avenue to 7th Avenue)

Project 7

Project Name: 8th Street Underpass

Project Location: 8th Street between 8th Avenue and 5th Avenue

Project Description: Retrofit 8th Street as a complete, livable street, incorporating green infrastructure, complete streets principles, and placemaking to develop a sense of identity and maximize function of the corridor. Goals include reduction of impervious surface, increased rate of groundwater recharge, and increased functionality of the corridor for bicycles, pedestrians, and motorized vehicles. The corridor is a major travel route for commuters and local residents across the CSX underpass, primarily accessing the central business district, and must provide reliable multimodal connectivity between 8th Avenue and the north during significant storm events.

Project Details: With a focus on access and safety, develop multimodal roadway improvements between 8th Avenue and 5th Avenue. This corridor is a primary central access point to the City of Huntington and the project will develop a reliable, safe connection between south side residential areas, commuters from I-64, and 5th Avenue that is a local arterial route with the flexibility to accommodate a large volume of vehicles and re-routed traffic from adjacent underpasses. The 8th Street corridor is envisioned as the primary south-north route for commuters to downtown Huntington.

The distinct roadway sections include:

Underpass Area (8th Avenue to 7th Avenue)

Current configuration: 2+2 travel lanes (bi-directional) with 3-foot sidewalk on east side.

Planned configuration: Two 12-foot travel lanes, a center 11-foot bioretention median and a raised 8-foot green bicycle / multiuse path on the east side. Pavement updated with porous concrete under the multiuse path (**Figure 3-12**).

Central Business District Area (7th Avenue to 5th Avenue)

Current configuration: 2+2 travel lanes (bi-directional) with 14-foot sidewalk and street parking on both sides.

Planned configuration: Four 10-foot travel lanes, a center turn lane with bioretention islands, an 8-foot dedicated two-way cycle track, and bioretention swales in bulb outs at each intersection. Sidewalks reduced to 10 feet on each side. Pavement updated with porous asphalt or pervious pavers under parking areas and cycle track. Paired with 10th Street, this corridor can be established as a preferred commuter route (**Figure 3-13**).

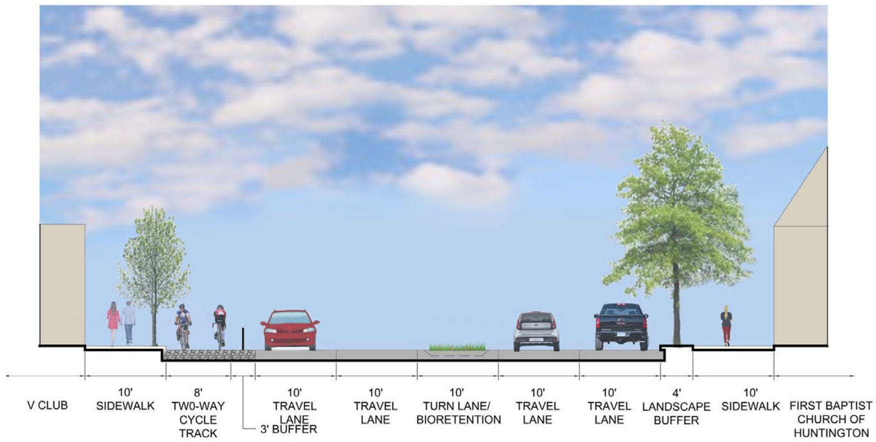


Figure 3-12: 8th Street Underpass (7th Avenue to 5th Avenue)

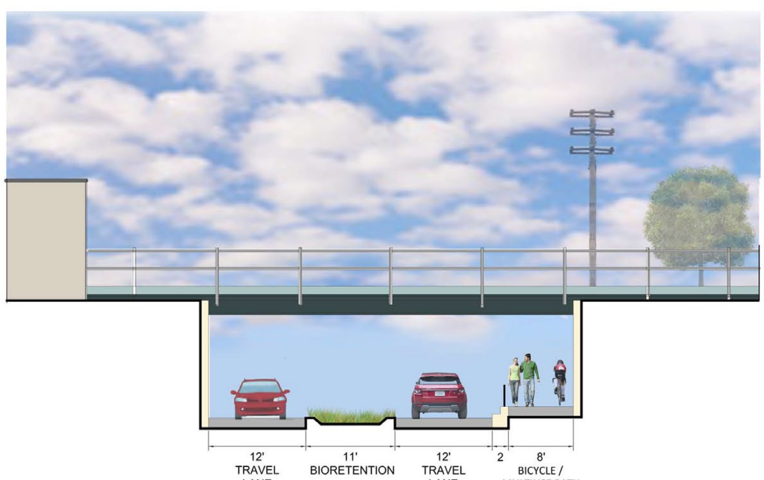


Figure 3-13: 8th Street Underpass (8th Avenue to 7th Avenue)

Project 8

Project Name: 1st Street Underpass

Project Location: 1st Street between 8th Avenue and 5th Avenue

Project Description: Retrofit 1st Street as a complete, livable street, incorporating green infrastructure, complete streets principles, and placemaking to develop a sense of identity and maximize function of the corridor. Goals include reduction of impervious surface, increased rate of groundwater recharge, and increased functionality of the corridor for bicycles, pedestrians, and motorized vehicles. The corridor is a secondary travel route for commuters and local residents across the CSX underpass, primarily accessing West Huntington and the Central Business District, and must provide reliable multimodal connectivity between 8th Avenue and the north during significant storm events.

Project Details: With a focus on access and safety, develop multimodal roadway improvements between 8th Avenue and 5th Avenue. This corridor is the westernmost underpass under the CSX right-of-way and has the least impact on commuter travel from periodic flooding. It is a secondary access point to the City of Huntington and the project will develop a reliable, safe connection between Enslow Park and West Huntington residential areas, commuters from I-64, and 5th Avenue that is a local arterial route with the flexibility to accommodate a large volume of vehicles and re-routed traffic from adjacent underpasses. The 1st Street corridor is envisioned as a secondary south-north route for commuters to downtown Huntington.

The distinct roadway sections include:

Underpass Area (8th Avenue to 7th Avenue)

Current configuration: 2+2 travel lanes (bi-directional) with 6-foot sidewalk on both sides

Planned configuration: Two 12-foot travel lanes and a raised 8-foot green bicycle / multiuse path on the east side. Pavement updated with porous concrete under the multiuse path (**Figure 3-14**).

Central Business District Area (7th Avenue to 5th Avenue)

Current configuration: 1+1 travel lanes (bi-directional) with a center striped turn lane and 5-foot sidewalk. 10-foot green buffer on west side and 7-foot sidewalk and 11-foot green buffer on east side.

Planned configuration: Two 10-foot travel lanes, a center turn lane with bioretention islands, and an 8-foot dedicated two-way cycle track on the east side. Sidewalks designed to 8 feet on each side with remaining 5 feet on each side dedicated to green buffer. Pavement updated with porous asphalt or pervious pavers under parking areas and cycle track. The cycle track will connect with a future cycle track along 5th Avenue (US 60) that provides continuous east-west non-motorized commuter options between 1st Street and 13th Street (**Figure 3-15**).

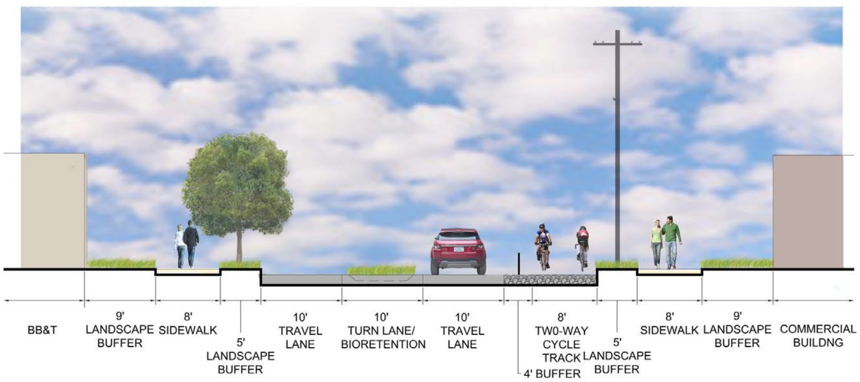


Figure 3-14: 1st Street Underpass (7th Avenue to 5th Avenue)

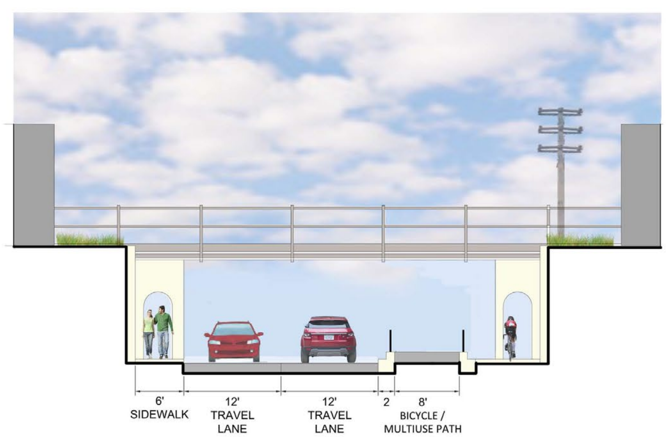


Figure 3-15: 1st Street Underpass (8th Avenue to 7th Avenue)

Project 9

Project Name: 5th Avenue Complete Street Part 2

Project Location: 5th Avenue between 1st Street and 13th Street

Project Description: Update 5th Avenue as a complete, livable street, incorporating green infrastructure, complete streets principles, and placemaking to develop a sense of identity and maximize function of the corridor. Goals include reduction of impervious surface, increased rate of groundwater recharge, and increased functionality of the corridor for bicycles, pedestrians, and motorized vehicles. The corridor is a primary travel route for commuters and local residents from West Huntington through downtown towards Marshall University, and must provide reliable multimodal connectivity on the north side of the CSX underpasses during significant storm events. This corridor also serves Federal, County and City of Huntington institutional offices and major faith-based organizations in the city.

Project Details: With a focus on access and safety, develop multimodal roadway improvements between 1st Street and 13th Street. This corridor will serve multiple destinations in the City of Huntington, including residential, retail, industrial, and institutional uses and the project will develop a reliable, safe connection between West Huntington residential areas, downtown businesses, and Marshall University that can serve regional traffic with the flexibility to accommodate a large volume of vehicles and various levels of congestion. The 5th Avenue corridor is envisioned as a major arterial route for commuters to downtown Huntington.

The distinct roadway sections include:

West of CBD (1st Street to 6th Street)

Current configuration: Two travel lanes (one way east) with street parking on both sides plus 6-foot sidewalk and 19-foot green buffer on both sides

Planned configuration: Two 11-foot travel lanes and an 8-foot two-way cycle track on the north side. Street parking on both sides. Retain a 6-foot sidewalk and 14-foot green buffer on both sides. Pavement updated with porous asphalt under the cycle track (**Figure 3-16**).

Central Business District (6th Street to 10th Street)

Current configuration: 3 travel lanes (one way east) with street parking on south side plus 6-foot sidewalk and 20-foot green buffer on both sides from 6th Street to 8th Street. 4 travel lanes (one way east) with 45 degree pull-in parking on both sides from 8th Street to 9th Street. This block also includes 20-foot sidewalk / public space on the north side and 15-foot sidewalk / pubic space on the south side. 4 travel lanes (one way east) with parallel parking on both sides from 9th Street to 10th Street. This block includes 30-foot sidewalk / public space on both sides.

Planned configuration: From 6th Street to 7th Street, develop two 11-foot travel lanes and an 8-foot two-way cycle track on the north side. Develop parallel street parking on both sides. Retain a 6-foot sidewalk and 10-foot green buffer on both sides. Pavement updated with porous asphalt under the cycle track.

From 7th Street to 10th Street, develop two 11-foot travel lanes and an 8-foot two-way cycle track on the north side. Include a 10-foot center pedestrian refuge with bioretention bulbs, as well as bioretention swales adjacent to sidewalks. Install 45 degree street parking on both sides. On the north side, install 10-foot sidewalk and a 20-foot wide linear green community feature (art, garden, plaza, etc). On the south side, install 8-foot sidewalk and 6-foot green buffer. Pavement updated with porous asphalt under the cycle track (**Figure 3-17**).

Religion Row (10th Street to 13th Street)

Current configuration: 4 travel lanes (one way east) with parallel parking on each side from 10th Street to 11th Street. This block has 20-foot sidewalk / public space on both sides. 4 travel lanes (one way east) from 11th Street to 13th Street. This block has no street parking but has 25-foot sidewalk / public space on the north side and 30-foot sidewalk / public space on the south side.

Planned configuration: From 10th Street to 11th Street, develop two 11-foot travel lanes and an 8-foot two-way cycle track on the north side. Include a 10-foot center pedestrian refuge with bioretention bulbs as well as bioretention swales adjacent to sidewalks. Install 45 degree street parking on both sides. On the north side, install 10-foot sidewalk and a 20-foot wide linear green community feature (art, garden, plaza, etc). On the south side, install 8-foot sidewalk and 6-foot green buffer. Pavement updated with porous asphalt under the cycle track.

From 11th Street to 13th Street, develop two 11-foot travel lanes and an 8-foot two-way cycle track on the north side. Include a 10-foot center pedestrian refuge with bioretention bulbs. Install parallel parking on both sides. On the north side, install 6-foot sidewalk and a 6-foot green buffer. On the south side, install 6-foot sidewalk and 6-foot green buffer. Pavement updated with porous asphalt under the cycle track (**Figure 3-18**).

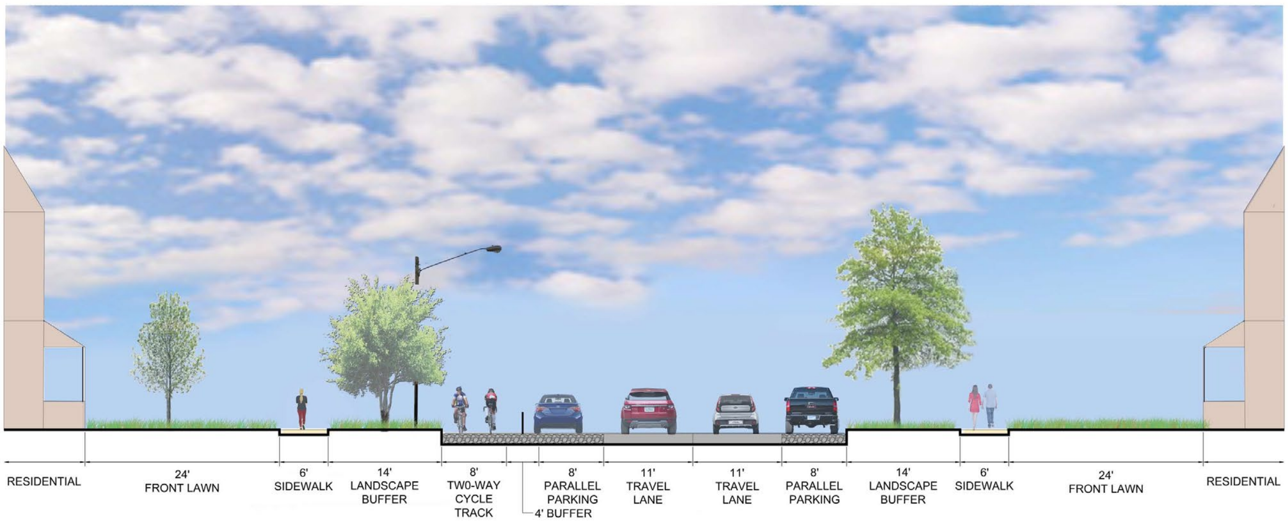


Figure 3-16: 5th Avenue Complete Street Part 2 (1st Street to 6th Street)

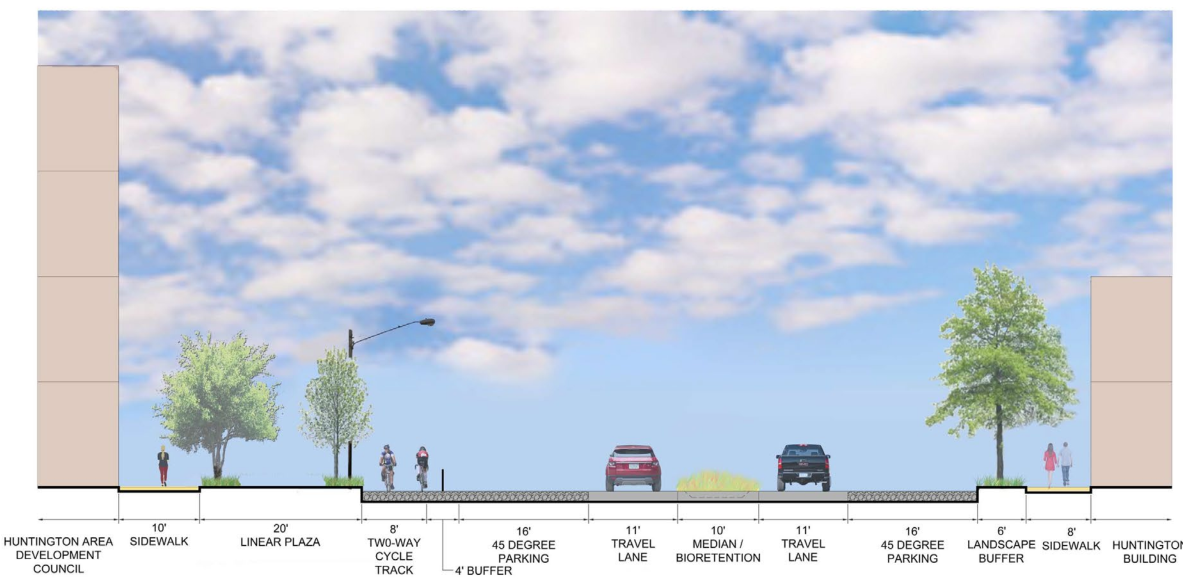


Figure 3-17: 5th Avenue Complete Street Part 2 (6th Street to 10th Street)

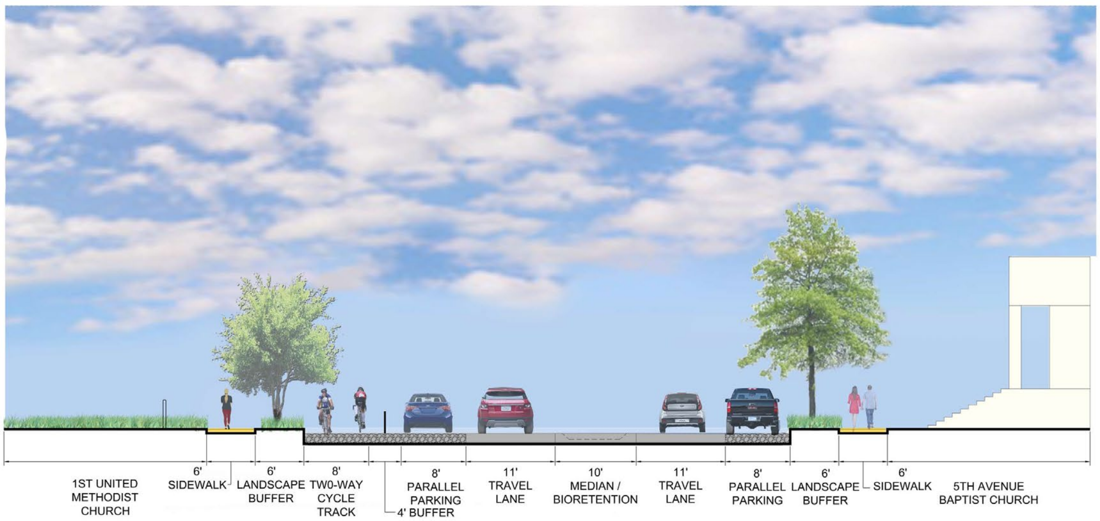


Figure 3-18: 5th Avenue Complete Street Part 2 (10th Street to 13th Street)

Surface Transportation Project Cost Estimates

Utilizing the typical sections in this chapter, the study team developed a set of planning-level cost estimates for use in seeking additional funding and resources that will enable community leaders to move from project planning through to project construction.

The following costs in **Table 3-03** are only intended to inform decision-makers of the cost magnitude for each street section. In the next chapter, there are multiple resources presented that can potentially be used as funding mechanisms for this work.

Table 3-03: Surface Transportation Project Cost Estimates

Alt #	Section		Hardscape (feet)						Vegetative (feet)			Permeable (feet)			Total Width	Roadway Width
		Length	Existing Sidewalk	Drop-off Area	Existing Front Yard	Outdoor Public Realm	Travel lane	Bicycle / Multi-use Path	Landscape Buffer	Median / Turn Lane / Bioretention	Bioretention	Parking (parallel, 45 degree)	Two-way cycle track	Buffer		
1	3rd Avenue: Stadium Area (25th Street to 16th Street)	5,625	26				33		6		12	8	8	5	98	72
1	3rd Avenue: CBD Area (16th Street to 13th Street)	1,500	12		15		22		6	10	18	8	8	5	104	77
2	5th Avenue: Business Area (29th Street to 20th Street)	7,040	12			27	33		5		34		8	5	124	85
2	5th Avenue: University Area (20th Street to 16th Street)	2,630	14	42	5		22		29	10		16	8	5	151	90
2	5th Avenue: Residential Area (16th Street to 13th Street)	1,500	12				22		21	10		16	8	5	94	82
3	20th Street: University Area (7th Avenue to 5th Avenue)	1,020	16				22		6	6	13	8	8	3	82	66
3	20th Street: Underpass Area (8th Avenue to 7th Avenue)	635					22			11			8	4	45	45
4	Hal Greer Boulevard: University Area (7th Avenue to 5th Avenue)	1,020	12				22		6	6	13	8	8	3	78	66
4	Hal Greer Boulevard: Underpass Area (8th Avenue to 7th Avenue)	635					22			11			8	4	45	45
6	10th Street: Central Business District (7th Avenue to 5th Avenue)	1,050	16				22				15	16	8	3	80	64
6	10th Street: Underpass Area (8th Avenue to 7th Avenue)	630					22	8							30	30
7	8th Street: Central Business District (7th Avenue to 5th Avenue)	1,010	20				40		4	10			8	3	85	65
7	8th Street: Underpass Area (8th Avenue to 7th Avenue)	640					24	10			11				45	45
8	1st Street: Central Business District (7th Avenue to 5th Avenue)	1,015	16		18		20		10	10			8	4	86	52
8	1st Street: Underpass Area (8th Avenue to 7th Avenue)	640	12				24	10							46	34
9	5th Avenue: West of CBD (1st Street to 6th Street)	2,515	12		48		22		28			16	8	4	138	78
9	5th Avenue: Central Business District (6th Street to 10th Street)	2,000	18			20	22		6	10		32	8	4	120	82
9	5th Avenue: Religion Row (10th Street to 13th Street)	1,520	12				22		12	10		16	8	4	84	72

a. Planning-level cost estimates include demolition and site preparation.
b. Projects assume reconstruction of existing facilities to better integrate into the design (i.e. sidewalks)

Table 3-03: Surface Transportation Project Cost Estimates (Cont.)

Alt #	Section	Hardscape ($/SF)						Vegetative ($/SF)			Permeable ($/SF)		
		Existing Sidewalk	Drop-off Area	Existing Front Yard	Outdoor Public Realm	Travel lane	Bicycle / Multi-use Path	Landscape Buffer	Median / Turn Lane / Bioretention	Bioretention	Parking (parallel, 45 degree)	Two-way cycle track	Buffer
1	3rd Avenue: Stadium Area (25th Street to 16th Street)	$50				$25		$20		$20	$30	$30	$30
1	3rd Avenue: CBD Area (16th Street to 13th Street)	$50		$5		$25		$20	$30	$20	$30	$30	$30
2	5th Avenue: Business Area (29th Street to 20th Street)	$50			$80	$25		$20		$20		$30	$30
2	5th Avenue: University Area (20th Street to 16th Street)	$50	$15	$5		$25		$20	$30		$30	$30	$30
2	5th Avenue: Residential Area (16th Street to 13th Street)	$50				$25		$20	$30		$30	$30	$30
3	20th Street: University Area (7th Avenue to 5th Avenue)	$50				$25		$20	$30	$20	$30	$30	$30
3	20th Street: Underpass Area (8th Avenue to 7th Avenue)					$25			$30			$30	$30
4	Hal Greer Boulevard: University Area (7th Avenue to 5th Avenue)	$50				$25		$20	$30	$20	$30	$30	$30
4	Hal Greer Boulevard: Underpass Area (8th Avenue to 7th Avenue)					$25			$30			$30	$30
6	10th Street: Central Business District (7th Avenue to 5th Avenue)	$50				$25	$15			$20	$30	$30	$30
6	10th Street: Underpass Area (8th Avenue to 7th Avenue)					$25	$15						
7	8th Street: Central Business District (7th Avenue to 5th Avenue)	$50				$25		$20	$30			$30	$30
7	8th Street: Underpass Area (8th Avenue to 7th Avenue)					$25	$15			$20			
8	1st Street: Central Business District (7th Avenue to 5th Avenue)	$50		$5		$25		$20	$30			$30	$30
8	1st Street: Underpass Area (8th Avenue to 7th Avenue)	$50				$25	$15						
9	5th Avenue: West of CBD (1st Street to 6th Street)	$50		$5		$25	$15	$20			$30	$30	$30
9	5th Avenue: Central Business District (6th Street to 10th Street)	$50			$80	$25		$20	$30		$30	$30	$30
9	5th Avenue: Religion Row (10th Street to 13th Street)	$50				$25		$20	$30		$30	$30	$30

a. Planning-level cost estimates include demolition and site preparation.
b. Projects assume reconstruction of existing facilities to better integrate into the design (i.e. sidewalks)

Table 3-03: Surface Transportation Project Cost Estimates (Cont.)

Alt #	Section	Hardscape (cost)						Vegetative (cost)			Permeable (cost)			Total Cost
		Existing Sidewalk	Drop-off Area	Existing Front Yard	Outdoor Public Realm	Travel lane	Bicycle / Multi-use Path	Landscape Buffer	Median / Turn Lane / Bioretention	Bioretention	Parking (parallel, 45 degree)	Two-way cycle track	Buffer	
1	3rd Avenue: Stadium Area (25th Street to 16th Street)	$7,312,500	$0	$0	$0	$4,640,625	$0	$675,000	$0	$1,350,000	$1,350,000	$1,350,000	$843,750	$17,520,000
1	3rd Avenue: CBD Area (16th Street to 13th Street)	$900,000	$0	$112,500	$0	$825,000	$0	$180,000	$450,000	$540,000	$360,000	$360,000	$225,000	$3,950,000
2	5th Avenue: Business Area (29th Street to 20th Street)	$4,224,000	$0	$0	$15,206,400	$5,808,000	$0	$704,000	$0	$4,787,200	$0	$1,689,600	$1,056,000	$33,480,000
2	5th Avenue: University Area (20th Street to 16th Street)	$1,841,000	$1,656,900	$65,750	$0	$1,446,500	$0	$1,525,400	$789,000	$0	$1,262,400	$631,200	$394,500	$9,610,000
2	5th Avenue: Residential Area (16th Street to 13th Street)	$900,000	$0	$0	$0	$825,000	$0	$630,000	$450,000	$0	$720,000	$360,000	$225,000	$4,110,000
3	20th Street: University Area (7th Avenue to 5th Avenue)	$816,000	$0	$0	$0	$561,000	$0	$122,400	$183,600	$265,200	$244,800	$244,800	$91,800	$2,530,000
3	20th Street: Underpass Area (8th Avenue to 7th Avenue)	$0	$0	$0	$0	$349,250	$0	$0	$209,550	$0	$0	$152,400	$76,200	$790,000
4	Hal Greer Boulevard: University Area (7th Avenue to 5th Avenue)	$612,000	$0	$0	$0	$561,000	$0	$122,400	$183,600	$265,200	$244,800	$244,800	$91,800	$2,330,000
4	Hal Greer Boulevard: Underpass Area (8th Avenue to 7th Avenue)	$0	$0	$0	$0	$349,250	$0	$0	$209,550	$0	$0	$152,400	$76,200	$790,000
6	10th Street: Central Business District (7th Avenue to 5th Avenue)	$840,000	$0	$0	$0	$577,500	$0	$0	$0	$315,000	$504,000	$252,000	$94,500	$2,580,000
6	10th Street: Underpass Area (8th Avenue to 7th Avenue)	$0	$0	$0	$0	$346,500	$75,600	$0	$0	$0	$0	$0	$0	$420,000
7	8th Street: Central Business District (7th Avenue to 5th Avenue)	$1,010,000	$0	$0	$0	$1,010,000	$0	$80,800	$303,000	$0	$0	$242,400	$90,900	$2,740,000
7	8th Street: Underpass Area (8th Avenue to 7th Avenue)	$0	$0	$0	$0	$384,000	$96,000	$0	$0	$140,800	$0	$0	$0	$620,000
8	1st Street: Central Business District (7th Avenue to 5th Avenue)	$812,000	$0	$91,350	$0	$507,500	$0	$203,000	$304,500	$0	$0	$243,600	$121,800	$2,280,000
8	1st Street: Underpass Area (8th Avenue to 7th Avenue)	$384,000	$0	$0	$0	$384,000	$96,000	$0	$0	$0	$0	$0	$0	$860,000
9	5th Avenue: West of CBD (1st Street to 6th Street)	$1,509,000	$0	$603,600	$0	$1,383,250	$0	$1,408,400	$0	$0	$1,207,200	$603,600	$301,800	$7,020,000
9	5th Avenue: Central Business District (6th Street to 10th Street)	$1,800,000	$0	$0	$3,200,000	$1,100,000	$0	$240,000	$600,000	$0	$1,920,000	$480,000	$240,000	$9,580,000
9	5th Avenue: Religion Row (10th Street to 13th Street)	$912,000	$0	$0	$0	$836,000	$0	$364,800	$456,000	$0	$729,600	$364,800	$182,400	$3,850,000

a. Planning-level cost estimates include demolition and site preparation.
b. Projects assume reconstruction of existing facilities to better integrate into the design (i.e. sidewalks)

Chapter 4. Implementation

Approach

When considering how to develop and finance a flood mitigation plan, it is it is important to prepare a business plan that identifies strategic decisions and guides the program evolution and funding decisions. Emerging trends in funding practices include increasing complexity, blended funding, multi-jurisdictional funding, cost-sharing with other public programs, broader private sector participation, and increasing influence of technology and data. The development of this matrix follows these principles and involves vast experience in community development, interviews with key individuals in flooding and water management, government websites searches, and emails and phone conversations with people overseeing the management of programs that could assist or provide potential funding.

Some mitigation actions may be low-cost initiatives that can be readily adopted; others may depend on available funding or would be best implemented following a disaster when additional funding may become available, such as the flooding in West Virginia in June 2016. The cost of implementing this list of mitigation opportunities will most likely be far greater than the funds that are or will be available.

The following section prioritizes the projects identified in the previous chapter and details available initiatives to ensure that the priority projects get implemented as funding or resources become available.

Project Prioritization

The projects identified in **Table 4-01** are ranked according to a number of categories that have been chosen based on long-term expected impacts and benefits to the community. These categories represent a qualitative analysis of conditions based on local knowledge and readily available data.

As the table shows, the following projects were identified as the top 5 projects to undertake based on the scr eening:

1. 5th Avenue Complete Street from 16th Street to 13th Street
2. 3rd Avenue Complete Street from 25th Street to 16th Street
3. 3rd Avenue Complete Street from 16th Street to 13th Street
4. 5th Avenue Complete Street from 29th Street to 20th Street
5. 5th Avenue Complete Street from 20th Street to 16th Street
6. 5th Avenue Complete Street from 6th Street to 10th Street

Out of the nineteen projects, seventeen were grouped very tightly at the top, mostly due to the minimal impacts on the community and benefits to future traffic and travel choice. Factoring in the cost estimates from Chapter 3 allows the project listing to be grouped into short, medium, and long-range timeframes. **Table 4-02** illustrates that grouping and provides a summary of planning-level costs for each category. This table shows a realistic grouping of projects based on projected annual revenues contained in the 2040 KYOVA Metropolitan Transportation Plan. Based on expected revenues of $13.7 million for Bicycle-Pedestrian projects and $256.3 million for highway projects, Cabell and Wayne Counties can expect roughly $12 million per year in just those two categories. The phasing plan in this table assumes each phase lasts approximately 5 years, so each phase could potentially have $61 million in revenues to apply if these projects were ranked above others shown in the MTP. This plan does not attempt to qualify the ranking of these recommendations compared to all the projects in the MTP.

Table 4-01: Project Prioritization

Facility	Description		Project Impacts: Environmental/Natural Features (0-4 Points): Wetlands/ 401 Certification Sites	Project Impacts: Environmental/Natural Features (0-4 Points): Hazardous Waste/ Superfund Sites	Project Impacts: Cultural/Economic Impacts (0-18 Points): Schools/Hospitals	Project Impacts: Cultural/Economic Impacts (0-18 Points): Churches/ Cemeteries	Project Impacts: Cultural/Economic Impacts (0-18 Points): Parks/Historic Resources/ Protected Land	Project Impacts: Cultural/Economic Impacts (0-18 Points): Land Use/ Economic Impact	Project Impacts: Environmental Justice (0-12 Points): Minority	Project Impacts: Environmental Justice (0-12 Points): Low Income	Mobility and Implementation: Constructability (0-10 Points): Feasibility	Mobility and Implementation: Travel Demand Benefits (0-56 Points): Safety	Mobility and Implementation: Travel Demand Benefits (0-56 Points): Intermodal Use	Mobility and Implementation: Travel Demand Benefits (0-56 Points): Relief of Congestion	Mobility and Implementation: Travel Demand Benefits (0-56 Points): Total Volume	Mobility and Implementation: Travel Demand Benefits (0-56 Points): Connectivity	Total Ranking (0-100 Points)
Points			2	2	6	2	2	8	6	6	10	14	10	10	6	16	100
5th Avenue Complete Street Pt. 1	16th Street	13th Street	○	○	○	○	○	○	◒	◒	○	○	○	○	○	○	96
3rd Avenue Complete Street	25th Street	16th Street	○	○	○	◒	○	○	◒	◒	○	○	○	○	○	○	95
3rd Avenue Complete Street	16th Street	13th Street	○	○	○	◒	○	○	◒	◒	○	○	○	○	○	○	95
5th Avenue Complete Street Pt. 1	29th Street	20th Street	○	○	○	◒	○	○	◒	◒	○	○	○	○	○	○	95
5th Avenue Complete Street Pt. 1	20th Street	16th Street	○	○	○	◒	○	○	◒	◒	○	○	○	○	○	○	95
5th Avenue Complete Street Pt. 2	6th Street	10th Street	○	○	○	○	◒	○	◒	◒	○	○	○	○	○	○	95
16th Street Viaduct	8th Avenue	7th Avenue	○	○	○	◒	◒	○	○	○	◒	○	○	○	○	○	94
16th Street Viaduct	7th Avenue	5th Avenue	○	○	○	◒	◒	○	○	○	◒	○	○	○	○	○	94
8th Street Viaduct	8th Avenue	7th Avenue	○	○	○	◒	◒	○	○	○	◒	○	○	○	○	○	94
8th Street Viaduct	7th Avenue	5th Avenue	○	○	○	◒	◒	○	○	○	◒	○	○	○	○	○	94
5th Avenue Complete Street Pt. 2	10th Street	13th Street	○	○	◒	○	○	◒	◒	◒	○	○	○	○	○	○	93
20th Street Viaduct	8th Avenue	7th Avenue	○	○	○	◒	◒	○	○	○	◒	○	○	○	○	◒	92
20th Street Viaduct	7th Avenue	5th Avenue	○	○	○	◒	◒	○	○	○	◒	○	○	○	○	◒	92
1st Street Viaduct	8th Avenue	7th Avenue	○	○	○	◒	◒	◒	○	○	◒	○	◒	○	○	○	91
10th Street Viaduct	8th Avenue	7th Avenue	○	○	○	◒	◒	○	○	○	◒	○	○	○	○	●	90
10th Street Viaduct	7th Avenue	5th Avenue	○	○	○	◒	◒	○	○	○	◒	○	○	○	○	●	90
5th Avenue Complete Street Pt. 2	1st Street	6th Street	○	○	○	◒	◒	◒	◒	◒	○	○	◒	○	○	○	90
1st Street Viaduct	7th Avenue	5th Avenue	○	○	◒	◒	◒	●	○	○	◒	○	◒	○	○	○	88
Hal Greer Storm Separation	N/A	N/A	○	○	◒	◒	○	○	●	●	●	○	●	●	●	●	55

Notes:
This ranking is a qualitative screening only. Observations were made by overlaying potential alignments on a map with environmental and community resource information. A very limited field review was conducted.
General "rules of thumb" were followed (see categorical examples below) to assess potential impacts to various issues.

Project Evaluation Matrix - Weighted Rankings	
(Weighted values identified by study team)	
Traffic Demand Benefits (Mobility)	56
Constructability	10
Environmental Justice	12
Cultural/Economic Features	18
Environmental/Natural Features	4

Environmental/Natural Features

○	Minor - Widening: single small creek crossing; near sensitive area.
◒	Moderate - Widening: multiple small creek crossings; cross or near edge of sensitive area. New Location: single small creek crossing or near sensitive area.
●	Major - New alignment: along stream; multiple impacts; through middle of sensitive area.

Cultural/Economic Features; Environmental Justice

○	Minor - Road widening within proximity to a community resource or sensitive area where no right-of-way is required nor are community resource buildings/structures directly affected
◒	Moderate - Road widening within proximity to a community resource or sensitive area where minimal amounts of right-of-way are required but no community resource buildings/structures are directly affected
●	High - Roadway widening and new location projects where significant right-of-way is required and possible direct impacts to buildings/structures are expected

Constructability

○	Low impact, easy to implement; high public support.
◒	Moderate impact to utilities, relocations, bridges, traffic control, etc.; moderate public support.
●	High impact to utilities, relocations, bridges, traffic control; little or no public support.

Travel Demand Benefits

○	Provides a low level of congestion relief to roadway system.
◒	Provides a moderate level of congestion relief to roadway system.
●	Provides a high level of congestion relief to roadway system

Total 2040 Volume

○	Volume greater than 25,000
◒	Volume between 10,000 and 25,000
●	Volume less than 10,000

Connectivity

○	Greatly promotes local or regional connectivity
◒	Promotes local or regional connectivity
●	Does not promote local or regional connectivity

Table 4-02: Project Ranking

Alternative	Section	From	To	Rating	Length (ft)	Total Width	Roadway Width	Cost ($1,000)
Phase 1								
2	5th Avenue Complete Street Pt. 1	16th Street	13th Street	96	1500	94	82	$4,110
1	3rd Avenue Complete Street	25th Street	16th Street	95	5625	98	72	$17,520
1	3rd Avenue Complete Street	16th Street	13th Street	95	1500	104	77	$3,950
2	5th Avenue Complete Street Pt. 1	20th Street	16th Street	95	2630	151	90	$9,610
4	16th Street Underpass	8th Avenue	7th Avenue	94	635	45	45	$790
7	8th Street Underpass	8th Avenue	7th Avenue	94	640	45	45	$620
3	20th Street Underpass	8th Avenue	7th Avenue	92	635	45	45	$790
6	10th Street Underpass	8th Avenue	7th Avenue	90	630	30	30	$420
							Subtotal:	*$37,810*
Phase 2								
2	5th Avenue Complete Street Pt. 1	29th Street	20th Street	95	7040	124	85	$33,480
9	5th Avenue Complete Street Pt. 2	6th Street	10th Street	95	2000	120	82	$9,580
4	16th Street Underpass	7th Avenue	5th Avenue	94	1020	78	66	$2,330
7	8th Street Underpass	7th Avenue	5th Avenue	94	1010	85	65	$2,740
9	5th Avenue Complete Street Pt. 2	10th Street	13th Street	93	1520	84	72	$3,850
							Subtotal:	*$51,980*
Phase 3								
3	20th Street Underpass	7th Avenue	5th Avenue	92	1020	82	66	$2,530
8	1st Street Underpass	8th Avenue	7th Avenue	91	640	46	34	$860
6	10th Street Underpass	7th Avenue	5th Avenue	90	1050	80	64	$2,580
9	5th Avenue Complete Street Pt. 2	1st Street	6th Street	90	2515	138	78	$7,020
8	1st Street Underpass	7th Avenue	5th Avenue	88	1015	86	52	$2,280
							Subtotal:	*$15,270*
Phase 4								
5	Hal Greer Storm Separation	N/A	N/A	55	N/A	N/A	N/A	$191,817
							Subtotal:	*$191,817*
							Total Cost:	*$296,877*

*Grouping based on 2040 MTP annual projected revenues
Bike-Ped Revenues: $620,000
Highway Revenues: $11,650,000

Funding Opportunities

The following opportunities have been identified as potential sources of funds for engineering design and construction of the plan projects identified in Chapter 4. Additional information on each of these resources can be found in **Appendix B**.

National Resources

Senators Manchin and Capito and Congressman Evan Jenkins - Huntington has excellent national representation that could secure national funding designated for community projects. When the new National agenda is revealed, all of the WV delegation should be contacted about the flooding mitigation projects in Huntington. The matrix will continually be updated to reflect any new national funding throughout January-June 2017.

Appalachian Regional Council (ARC) - This regional economic development agency represents not only a partnership with federal government, but also state and local governments. Huntington is within the ARC region and could access two grants; POWER Initiative and Flex-E-Grants. The POWER funding would require Huntington to work in partnership with local, regional and multi-state partners to be eligible for possible funding. In early 2017, the matrix will provide an update of any POWER initiatives in the Huntington region. The POWER grants that have been awarded in WV are between $200,000 and $2 million. Flex-E-Grants are small grants provided by ARC funding that flows through the WV Department of Commerce. These grants are usually dedicated to plans or studies and are due each year in January. If the implementation plan recommends any smaller studies ($10,000), the Flex-E-Grant, with a local match of $2,000, would be able to assist with funding needs.

United States Department of Agriculture: Natural Resources Conservation Services (NRCS) - This NRCS has many programs and grants that assist communities to ensure the health of the land through sustainable management and works to prevent damage to natural resources and the environment, restores the resource base, and promote good land management.

United State Department of Housing and Urban Development (HUD) - Through HUD, Community Development Block Grants could provide some possible funding for water and waste disposal needs since they are a part of the environment. City leadership can determine the eligibility of the proposed projects for Huntington.

United States Department of Defense: Army Corps of Engineers - The Corps of Engineers operate water resource projects to meet three main needs: navigation, flood damage reduction, and aquatic ecosystem restoration. Even though Huntington's flooding issues are not from the river, the Corps might have some technical expertise to assist Huntington.

United States Department of Commerce: Economic Development Administration (EDA) (Public Works and Economic Development Program) - The EDA is authorized to support community water and sewer projects. Projects must be located in areas with at least one of the following: low per-capita income, unemployment above the national average, or anticipated abrupt rise in unemployment. If Huntington meets these criteria, this could be a possible source of funding for the projects.

Federal Emergency Management Agency (FEMA) - FEMA has five flood mitigation grant programs. Three possible FEMA grant programs would be the Pre-Disaster Mitigation (PDM), Flood Mitigation Assistance (FMA), and the Repetitive Flood Claims (RFC). Because program priorities and policies change from time to time, current information should be obtained from the WV State Hazard Mitigation

Office, once specific mitigation projects have been determined.

Federal Highway Administration - The Surface Transportation Program (STP) and the Surface Transportation Block Grant Program (STBGP) are the most flexible of the federal highway programs and historically one of the largest single programs. Because of KYOVA's suballocation, most of the funds would come through these funding sources.

State Resources

US Environmental Protection Agency/WV Brownfields Assistance Center - This organization has funding available for innovative redevelopment of brownfield sites in WV. There are grant funds available for assessment, cleanup and multi-purpose pilot grants. Also, there are loans, training, grant writing, and technical assistance for eligible projects. The ACF site, which is near the flooding zone on 3rd Avenue, meets the definition of a brownfield project. George Carico, Executive Director of WV Brownfields in Huntington, has been contacted regarding potential participation.

Rahall Transportation Institute - This organization, located in Huntington, may be a conduit to resources and additional relationships focused on transportation and economic development. The Director of Research & Strategy, Kent Sowards, has expressed an interest to be involved and welcomes an update as soon as recommendations are identified.

West Virginia of Agriculture and WV State Conservation Agency - This State agency receives funds via the US EPA that are given out as AGO (Additional Grant Opportunities), which are funds identified in the Clean Water Act for nonpoint source pollution issues. Typically, organizations may submit proposals on education and outreach, monitoring, and systems evaluations, but the agency can also fund projects that help build capacity and equipment. Examples of past AGOs that could possibly be used on the Huntington project are rain gardens, wetlands, urban tree plantings, and other low impact and stormwater controls for communities.

WV Infrastructure and Jobs Development Council - This council was created to be WV funding clearinghouse for water and wastewater projects. Their funding is limited to sanitary line projects.

WV Homeland Security and Emergency Management - This State agency is charged with ensuring the protection of life and property by providing coordination, guidance, support and assistance. The agency is made up of four key branches and the branch that might be applicable to Huntington's flooding is the Mitigation and Recovery Branch. This branch deals with floodplan management, hazard mitigation, or individual assistance.

Robert C. Byrd Institute - This organization has a branch in Huntington and is focused on meeting the needs of manufacturers in the region. This organization could work with a local sign fabricator that would be interested in building innovative warning signage and other products that could alert Huntington residents and drivers of a flooding event. This group could also assist any manufacturers that would design and product custom products that would help Huntington with their flooding problems.

University of Maryland Environmental Finance Center - This center provides communities with tools and information necessary to manage change for a healthy environment and an enhanced quality of life. Their focus is protecting natural resources and watersheds by strengthening the capacity of local leadership to analyze environmental problems, develop innovative and effective methods of financing environmental efforts, and educate communities about the role of finance and economic development in the protection of the environment. This University of Maryland center has expressed an interest in West

Virginia communities and has experience most recently in Berkeley County.

West Virginia Division of Highways/Federal Highways - The Transportation Alternatives Program (TAP) is a funding source for local community development. These funds can be accessed through the WV Department of Transportation. Also, Federal Highway grants could possibly be identified by working with officials at WV DOT.

West Virginia Region 2 Planning and Development Council - This Council could provide support planning and programming assistance for our implementation plan.

<u>Local and Private Resources</u>

Federal Home Loan Bank (FHLB)/United Bank - This national bank's mission is to provide liquidity to member institutions (United Bank in Huntington is a member bank) to support housing finance and community investments. Their Community Investment Program provides below- market-rate advances to their members for community investments. Also, FHLB has provided mini- grants to member communities for projects that impact the community's needs and improve their quality of life.

City of Huntington Municipal Parking Board - The Parking Board could be engaged in redevelopment plans with off -site parking that could include green space or permeable surfaces to assist with stormwater run-off in the flooding zones.

Huntington/Cabell County Family Foundations - Private family foundations that focus on community projects could be a source of grants or funding to access for the implementation of projects.

Tri-State Foundation - The Foundation has charitable funds established for the long-term benefit of the residents of the areas they serve (Kentucky, southwestern West Virginia and southern Ohio). This Foundation strives to improve quality of life in the Tri-State region. There is a possibility that funds have already been established to assist Huntington with this community challenge or that the Foundation could assist the City in establishing and identifying donors for their project.

The Benedum Foundation - The Benedum Foundation, housed in Pittsburgh, PA, was established to advance specific initiatives and all communities in West Virginia are eligible to access these funds. Grants are made to support specific initiatives in the areas of education, economic development, health and human services, and community development. Huntington could access funds through their community development grants to improve capabilities of leaders, organizations and interested citizens to address the challenge of the flooding in Huntington. This foundation does not fund brick-and-mortar projects, but can be a tremendous resource as Huntington looks toward building capacity and for project funding.

Huntington Urban Renewal Authority - This Authority owns property and homes throughout Huntington that could be repurposed for rain gardens and community gardens, that would help alleviate stormwater run-off. A review of the project areas and the Renewal Authorities inventory of property could yield opportunity that would assist in the flooding issues.

CSX Railroad and Beyond Our Rails - CSX Railroad could be corporate partner in mitigating Huntington's street flooding. CSX is the property owner throughout many of the flooding zones, and there is the potential of collaboration with the City to benefit the community. CSX also has a grant program, Beyond Our Rails, that provides funding for community gardens. These gardens could help mitigate stormwater runoff and also help provide healthy foods to the community.

St. Mary's Medical Center Foundation and Cabell Huntington Hospital Foundation - Huntington is fortunate to have two hospitals within their city limits. Both hospitals have private foundations that could provide resources for community projects. St Mary's Foundation should have particular interest in the mitigation issues due to being located within one of the flooding zones. In many communities, hospitals participate in community projects that improve the quality of life for its residents outside of the medical center itself and not necessarily as a direct medical service or project.

Establish Business Improvement Districts (BID) - Huntington has the opportunity to establish Business Improvement District(s) in the areas of flooding. This community financial tool could provide engagement and funding from private property owners, which could leverage additional local, state, or national funding for the implementation of mitigation projects. The West Virginia code that provides municipalities with the ability to establish a BID is Chapter 8. Municipal Corporations, Article 13A Business Improvement Districts.

Tax Increment Financing (TIF) - A TIF is an economic development tool that can capture projected increase in property tax revenue to be put towards infrastructure improvements. Huntington should monitor potential development that will occur within the flooding zones and consider establishing TIF(s) that could provide funding for public improvements to mitigate the flooding.

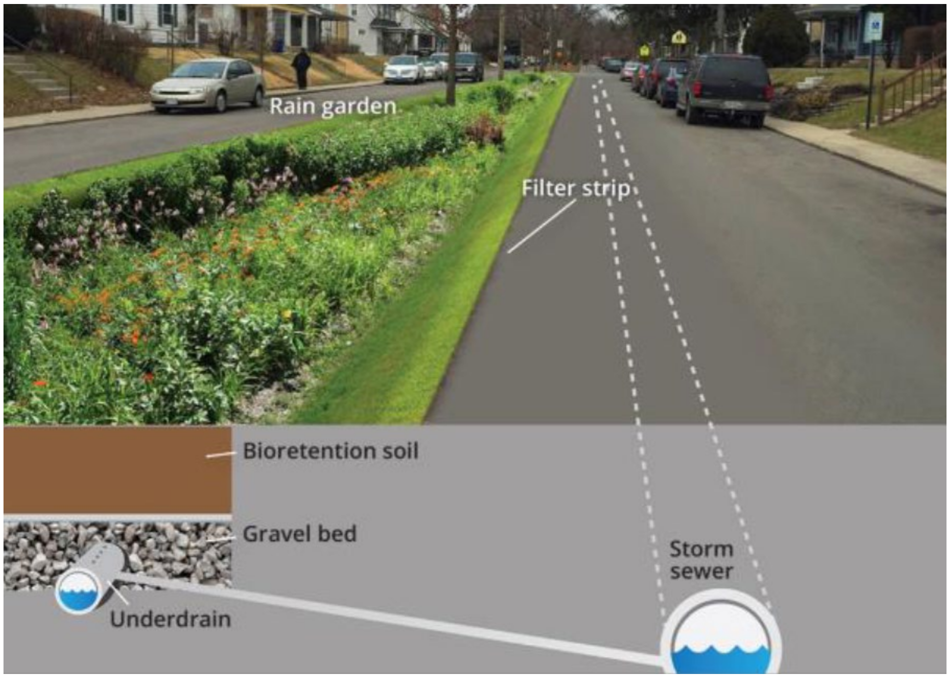
City of Huntington - Over the years, The City of Huntington has been successful accessing funding for public projects. These funding sources could be reviewed for present-day project for Huntington. A thorough review could yield possible funders for green infrastructure and/or sanitary and stormwater projects.

Tri-State Transit Authority - The Transit Authority has historically had some flooding issues at their Greyhound station and the Authority could apply for FTA 5307 funds to assist in the mitigation issues on their property.

Marshall University - The University could be involved in the possible funding of projects via donations and also provide technical assistance and projects through their Sustainability Department and Environmental, Health, and Safety Department, as well as the Rahall Transportation Institute. The University has expressed interest in assisting the City of Huntington in the street flooding mitigation problem, as it has a direct effect on their operations and the University community.

Appendix A - Green Infrastructure Types

Green Infrastructure Types - Green Alley

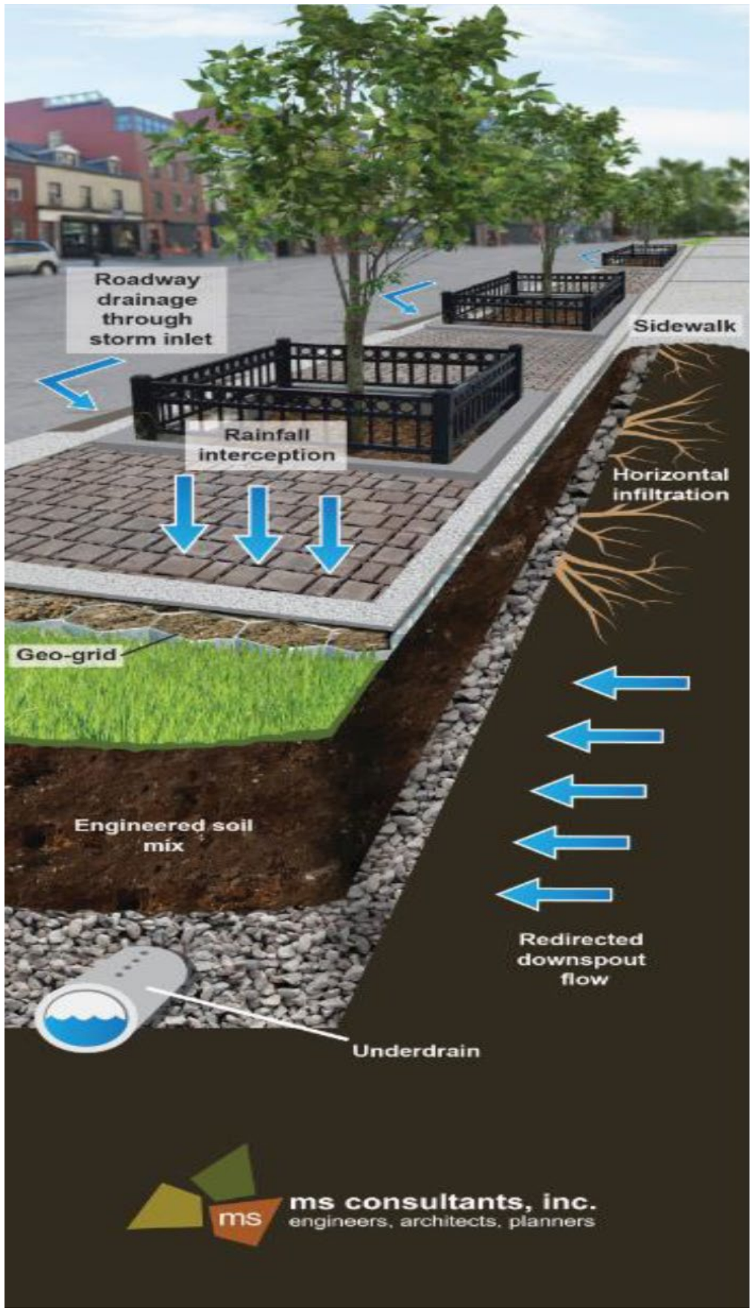


Green Infrastructure Types - Bioretention Boulevards / Cascade Rain Gardens

Green Infrastructure Types - Bioretention Bumpouts

Green Infrastructure Types - Permeable Pavement

Green Infrastructure Types - Bio-Tree Trench



Green Infrastructure Types - Bio-Tree Trench

Appendix B - Implementation Resources

<table>
<tr><th colspan="3">WV Brownfields Assistance Center
To promote economic development and environmental and public health protection through innovative redevelopment of brownfield sites in WV. Providing training and technical assistance, assistance in engaging community stakeholders, and assistance in grant writing and leveraging of project funding. Projects funded or approved for loans are associated with the clean-up efforts in relation to brownfields.</th></tr>
<tr><td rowspan="6">Funding Program/ Grants</td><td>Assessment Grants</td><td>Revolving Loan Fund Grants</td></tr>
<tr><td>Assessment grants provide funding for a grant recipient to inventory, characterize, assess, and conduct planning and community involvement related to Brownfields sites.</td><td>The purpose of revolving loan fund grants is to enable states, political subdivisions, and Indian tribes to make low interest loans to carryout cleanup activities at Brownfields properties. The Ohio River Corridor is a targeted area for this grant.</td></tr>
<tr><td>Cleanup Grants</td><td>Area-Wide Planning Grants (AWP)</td></tr>
<tr><td>Cleanup grants provide funding for a grant recipient to carry out cleanup activities at Brownfields sites.</td><td>Grant funding to communities to research, plan and develop implementation strategies for an area affected by one or more Brownfields. Developing an area-wide plan will inform the assessment, cleanup and reuse of Brownfields properties and promote area-wide revitalization.</td></tr>
<tr><td>Multi-Purpose Pilot Grants</td><td>Training, Research, and Technical Assistance Grants</td></tr>
<tr><td>EPA is piloting a new grant program that will provide a single grant to an eligible entity for both assessment and cleanup work at a specific Brownfields site owned by the applicant.</td><td>Training, research, and technical assistance grants provide funding to eligible organizations to provide training, research, and technical assistance to facilitate Brownfields revitalization.</td></tr>
<tr><td>Utilization of Funds</td><td colspan="2">Clean up the ACF brownfield site and install permeable or green surfaces within brownfields sites.</td></tr>
<tr><td>Contact Person (s)</td><td colspan="2">George Carico</td></tr>
<tr><td>Contact Information</td><td colspan="2">carico@marshall.edu 304-696-5456</td></tr>
<tr><td>Application Cycle</td><td colspan="2">December</td></tr>
<tr><td rowspan="3">Funding Levels and Requirements</td><td colspan="2">Assessment Grant – up to $200,000</td></tr>
<tr><td colspan="2">Clean-Up Grant – up to $200,000</td></tr>
<tr><td colspan="2">Revolving Loan Grant – up to $1,000,000</td></tr>
<tr><td>Match</td><td colspan="2">20% (cash, in-kind etc…)</td></tr>
<tr><td>Project Lead</td><td colspan="2">ACF property owner</td></tr>
<tr><td>Collaborative Partners</td><td colspan="2">City of Huntington</td></tr>
</table>

Federal Home Loan Bank/United Bank The Federal Home Loan Bank System (the System) is comprised of 12 banks and the Office of Finance, which provides funds for mortgages and community lending.	
Funding Program/Grants	**Community Investment Program (CIP):** The CIP is a noncompetitive, community development lending program that provides below-market-rate advances to members. National banks may make investments primarily to promote the public welfare under the community development investment authority in 12 USC 24 (Eleventh) and its implementing regulation, 12 CFR 24. National banks are authorized to make loans and investments to promote the public welfare by benefiting primarily LMI individuals, LMI areas or government targeted redevelopment areas. Eligible public welfare investments also include projects that would be "qualified investments" under CRA.
Utilization of Funds	City Infrastructure improvements
Contact Person (s)	Laura Rye-Kemp
Contact Information	Laura.rye@fhlb-pgh.com
Application Cycle	On demand
Funding Levels and Requirements	Finance economic development projects in areas with a population greater than 25,000 that benefit families at or below 100% of the area median income. **Geographic Criteria:** • Located in a neighborhood with a median income at or below 100% of the area median income; • Located in an urban Champion Community, or an urban Empowerment Zone, or an urban Enterprise Community, as designated by the Secretary of HUD; • Located in a federal or state declared disaster area; • Eligible for a federal Brownfield Tax Credit; • Located in an Indian area, as defined by the Native American Housing Assistance and Self Determination Act of 1996; • Located in an area affected by a federal military base closing or realignment; and/or Located in an area identified as a designated community under the Community Adjustment and Investment Program.
Match	N/A
Project Lead	City of Huntington
Collaborative Partners	United Bank

Appalachian Regional Council

ARC's mission is to innovate, partner, and invest to build community capacity and strengthen economic growth in Appalachia.

The Appalachian Regional Commission (ARC) is a regional economic development agency that represents a partnership of federal, state, and local government. Established by an act of Congress in 1965, ARC is composed of the governors of the 13 Appalachian states and a federal co-chair, who is appointed by the president. Local participation is provided through multi-county local development districts. ARC invests in activities that address the five goals identified in the Commission's strategic plan:

Goal 1: Economic Opportunities
Goal 2: Ready Workforce
Goal 3: Critical Infrastructure
Goal 4: Natural and Cultural Assets
Goal 5: Leadership and Community Capacity

Funding Program / Grants	**POWER Initiative**	**Flex-E-Grants**
	POWER (Partnerships for Opportunity and Workforce and Economic Revitalization) is a multi-agency initiative that targets federal resources to help communities and regions that have been affected by job losses in coal mining, coal power plant operations, and coal-related supply chain industries due to the changing economics of America's energy production. ARC is participating in POWER with the U.S. Economic Development Administration (EDA) and 8 other agencies	A Flex-E-Grant is a small grant, up to $10,000 total project cost, that may be used to support local leadership, civic engagement and capacity building. In West Virginia, community values -- responsibility, strong work ethic, sense of community and caring about our neighbors -- grow when our communities are strong and all people have access to genuine opportunity. It is a joint effort of the West Virginia Development Office, the Appalachian Regional Commission (ARC) and the Claude W. Benedum Foundation. WVDO continues to collaborate with many other organizations on the Flex-E-Grant project.
Utilization of Funds	Projects that are defined within the implementation plan to mitigate flooding	
Contact Person (s)	James Bush	
Contact Information	304-558-2234	
Application Cycle	POWER grants on demand	Flex-E-Grant due
Funding Levels and Requirements	POWER grants require regional partnerships and the requested minimal grant is $500,000. 501c-3 or governments	Flex-E-Grant are usually between $8,000 - $10,000 501c-3 or government
Match	POWER grants require a 50% match	20% match
Project Lead	KYOVA	
Collaborative Partners	POWER grants require numerous regional partnerships.	

City of Huntington Municipal Parking Board	
Funding Program/Grants	Possible leasing/ownership of parking lots need the flood zones with the ability to provide for permeable or soil surfacing
Utilization of Funds	Projects that are defined within the implementation plan to mitigate flooding
Contact Person (s)	Mike Wilson, Director
Contact Information	304-696-5909 wilsonm@cityhuntington.com
Application Cycle	N/A
Funding Levels and Requirements	N/A
Match	N/A
Project Lead	The City of Huntington
Collaborative Partners	N/A

Rahall Transportation Institute

The Nick J. Rahall, II Appalachian Transportation Institute (RTI) is a leader in multimodal transportation and economic development in West Virginia and the surrounding 13 state Appalachian Region. RTI is recognized by the U.S. Department of Transportation (DOT) for transportation excellence focused on applied technology, research, education, outreach and training. RTI is also the lead research institution in the Multimodal Transportation and Infrastructure Consortium (MTIC) funded through the Research and Innovative Technology Administration (RITA) of the U.S. Department of Transportation.

Funding Program/Grants	
Utilization of Funds	Projects that are defined within the implementation plan to mitigate flooding
Contact Person (s)	Kent Sowards, Director of Research & Strategy
Contact Information	sowardsk@njrati.org 304-634-7057
Application Cycle	N/A
Funding Levels and Requirements	N/A
Match	N/A
Project Lead	N/A
Collaborative Partners	N/A

USDA: Natural Resources Conservation Services Natural Resources and Environment ensures the health of the land through sustainable management. Its agencies work to prevent damage to natural resources and the environment, restore the resource base, and promote good land management.	
Funding Program/Grants	**Conservation Programs** NRCS's natural resources conservation programs help people reduce soil erosion, enhance water supplies, improve water quality, increase wildlife habitat, and reduce damages caused by floods and other natural disasters.
Utilization of Funds	Technical assistance on soil quality and engineering on rain, community, and other types of gardens
Contact Person (s)	Corine Powell, District Conservationist
Contact Information	Corine.powell@wv.usda.gov 304-697-6033 Ext. 101
Application Cycle	On demand
Funding Levels and Requirements	N/A
Match	N/A
Project Lead	
Collaborative Partners	Marshall University

Huntington/Cabell County Family Foundations	
Funding Program/Grants	Donations or fundraising expertise
Utilization of Funds	Projects that are defined within the implementation plan to mitigate flooding
Contact Person (s)	TBD
Contact Information	TBD
Application Cycle	N/A
Funding Levels and Requirements	N/A
Match	N/A
Project Lead	TBD
Collaborative Partners	N/A

Benedum Foundation The Claude Worthington Benedum Foundation serves West Virginia and Southwestern Pennsylvania since it was established in 1944 by Michael and Sarah Benedum. Grants are made to support specific initiatives in the areas of Education, Economic Development, Health and Human Services, and Community Development.	
Funding Program/Grants	A program grant in the grant category of Health and Community Development
Utilization of Funds	Funds could be used to engage community partnerships to help with this community problem and also to provide funding for a grant writer to identify and write grants to implement project recommendations
Contact Person (s)	Mary Hunt
Contact Information	mhunt@benedum.org
Application Cycle	Quarterly
Funding Levels and Requirements	N/A
Match	No direct match needed, but grants usually do not fully fund project
Project Lead	KYOVA
Collaborative Partners	N/A

Huntington Urban Renewal Authority	
Funding Program/Grants	Donation of property
Utilization of Funds	Storm Waste Water Management/via land banked properties – i.e. parks/community gardens
Contact Person (s)	Crystal Barry
Contact Information	304-696-4486 Ext: 2048
Application Cycle	N/A
Funding Levels and Requirements	N/A
Match	N/A
Project Lead	TBD
Collaborative Partners	N/A

Tri-State Foundation	
Funding Program/Grants	Unrestricted Funds or Restricted Funds for The City of Huntington
Utilization of Funds	Projects that are defined within the implementation plan to mitigate flooding
Contact Person (s)	Mary Witten Wiseman mwwiseman@tristatefoundation.org
Contact Information	916 Fifth Ave. Suite 403 P.O. Box 7932 Huntington, WV 25701 Phone: (304) 942-0046 Fax: (304) 942-0048 info@tristatefoundation.org http://www.tristatefoundation.org/
Application Cycle	N/A
Funding Levels and Requirements	N/A
Match	N/A
Project Lead	TBD
Collaborative Partners	N/A

WV Department of Agriculture WV State Conservation Agency	
Funding Program/Grants	DEP – AGO Funding “319” State Matching Funds
Utilization of Funds	Projects that are defined within the implementation plan to mitigate flooding via clean water act
Contact Person (s)	Timothy Craddock
Contact Information	304-926-0499 timothy.d.craddock@wv.gov
Application Cycle	N/A
Funding Levels and Requirements	$2,000 - $20,000 Letter of Interest
Match	40%
Project Lead	TBD
Collaborative Partners	N/A

CSX Railroad CSX is proud to work with national, regional and local partners in our key focus areas of safety, community, wellness and environment.		
Funding Program/Grants	CSX Beyond Our Rails	CSX Transporting Nutrition to Communities in Need
Utilization of Funds	Donation of unused CSX property for the City of Huntington to use in flood mitigation projects	Community Gardens to mitigate storm water runoff and provide healthy foods to the community.
Contact Person (s)	CSX Real Estate Sales and Development Division	Katie Allen, Director of The Conservation Fund
Contact Information	Huntington Rail Manager	304-876-7925
Application Cycle	N/A	July
Funding Levels and Requirements	N/A	$2,500 - $5,000 typical grant
Match	N/A	N/A
Project Lead	TBD	TBD
Collaborative Partners	N/A	N/A

BID – Business Improvement District	
Funding Program/Grants	The establishments of a business improvement district(s) within the City of Huntington, in accordance with the purpose and powers set forth to serve a public purpose, promote the health, safety, prosperity, security and general welfare of all citizens.
Utilization of Funds	Projects that are defined within the implementation plan to mitigate flooding
Contact Person (s)	Mayor Stephen T. Williams
Contact Information	304-696-5540
Application Cycle	N/A
Funding Levels and Requirements	N/A
Match	N/A
Project Lead	City of Huntington
Collaborative Partners	Property owners in the proposed district

WV Homeland Security and Emergency Management	
Funding Program/Grants	Training and consultancy to assist with the Huntington flooding situations
Utilization of Funds	TBD
Contact Person (s)	Michelle Craig, Emergency Services Associates Jeremiah Nelson, Flood Warning Program Director
Contact Information	mcraig@region2pdc.org jeremiah.e.nelson@wv.gov 304-529-3357
Application Cycle	N/A
Funding Levels and Requirements	N/A
Match	N/A
Project Lead	N/A
Collaborative Partners	N/A

WV Development Office	
Funding Program/Grants	Secretary of Commerce's Community Development Grant for Economic Development
Utilization of Funds	Projects that are defined within the implementation plan to mitigate flooding that is impacting economic development opportunity.
Contact Person (s)	Jennifer Ferrell
Contact Information	304-957-2019
Application Cycle	Spring 2017
Funding Levels and Requirements	$50,000
Match	50%
Project Lead	?
Collaborative Partners	

University of Maryland Environmental Finance Center	
Funding Program/Grants	Storm Water Finance Outreach
Utilization of Funds	Technique assistance in helping craft a strategy that can provide a plan for the management and financing support for a community with their stormwater and flooding problems. A local government stormwater financing manual available on line. efc.umd.edu
Contact Person (s)	Dan Nees, Director
Contact Information	301-405-5421 dnees@umd.edu
Application Cycle	N/A
Funding Levels and Requirements	N/A
Match	N/A
Project Lead	N/A
Collaborative Partners	N/A

Advance Signage for Flood Warning – Robert C Byrd Institute	
Funding Program/Grants	Provide new produce seed funding to companies that develop unique products that assist the community in providing advance warning signage
Utilization of Funds	To design and construct the signage and system to implement
Contact Person (s)	Bill Woodrum
Contact Information	bwoodrum@rcbi.org
Application Cycle	N/A
Funding Levels and Requirements	N/A
Match	N/A
Project Lead	N/A
Collaborative Partners	N/A

St. Mary's Medical Center Foundation	
Funding Program/Grants	Community Donation
Utilization of Funds	Projects that are defined within the implementation plan to mitigate flooding near St Mary's Medical Center
Contact Person (s)	David Sheils, President
Contact Information	304-526-1211
Application Cycle	N/A
Funding Levels and Requirements	N/A
Match	N/A
Project Lead	N/A
CollaborativePartners	

Cabell Huntington Hospital Foundation	
Funding Program/Grants	Community Donation
Utilization of Funds	Projects that are defined within the implementation plan to mitigate flooding
Contact Person (s)	Bradley Burck, President
Contact Information	304-526-6314 Bradley.Burck@chhi.org
Application Cycle	N/A
Funding Levels and Requirements	N/A
Match	N/A
Project Lead	
Collaborative Partners	

Senator Manchin	
Funding Program/Grants	No funds identified at this time
Utilization of Funds	Projects that are defined within the implementation plan to mitigate flooding
Contact Person (s)	Keith McIntosh, State Projects Coordinator
Contact Information	304-264- 4626 keith_mcintosh@manchinsenate.com
Application Cycle	N/A
Funding Levels and Requirements	N/A
Match	N/A
Project Lead	
Collaborative Partners	

Senator Capito	
Funding Program/Grants	No funds identified at this time
Utilization of Funds	Projects that are defined within the implementation plan to mitigate flooding
Contact Person (s)	Aaron T. Sporck, Director of Economic Development
Contact Information	202-224-6472
Application Cycle	N/A
Funding Levels and Requirements	N/A
Match	N/A
Project Lead	
Collaborative Partners	

Congressman Evan Jenkins	
Funding Program/Grants	No Funds identified at this time
Utilization of Funds	Projects that are defined within the implementation plan to mitigate flooding
Contact Person (s)	
Contact Information	845 Fifth Ave. Suite 314 Huntington, WV 25701 Phone: (304) 522-2201 Fax: (304) 529-5716
Application Cycle	N/A
Funding Levels and Requirements	N/A
Match	N/A
Project Lead	
Collaborative Partners	

Tax Increment Financing (TIF)	
Under the Tax Increment Financing (TIF) Act, a county or municipality can create an economic development project area or district that is developed through funding created by increased property taxes. TIF captures the projected increase in property tax revenue gained by developing a discrete geographic area and uses that increase to assist in paying for the project. This funding makes it possible to go forward with projects that otherwise would not be built. TIF can be used by West Virginia counties and class I and II municipalities to help fund their own development projects or projects brought to them by private developers or other entities. Class III and IV municipalities must work with their local county commissions in order to utilize TIF. (Class I municipalities have more than 50,000 people. Class II municipalities have more than 10,000 and up to 50,000 people. Class III municipalities have more than 2,000 and up to 10,000 people. Class IV municipalities have less than 2,000 people.)	
Funding Program/Grants	Establishment of a Tax Increment Financing District
Utilization of Funds	Projects that are defined within the implementation plan to mitigate flooding
Contact Person (s)	Todd Hooker, Senior Manager Financial Programs & National Accounts
Contact Information	304-957-2029 todd.e.hooker@wv.gov
Application Cycle	N/A
Funding Levels and Requirements	N/A
Match	N/A
Project Lead	The City of Huntington
Collaborative Partners	

WV (DEP) and US Department of Environmental Protection Born in the wake of elevated concern about environmental pollution, the EPA was established on December 2, 1970 to consolidate in one agency a variety of federal research, monitoring, standard-setting and enforcement activities to ensure environmental protection. Since its inception, the EPA has been working for a cleaner, healthier environment for the American people.		
Funding Program/Grants	Environmental Justice Small Grants Program	AGO Grant Proposal
	Provides financial assistance to eligible organizations to build collaborative partnerships, to identify the local environmental and/or public health issues, and to envision solutions and empower the community through education, training, and outreach.	The applicants whose initial proposals have been determined to qualify will be asked to submit a formal proposal (workplan). This is not a commitment to fund the project; this proposal will be reviewed in detail before approval. Comments, questions or requested changes may be returned to the applicant for action. Again a reminder that all grant recipients must have a FEIN and DUNS number and be able to verify that the appropriate accounting, procurement, purchasing and other organizational procedures are in place.
Utilization of Funds	Projects that are defined within the implementation plan to mitigate flooding and can involve point and non-point source projects	
Contact Person (s)	Tomi Bergstrom, Basin Coordinator	
Contact Information	304-926-0499 Ext 1198 www.dep.wv.gov	
Application Cycle		
Funding Levels and Requirements		
Match		
Project Lead	City of Huntington – Storm Water Utility	
Collaborative Partners		

Marshall University			
Funding Program/ Grants	**Sustainability Department**	**Environmental, Health and Safety**	**Donation**
	Projects that are defined within the implementation plan to mitigate flooding	Storm Water Management Expertise, experience in grass cells, permeable pavers, & rain gardens	Projects that are defined within the implementation plan to mitigate flooding
Utilization of Funds			
Contact Person (s)	Eve Marcum-Atkinson	Travis Bailey	Brandi Jacob-Jones, Vice President of Operations (previous City Manager)
Contact Information	Marcum13@marshall.edu 304-696-2992	Bailey@53marshall.edu 304-696-3032	jacobs2@marshall.edu 304-696-3328
Application Cycle			
Funding Levels and Requirements	N/A	N/A	N/A
Match	N/A	N/A	N/A
Project Lead	TBD	TBD	TBD
Collaborative Partners			

US Department of Defense - US Corp of Army Engineers	
Funding Program/Grants	WV Environmental Infrastructure Program Section 304 - Water Quality
Utilization of Funds	Water Quality and projects that are defined within the implementation plan to mitigate flooding
Contact Person (s)	Steven O'Leary, AIA, CFM
Contact Information	stephen.ed.oleary@usace.army.mil
Application Cycle	N/A
Funding Levels and Requirements	Cost sharing
Match	
Project Lead	
Collaborative Partners	

WV Infrastructure and Jobs Development Council	
Funding Program/Grants	ONLY FUND SANITARY LINE PROJECTS – RETAIN ON THE MAXTRIX FOR FURTHER REVIEW
Utilization of Funds	Projects that are defined within the implementation plan to mitigate flooding
Contact Person (s)	Jim Ellars, Executive Director
Contact Information	304-414-6501
Application Cycle	
Funding Levels and Requirements	
Match	
Project Lead	
Collaborative Partners	

City of Huntington – Previous grants/funding	
Funding Program/Grants	Several phone calls were not returned by the City
Utilization of Funds	Projects that are defined within the implementation plan to mitigate flooding
Contact Person (s)	Mayor Steve Williams and Bre Shell, City Planner
Contact Information	304-696-5540 mayorwilliams@cityofhuntington.com
Application Cycle	
Funding Levels and Requirements	
Match	
Project Lead	
Collaborative Partners	

Community Development Block Grant/HUD	
Funding Program/Grants	Funds that will serve low income neighborhoods – previous year's entitlement grant was $1.4 million
Utilization of Funds	Projects that are defined within the implementation plan to mitigate flooding
Contact Person (s)	Melinda Midkiff
Contact Information	mmidkiff@cityofhuntington.com 304-4486
Application Cycle	December 2017 – 2018/19 fiscal year funding
Funding Levels and Requirements	
Match	
Project Lead	
Collaborative Partners	

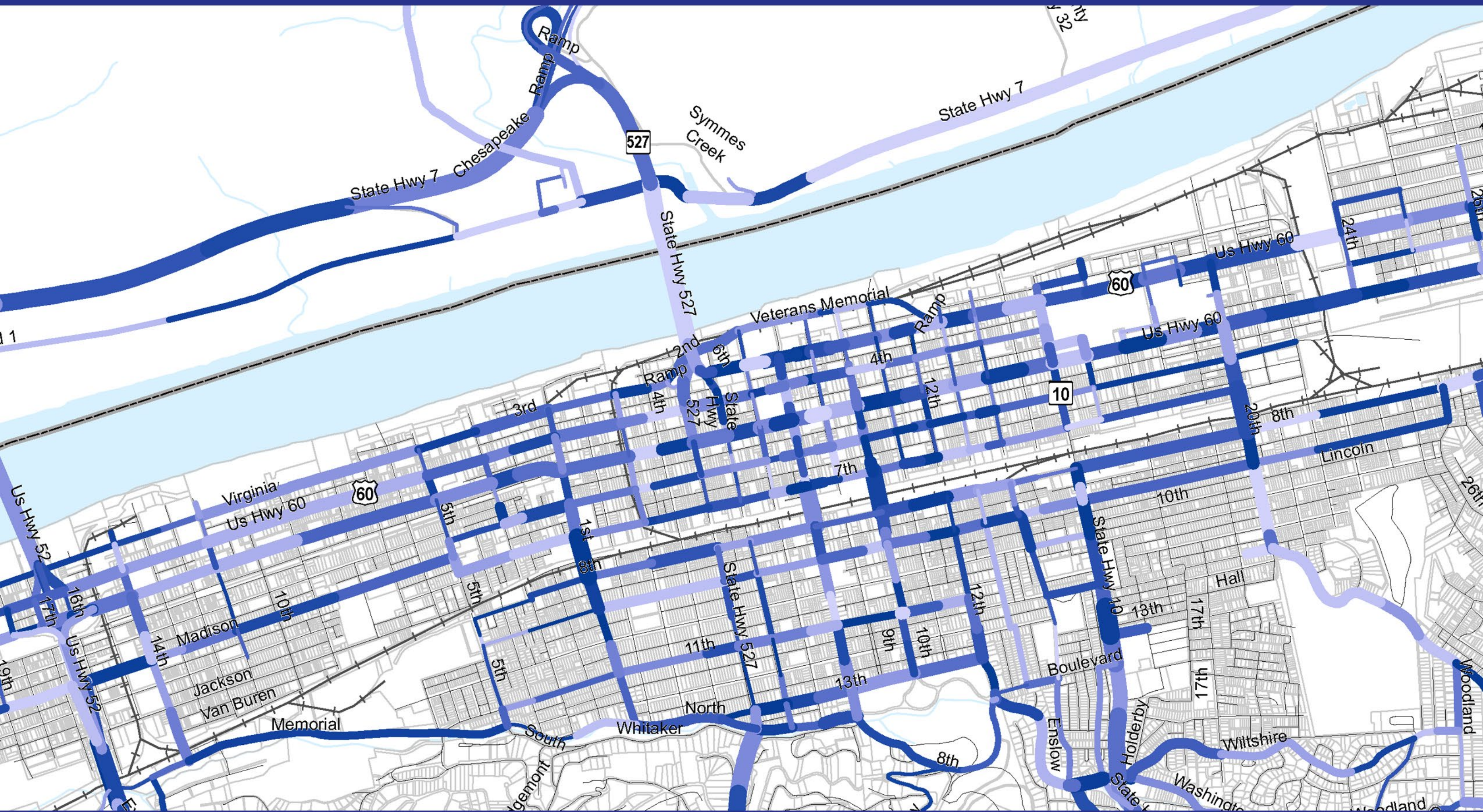
Tri-State Transit Authority	
Funding Program/Grants	FTA 5307 grant funds
Utilization of Funds	Mitigation projects on the Greyhound Bus Station
Contact Person (s)	Paul Davis
Contact Information	304-529-6094 pdavis@tta-wv.com
Application Cycle	
Funding Levels and Requirements	
Match	
Project Lead	
Collaborative Partners	

US Department of Commerce – Economic Development Administration (EDA)	
Funding Program/Grants	Grants for community water and sewer projects
Utilization of Funds	
Contact Person (s)	
Contact Information	
Application Cycle	
Funding Levels and Requirements	
Match	
Project Lead	
Collaborative Partners	

West Virginia Department of Highways/US Federal Highways	
Funding Program/Grants	TAP Grants, STP, CMAQ, FAST
Utilization of Funds	Implementation projects
Contact Person (s)	
Contact Information	
Application Cycle	
Funding Levels and Requirements	
Match	
Project Lead	
Collaborative Partners	

WV Region 2 Planning and Development Council	
Funding Program/Grants	
Utilization of Funds	
Contact Person (s)	Andy Peter
Contact Information	304-523-7434
Application Cycle	
Funding Levels and Requirements	
Match	
Project Lead	
Collaborative Partners	

KYOVA
KENTUCKY • OHIO • WEST VIRGINIA
INTERSTATE PLANNING COMMISSION



150 Clay Street, Suite 410
Morgantown, WV 26501, USA

AECOM