HANOVER STREET CORRIDOR STUDY
includes the Vietnam Veterans Memorial Bridge

CHAPTER 4: ANALYSIS OF THE EXISTING TRANSPORTATION NETWORK

Building on the data collected and described in Chapters 2 and 3, the Study Team evaluated the existing transportation network in the study area to identify potential barriers to multimodal safety, connectivity, and accessibility, and how they are related to bridge structure conditions, roadway conditions, pedestrian and bicycle facilities and demand, freight operations, transit facilities and demand, traffic operations, and safety. Understanding how the corridor functions today, and the deficiencies of the existing transportation network, will allow the City and its stakeholders to establish a baseline for developing Design Opportunities and Constraints as well as potential improvements to the corridor. For this phase of the study, the public outreach effort included meetings with the Interagency Advisory Group (IAG) and the Community Advisory Panel (CAP) on January 18, 2017 to present the analysis of the existing transportation network and obtain feedback, as well as a January 31, 2017 public meeting.

Barriers to Multimodal Safety, Connectivity, and Accessibility

Currently, travel can be challenging for pedestrians and bicyclists in South Baltimore attempting to connect with the many destinations around the Middle Branch of the Patapsco River, as other modes of transportation (vehicles, buses, and trucks) tend to dominate the road network. Evaluating the barriers to multimodal safety, connectivity, and accessibility aims to identify challenges facing all travelers and improve their overall experience by promoting better compatibility among all modes within the Hanover Street corridor centered on the Vietnam Veterans Memorial Bridge. The corridor represents a vital linkage, as it currently conveys residents and port-related truck traffic between destinations on both sides of the Patapsco's Middle Branch. As new destinations such as the proposed Port Covington development and Under Armour complex emerge, the corridor will need to accommodate even more diverse circulation and better serve all modes of transportation. The corridor has the potential to better support connectivity between pedestrians, bicyclists, light rail system riders, bus patrons, motor vehicles, freight operators, and an emerging water taxi system. As shown in **Figure 4-1**, the physical convergence of these modes and the existing public space along the corridor, especially along the Vietnam Veterans Memorial Bridge, creates barriers that hinder optimal multimodal connectivity.

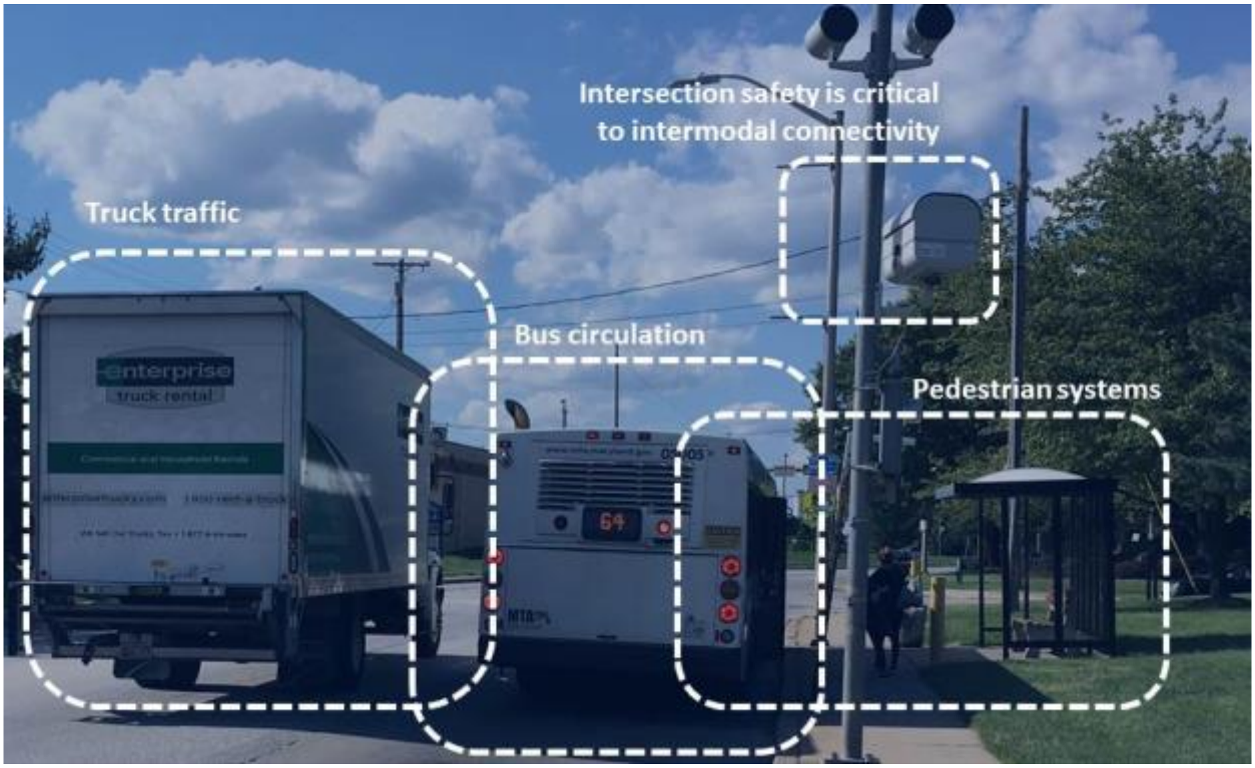

FIGURE 4-1: CONVERGENCE OF MULTIPLE TRANSPORTATION MODES

Barriers to connectivity take two fundamental forms. In some cases a “wall” exists that blocks a desired movement. In other cases a “gap” separates people from their desired destinations. Both types of barriers exist in the corridor. In many cases the dominance of high speed vehicular and truck traffic creates an intimidating experience for pedestrians and bicyclists as well as a potentially dangerous situation for slower moving transit riders. These conditions, combined with the “walls” and “gaps” of current pedestrian facilities, create an environment that deters optimal connectivity between local and regional origins and destinations.

In addition, the current built environment within the Hanover Street corridor can contribute to public safety concerns among pedestrians and transit riders at transfer points. In identifying these challenges as well as the opportunities to improve connectivity, it can be instructive to view the corridor through the lens of Crime Prevention Through Environmental Design (CPTED). The American Institute of Crime Prevention describes the premise of CPTED as the proper design and effective use of the built environment leading to a reduction in the fear and incidents of crime and an improvement in quality of life.[1] This theory is based on the goal of creating places with attributes that simultaneously reward and encourage legitimate behavior while making those who wish to engage in criminal activity feel less comfortable doing so. The theory can be used to diagnose barriers that hinder desired legitimate activity

[1] http://acpionline.com/cpted/

as well as to target interventions that can overcome those barriers based upon the following key principles:

- *Promoting natural surveillance* - designing public space and surrounding land use to maximize visibility of those inhabiting the space.
- *Enabling territorial reinforcement* - designing public spaces that can be easily occupied by legitimate activity and that instill community pride and a sense of stewardship.
- *Maintaining appropriate access control* - designing space that has the appropriate number and scale of access points.
- *Encouraging activity support* - designing public space to encourage and sustain legitimate gatherings and programed activities.
- *Prioritize maintenance* - design public spaces for ease of maintenance in order to avoid appearance of neglect.

Barriers

At many locations along the corridor, pedestrians can feel exposed and unprotected. This contributes to an intimidating atmosphere for many people connecting to transit, walking or bicycling.

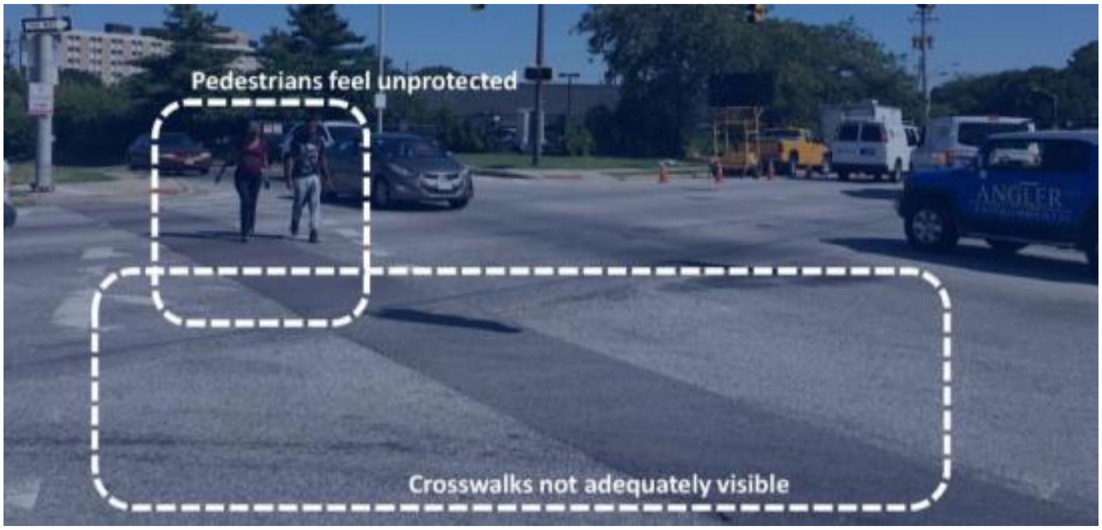

FIGURE 4-2: PEDESTRIAN VULNERABILITY AT STREET CROSSINGS

In addition, many conditions exist that encourage unnecessarily fast turning movements and travel speeds at pedestrian crossing points. This limits connectivity and increases chances of accidents.

FIGURE 4-3: EXAMPLE OF PEDESTRIAN/VEHICULAR CONFLICT AREA

In some cases the lack of desired pedestrian facilities such as sidewalks and the vehicular orientation of lighting can make pedestrians feel unwelcome.

FIGURE 4-4: MISSING PEDESTRIAN NETWORK LINK AND VEHICULAR LIGHTING

Topographic challenges exist as well as limited safe connections between the waterfront/Gwynns Falls Trail and the Vietnam Veterans Memorial Bridge.

FIGURE 4-5: TOPOGRAPHIC CHALLENGES AND INADEQUACY OF EXISTING BRIDGE CONNECTIONS

In some locations, site lines along regional pathways can be improved to promote visibility and reduce safety concerns.

FIGURE 4-6: LACK OF VISIBILITY AT SOUTHERN BRIDGE LANDING

Many conditions exist on the bridge itself that limit the potential for safe multimodal connectivity.

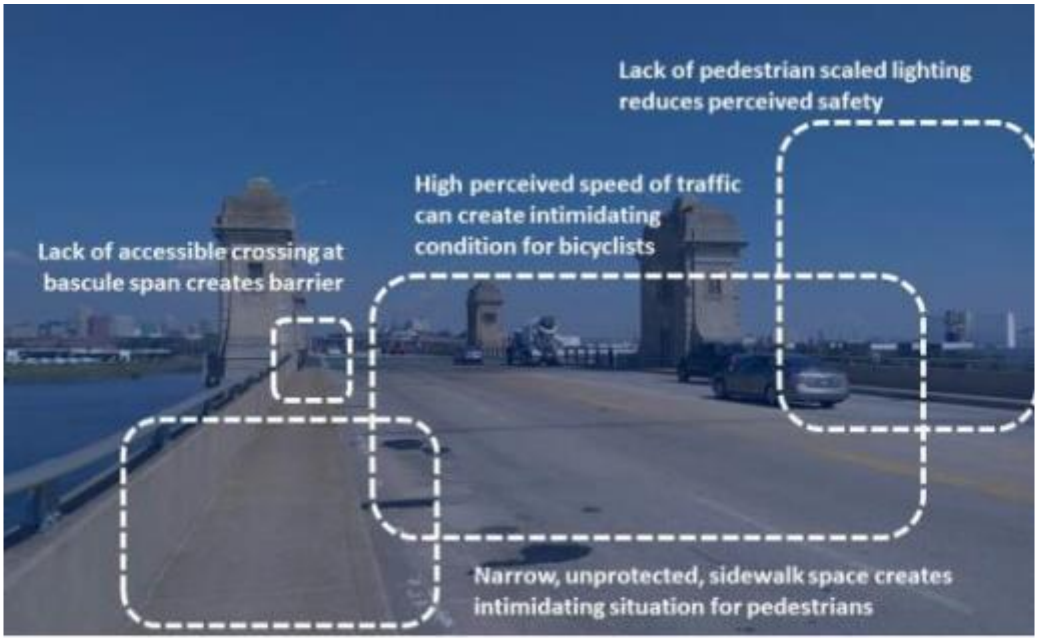

FIGURE 4-7: MULTIMODAL CHALLENGES ON THE BRIDGE DECK

The following diagrams summarize site-specific barriers to multimodal safety, connectivity, and accessibility:

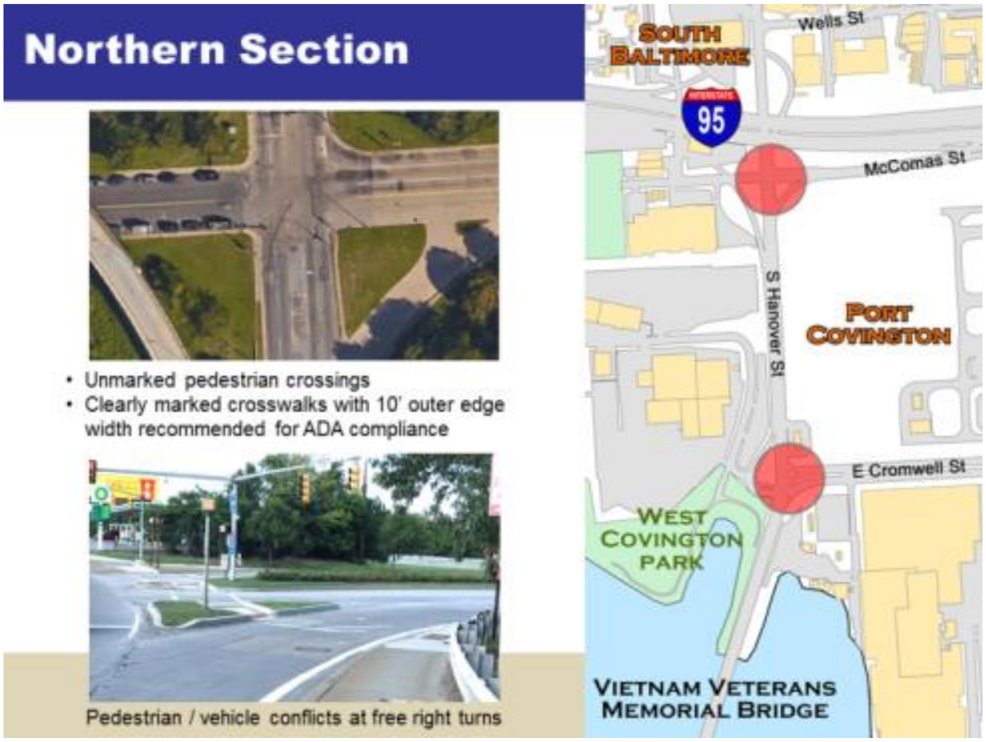

FIGURE 4-8: MULTIMODAL BARRIERS NORTH OF THE DRAWBRIDGE SPAN (1)

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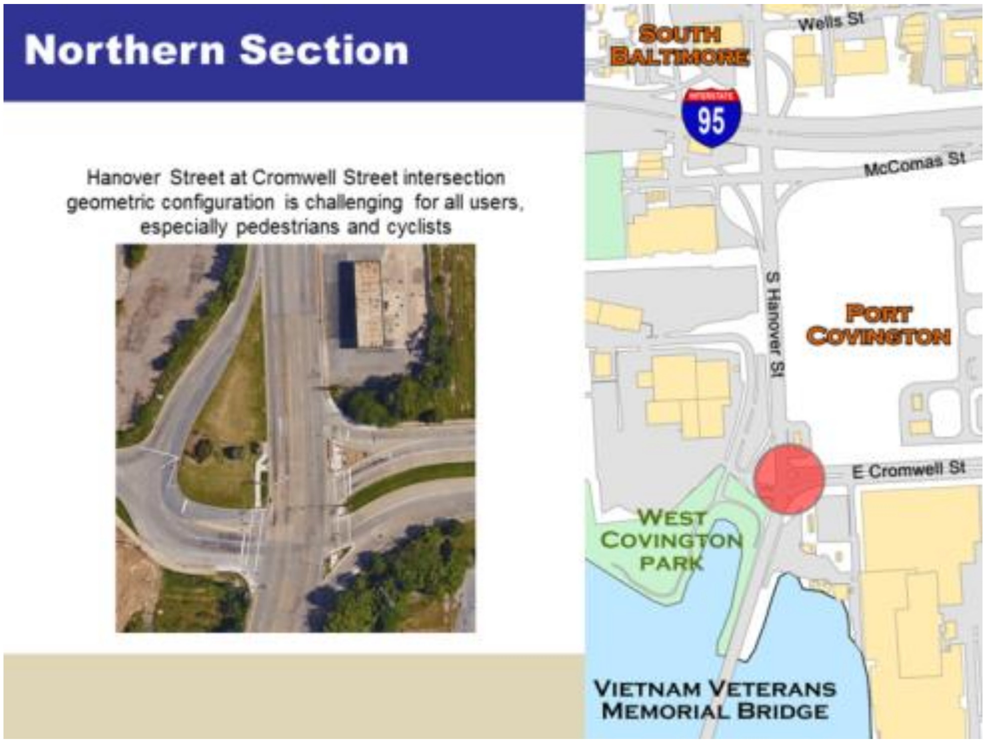

FIGURE 4-9: MULTIMODAL BARRIERS NORTH OF THE DRAWBRIDGE SPAN (2)

FIGURE 4-10: MULTIMODAL BARRIERS NORTH OF THE DRAWBRIDGE SPAN (3)

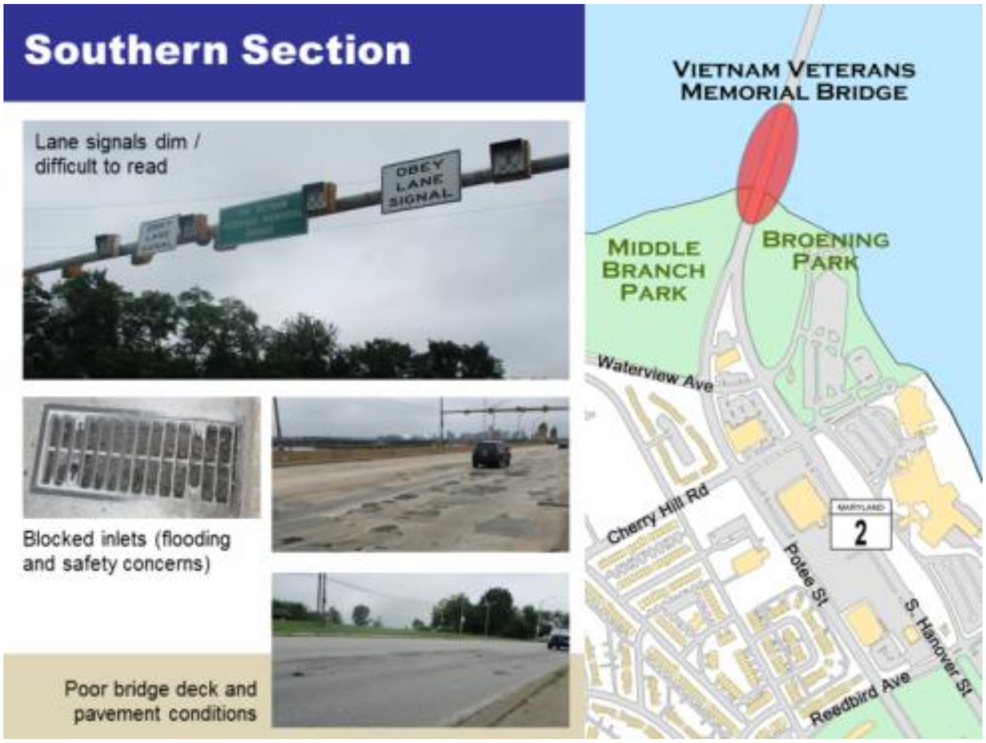

FIGURE 4-11: MULTIMODAL BARRIERS SOUTH OF THE DRAWBRIDGE SPAN (1)

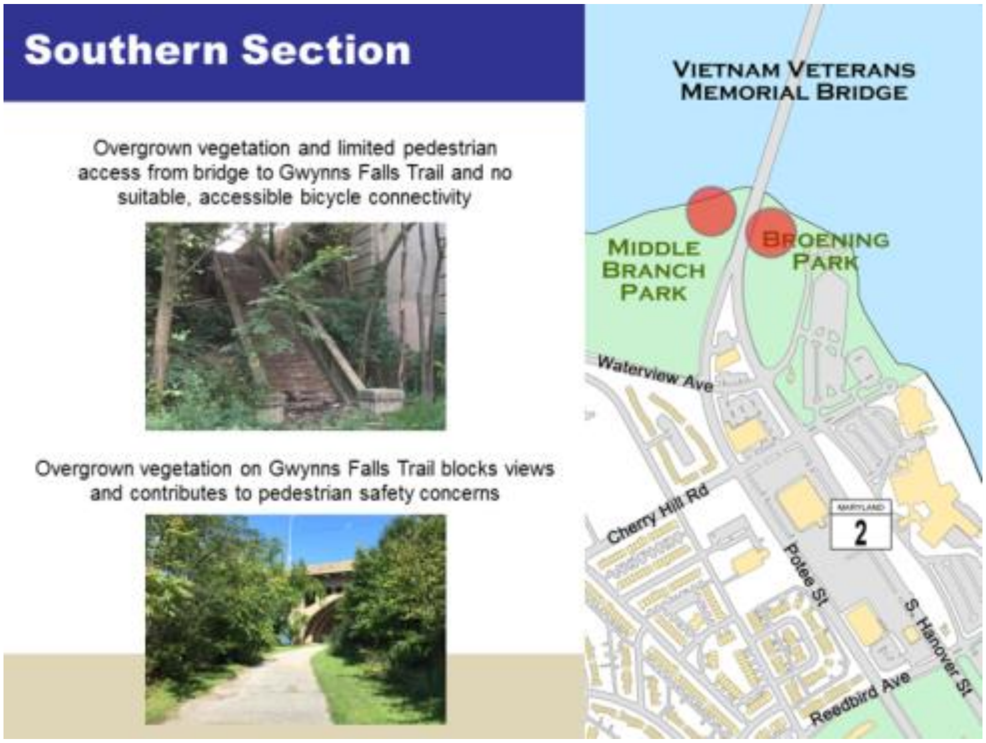

FIGURE 4-12: MULTIMODAL BARRIERS SOUTH OF THE DRAWBRIDGE SPAN (2)

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FIGURE 4-13: MULTIMODAL BARRIERS SOUTH OF THE DRAWBRIDGE SPAN (3)

FIGURE 4-14: MULTIMODAL BARRIERS SOUTH OF THE DRAWBRIDGE SPAN (4)

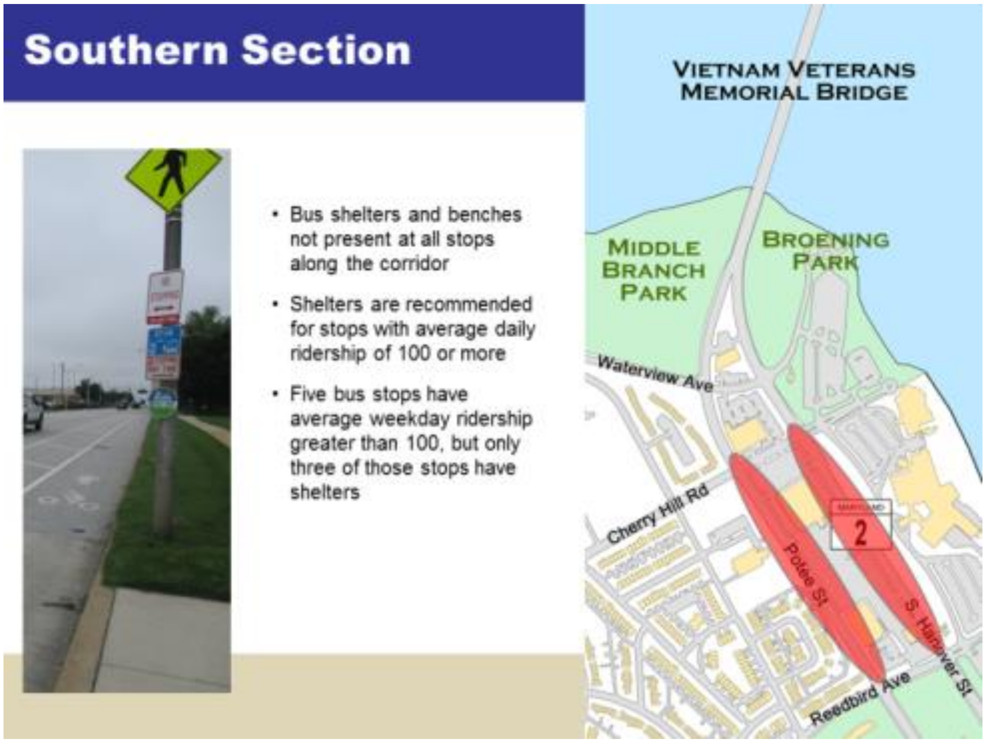

FIGURE 4-15: MULTIMODAL BARRIERS SOUTH OF THE DRAWBRIDGE SPAN (5)

In summary, the identification of barriers to multimodal connectivity is the first and necessary step in providing South Baltimore residents a safe transportation network, enabling accessibility to different transportation modes and thus allowing for better connectivity between major destinations that might not otherwise be linked together. While challenges exist, there are also signature opportunities to create public spaces that facilitate better connectivity and create new neighborhood amenities. Additional information on corridor opportunities will be further discussed in the next phase of the study.

The barriers shown in the above figures, as they relate to the bridge condition, traffic operations, and multimodal facility conditions, are explored further in this chapter. Additionally, the impacts of each of these elements on safety, connectivity, and accessibility are discussed.

Bridge Structures

As described in Chapter 2, a review of the bridge plans, inspection reports and load rating summaries was conducted for the five major bridge structures in the Hanover Street corridor (see **Figure 2-1** for bridge locations):

- Hanover Street Northbound Ramp to I-95 Southbound (Ramp J) – Bridge BCW 552
- I-95 Northbound Ramp to Southbound Hanover Street (Ramp K) – Bridge BCW 553
- Hanover Street over CSX Railroad – Bridge BC 5209

- Hanover Street over CSX Railroad – Bridge BC 5212
- Hanover Street over Middle Branch – Vietnam Veterans Memorial Bridge – Bridge BC 5210

The existing conditions of these structures were assessed to ascertain their maintenance and operations needs to effectively function as an element of the corridor for long-term use. The assessments are based upon the information provided in the aforementioned plans, reports and load ratings. Photos of the bridge locations are included in Chapter 2.

The Interstate 95 Ramp Bridges (BCW 552 and BCW 553) do not have any significant repair needs and currently require nominal upkeep associated with their maintenance and operations.

The two **Hanover Street Structures over CSX Railroad** (BC 5209 and BC 5212) both have significant rehabilitation needs identified for all structural elements – deck, steel superstructure, and reinforced concrete piers and abutments of the substructure – and reconstruction of these two bridges is recommended for their continued long-term use in the corridor. Bridge BC 5209 is almost 90 years old and is considered to be in "fair condition," and Bridge BC 5212, which has been in service for just over 40 years, is considered to be in "poor condition." These condition assessments are based upon the *Structure Inventory and Appraisal* provided in their respective *Bridge Inspection Reports*, dated 2015. The condition ratings are based upon standard guidelines for the assessment of structures based upon their repair needs, and not necessarily the load carrying capacity of the structure. The Load Rating Summary indicates no major deficiencies for either of these structures regarding load carrying capacities prescribed by current AASHTO design codes.

It is also understood that both the ramp structures and the Hanover Street crossings of CSX Railroad – all in the proximity of Interstate 95 – will likely be affected by the associated roadway construction for the proposed Port Covington development. The extent of the Port Covington work has not been finalized, but will likely include reconstruction of Hanover Street (north of Cromwell Street) and potential reconfiguration of the Interstate 95 interchange at Hanover Street.

The Vietnam Veterans Memorial Bridge (Bridge BC 5210, shown in **Photo 4-1**) which carries Hanover Street over Middle Branch is a major component of this corridor and is perhaps the most iconic structure in the inventory of the Baltimore City Department of Transportation – and given its age and unique structural configurations, can be considered a significant structure on a national scale as well.

PHOTO 4-1: VIETNAM VETERANS MEMORIAL BRIDGE VIEW FROM WATER

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The bridge was constructed in 1916. The overall design of this bridge was performed by the J. E. Greiner Co., a notable engineering company with roots in Baltimore, Maryland. The main span of this bridge is a bascule truss girder (see **Figure 4-16**) that utilizes a Rall type mechanical operating system – one of only two in use in the United States. Theodor Rall patented this design, and it was manufactured by the Strobel Steel Construction Company. The main approach spans are cantilevered concrete arch bridges that were cast into their elliptical arch forms through the use of encased structural steel trusses. These tied-back trusses were utilized to construct the arch shapes without the need for shoring in the Middle Branch (see **Photo 4-2** and **Figure 4-17**). In terms of rarity and historic significance, both the bascule span and the arched approaches are quite significant in terms of their structural configuration – with both configurations used on this one bridge.

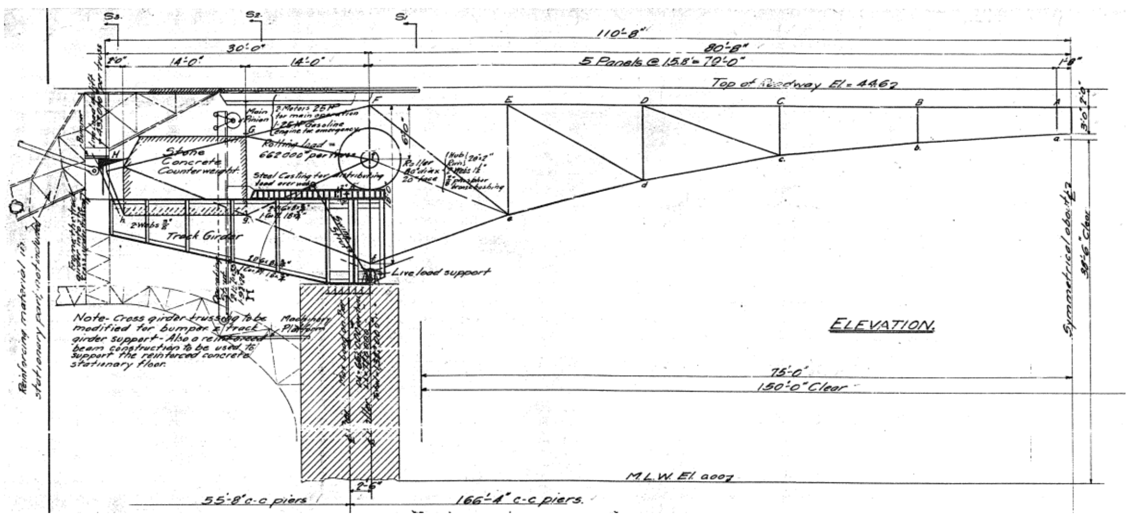

FIGURE 4-16: BASCULE TRUSS ELEVATION

PHOTO 4-2: ORIGINAL CONSTRUCTION – APPROACH SPANS

CATHERINE E. PUGH
MAYOR

DEPARTMENT OF TRANSPORTATION
BALTIMORE CITY

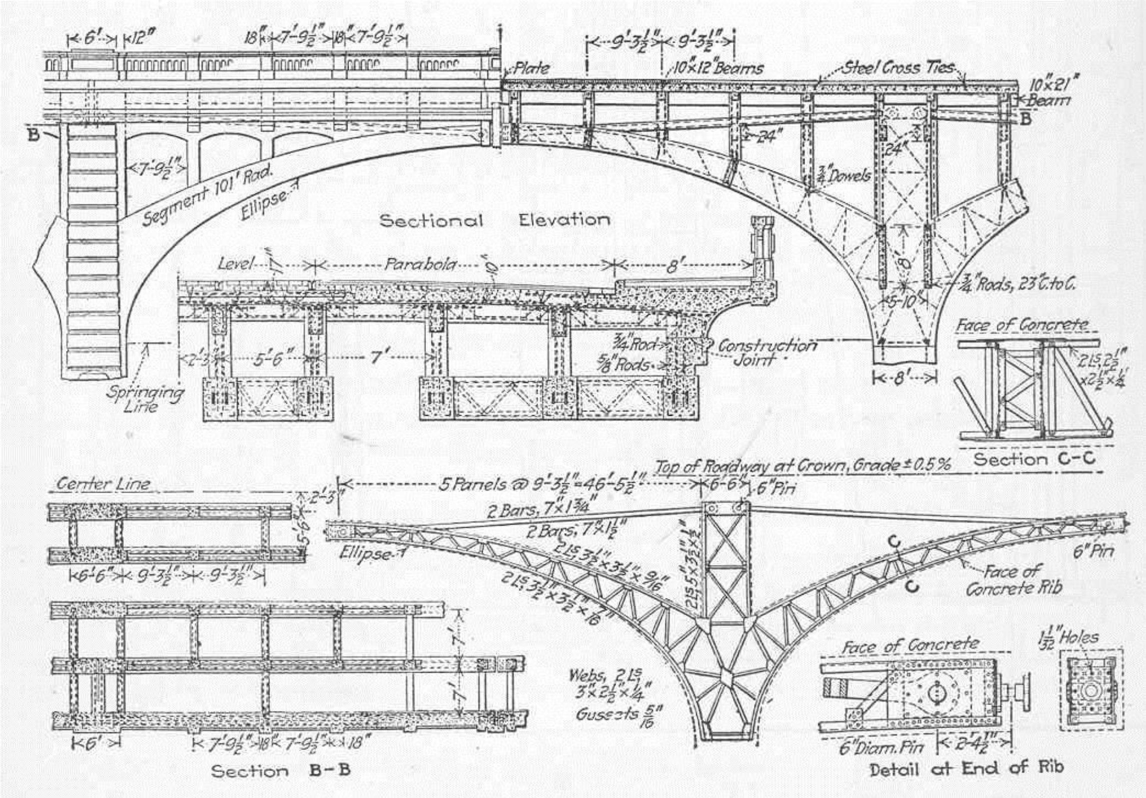

FIG. 17a. CANTILEVER ARCH BRIDGE. HANOVER STREET BRIDGE, BALTIMORE, MD.

FIGURE 4-17: APPROACH SPAN ELEVATION

The bridge is considered to be in poor condition – based upon the *Structure Inventory and Appraisal* provided in the *Bridge Inspection Report*, dated 2015. This “poor condition rating” is based upon standard guidelines for the assessment of structures based upon their repair needs, and not necessarily the load carrying capacity of the structure. For this structure, the “poor” rating is indicated because major rehabilitation work is required for both the deck and supporting superstructure. The Load Rating Summary indicates no major deficiencies regarding the load carrying capacities prescribed by current AASHTO design codes.

The following **Tables 4-1**, **4-2**, and **4-3** provide a summary of the Study Team assessments of the various elements of each major section of the bridge – the Movable Span, the Arched North and South Main Approach Spans, and the Arcade North Approach Spans. These assessments are based upon the guidelines established by the current AASHTO publications – *Manual for Bridge Element Inspection* and *Movable Bridge Inspection, Evaluation, and Maintenance Manual*. Included in the tables are listings of each major bridge element, a material description of that element, suggested rehabilitation needs (based upon the findings of current inspection reports), and Additional Study items required beyond the scope of this report and current available information.

These additional study items are not included in the scope of the current study, and would typically be associated with the required preliminary engineering efforts to assess the elements of a rehabilitation option. These future studies will be particularly important to understanding the necessary repairs and long-term maintenance requirements for an extended service life of the structure – as opposed to repairs required for immediate needs that are identified in the Inspection Reports. Furthermore, any feasible rehabilitation alternative would need to be advanced to a preliminary design stage prior to consideration of the suggested additional study items.

The elements included in the tables are, in some cases, a summary of a related group of items identified in the City's Bridge Inspection Reports. This presentation is made in the context of each major structural system of the bridge as opposed to a summary of its constituent elements. The aforementioned overall "poor" condition rating for this structure is appropriate for each of these elements where major rehabilitations have been identified. Therefore, individual condition ratings associated with each particular element are not provided in the tables.

As previously discussed, condition ratings are provided in bridge inspection reports using the following guidelines and definitions:

- Excellent condition
- Very good condition: No problems noted
- Good condition: Some minor problems
- Satisfactory condition: Structural elements show some minor deterioration
- Fair condition: All primary structural elements are sound, but may have minor section loss, cracking, spalling, or scour
- Poor condition: Advanced section loss, deterioration, spalling, or scour
- Serious condition: Loss of section, deterioration, spalling, or scour has seriously affected primary structural components. Local failures are possible. Fatigue cracks in steel or shear cracks in concrete may be present.
- Critical condition: Advanced deterioration of primary structural elements. Fatigue cracks in steel or shear cracks in concrete may be present or scour may have removed substructure support. Unless closely monitored, it may be necessary to close the bridge until corrective action is taken.
- Imminent failure condition: Major deterioration or section loss present in critical structural components or obvious vertical or horizontal movement affecting structure stability. Bridge is closed to traffic, but corrective action may put it back in light service.
- Failed condition: Out of service – beyond corrective action.

PHOTO 4-3: VIETNAM VETERANS MEMORIAL BRIDGE – MOVABLE SPANS

TABLE 4-1: VIETNAM VETERANS MEMORIAL BRIDGE – MOVABLE SPANS SUMMARY

Movable Span			
Element	**Description**	**Potential Repair**	**Additional Study**
Bridge Lighting	None Present	N/A	Architectural Evaluation of Period Lighting Standards
Traffic Barriers	Open Steel Barrier	Replacement	Barrier Studies to consider supplemental pedestrian protection and period elements
Deck and Sidewalk	Open Steel Grid	Replacement	N/A
Steel Superstructure	Riveted Steel Truss / Girder	• Clean and Paint Steel • General Retrofits	• Evaluate fatigue life • Detailed Inspection • Metallurgical Study of Structural Steel
Operator's Houses	Masonry and Concrete	Rehabilitation of exterior and interior elements	Architectural and Hazardous Materials Evaluations
Movable Span Electrical and Mechanical Operating Systems	Rall Mechanical Operating System	General Reconstruction	Detailed Inspection
Bascule Piers	Reinforced Concrete and Masonry	Rehabilitation	• Detailed Inspection • Underwater Inspection • Detailed Structural / Hydraulic Analyses
Concrete Pile Foundations	Reinforced Concrete	Unknown at this time	• In situ Investigation of Existing Piles • Detailed Structural Analysis
Waterway Fenders and Dolphins	Timber	Unknown at this time	Analyze piers in accordance with AASHTO Vessel Collision Criteria

PHOTO 4-4: VIETNAM VETERANS MEMORIAL BRIDGE – MAIN APPROACH SPANS

TABLE 4-2: VIETNAM VETERANS MEMORIAL BRIDGE – MAIN APPROACH SPANS SUMMARY

Arched North and South Main Approach Spans			
Element	**Description**	**Potential Repair**	**Additional Study**
Bridge Lighting	Standard Roadway	Replace/Augment with "Pedestrian Friendly" Period Lighting Standards	Architectural Evaluation of Period Lighting Standards
Traffic Barriers	Concrete w/ Steel Rail	Replacement	Barrier Studies to consider supplemental pedestrian protection and period elements
Deck and Sidewalk	Reinforced Concrete	Replacement	N/A
Floor System	Reinforced Concrete w/ Steel Encased Members	Replacement	Detailed Inspection
Concrete/Steel "Arched" Superstructure	Composite Steel Truss with Concrete	General Rehabilitation	• Detailed Inspection • Non-linear Structural Analysis - Member Capacities • In-situ metallurgical Study of Steel Members • Concrete Material and Corrosion Studies • Evaluate Riveted Connections
Piers	Reinforced Concrete	General Rehabilitation	• Detailed Inspection • Underwater Inspection • Detailed Structural / Hydraulic Analyses • Concrete Material and Corrosion Studies
Concrete Pile Foundations	Reinforced Concrete	Unknown at this time	• In situ Investigation of Existing Piles • Detailed Structural Analysis

PHOTO 4-5: VIETNAM VETERANS MEMORIAL BRIDGE – ARCADE APPROACH SPANS

TABLE 4-3: VIETNAM VETERANS MEMORIAL BRIDGE – ARCADE APPROACH SPANS SUMMARY

Arcade North Approach Spans			
Element	**Description**	**Potential Repair**	**Additional Study**
Bridge Lighting	Standard Roadway	Replace/Augment with “Pedestrian Friendly” Period Lighting Standards	Architectural Evaluation of Period Lighting Standards
Traffic Barriers	Concrete w/ Steel Rail	Replacement	Barrier Studies to consider supplemental pedestrian protection and period elements
Deck and Sidewalk	Reinforced Concrete	Replacement	N/A
Concrete Arcades	Reinforced Concrete	General Rehabilitation	• Detailed Inspection • Detailed Structural Analysis • Concrete Material and Corrosion Studies
Timber Pile Foundations	Georgia Long-leaf Pine	Unknown at this time	• In situ Investigation of Existing Piles • Detailed Structural / Hydraulic Analyses

Movable Span Observations

A site visit to observe the condition of the movable span operating machinery with respect to the recent condition inspections was conducted on November 17, 2016. The team observed that general reconstruction of movable span electrical and mechanical operating systems would be required for continued bridge openings. However, the major support elements (Rall wheels and track assembly), which are the most difficult elements to rehabilitate or replace with respect to the movable bridge system, are in working order and could be used in continued service of the bridge.

Marine Navigation

It is understood that boaters have a right to unobstructed travel in navigable waters, including tall boats in the Middle Branch. Navigation Regulations, provided in the *U.S. Coast Pilot 3, Chapter 2*, state that:

> *"The draw of the Hanover Street S2 bridge, mile 12.0 across the Middle Branch of the Patapsco River at Baltimore, will open on signal from 5 a.m. to 6:30 a.m., 9:30 a.m. to 4 p.m., and 6 p.m. to 9:00 p.m. The draw need not be opened from 6:30 a.m. to 9:30 a.m. and 4 p.m. to 6 p.m.; however, fire boats, police boats, and other vessels engaged in emergency operations will be passed immediately during this period. When a vessel desires to pass the draw from 9 p.m. to 5 a.m., notice will be given to the superintendent of the bridge, either at the bridge before 9 p.m. or at the superintendent's residence after 9 p.m. If the notice is given from 5 a.m. to 9 p.m. or if at least one half hour has elapsed since the notice was given, the draw will open promptly at the time requested."*

Based on stakeholder discussions, there is currently no commercial freight accommodated by maritime shipping along the Patapsco River that would require the drawbridge to open. The only identified needs for bridge openings are related to a private marina located on the Middle Branch, routine maintenance of the bridge, and MDTA and MTA access for I-95, I-395, and Light Rail piers. Coordination in future phases of project development will be required between the City and the United States Coast Guard to discuss the evaluation of a fixed versus movable bridge span.

Existing water depths and clearances are shown in **Figure 4-18**. The **c**urrent vertical clearance of the bridge in the closed position is 38 feet at the center and 23 feet for the entire 150-foot channel width. The existing clearance is adequate for barge and small tug access if necessary for future dredging and marine construction, including maintenance access for I-95, I-395, and Light Rail piers.

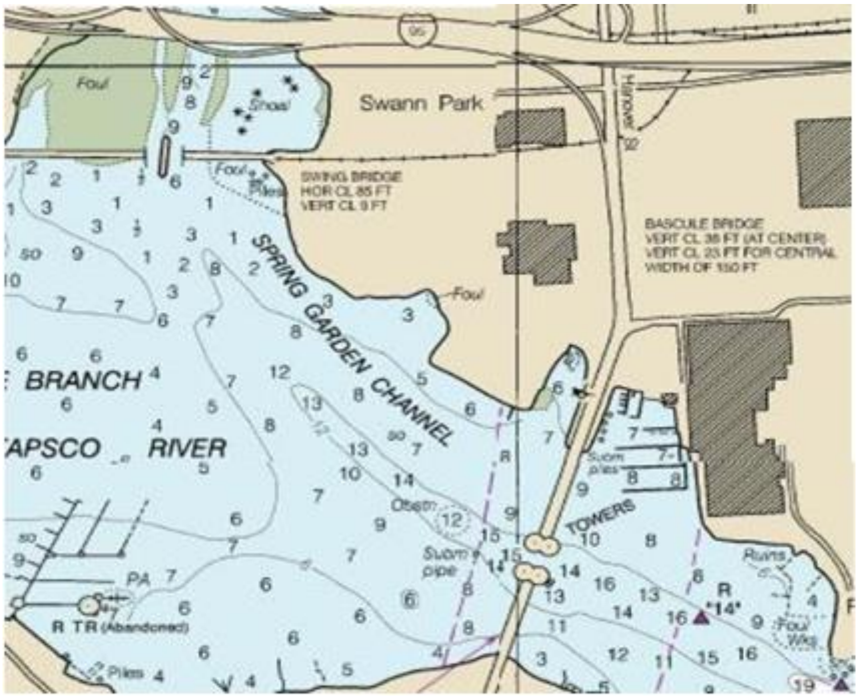

FIGURE 4-18: MIDDLE BRANCH WATER DEPTHS AND VERTICAL CLEARANCE

Historic Context

As noted in Chapter 2, the Vietnam Veterans Memorial Bridge was determined to be eligible for the National Register of Historic Places (NRHP) in May 3001. As such, for any future rehabilitation and replacement options, improvements to a NRHP (or NHRP-eligible) site must comply with federal and state laws, such as Section 106 of the National Historic Preservation Act and the Maryland Historical Trust Act. All actions (projects) must take steps to avoid, minimize, or mitigate adverse effects to the site.

Impact of Existing Bridge Condition on Safety, Connectivity, and Accessibility

Safety

The primary issues associated with safety and the bridge structures are associated with the relatively large joints in the existing bridge decks which are potential pedestrian/bicycle hazards. There is also insufficient pedestrian lighting for such a lengthy structure as the Vietnam Veterans Memorial Bridge. Another issue related to safety is the poor condition of the bridge deck.

Connectivity

The Vietnam Veterans Memorial Bridge is a key link within the corridor. The requirements of the upcoming Port Covington development will very likely redefine the connectivity needs and reshape the structures north of Cromwell Street. As discussed previously, the evaluation of a fixed versus movable bridge span and potential impacts on unobstructed travel in navigable waters will be necessary and coordination will be required between the City and the United States Coast Guard.

Accessibility

The bridges provide the required access to destinations throughout the corridor. The indicated deficiencies have little effect on vehicular traffic, except with respect to potential damage associated with the deck condition of the Vietnam Veterans Memorial Bridge. Pedestrian and bicycle access are also impeded by the lack of satisfactory pedestrian lighting, adequate protection from vehicular traffic, and hazards associated with large deck joint openings. Marine traffic on Middle Branch, which is limited to recreational boat traffic, could potentially be constrained by the lack of dredging in the waterway.

Existing Roadway Conditions

The existing roadway conditions inventory in the study area was previously discussed in Chapter 2. It should be noted that no roadway as-built drawings or construction documents were available from BCDOT for the Hanover Street corridor and that assessments were made using aerial photography, GIS-based photogrammetry, and field observations. The analysis for the existing roadway conditions was performed in accordance with BCDOT design standards and American Association of State Highway and Transportation Officials (AASHTO) *A Policy on Geometric Design of Highways and Streets*, commonly referred to as the “Green Book."

The existing 12-foot travel lanes on Hanover Street, which match the width of the lanes on the Vietnam Veterans Memorial Bridge are appropriate for the major arterial roadway classification of the corridor. Based on field observations, the turning radii onto ramps, intersection cross streets, and into the commercial establishments along Hanover Street are adequate for the cars and trucks traveling the corridor, including accommodating the 45-foot minimum turning radius for an interstate semitrailer truck.

Stopping sight distance can be described as the distance a vehicle driver requires to be able to see something in the roadway, such as a pedestrian in a crosswalk or a stopped vehicle, and stop before colliding with that object. Using the highest posted speed limit in the corridor as the design speed (40 mph from Cherry Hill Road to Reedbird Avenue), the minimum stopping sight distance in the corridor is 305 feet. Even though the reported crash data does not necessarily highlight any areas of sight distance related crashes, one location in the corridor that warrants mention is southbound Potee Street approaching Waterview Avenue, just south of the bridge. The combination of a vertical incline, horizontal curve, and the buildings in the median of Potee Street/Hanover Street limit sight distance to an extent and may make it somewhat difficult for a southbound driver to see pedestrians on the east side of Potee Street. Based on aerial photography, it appears that the sight line from the horizontal curve to the intersection is approximately 300 feet.

Overhead “cobrahead” type roadway lighting exists along the corridor. This type of high-level lighting is designed for vehicular visibility. No public complaints regarding insufficient roadway lighting were obtained from drivers as part of this study and no lighting tests were conducted to quantitatively measure visibility within the study area.

As documented throughout this report, poor pavement conditions exist in the corridor. Significant truck traffic in the area causes pavement rutting, as shown in **Photo 4-6**, which leads to increased maintenance costs and potential safety concerns.

PHOTO 4-6: TYPICAL HANOVER STREET PAVEMENT RUTTING

Drainage and Stormwater Management

The existing roadways within the study area are served by a closed storm drain system in City right-of-way with curb, gutter, and pipe system. Based on inspection and GIS data, it appears that each of the outfalls discharge to the Middle Branch of the Patapsco River, although no as-built records were available to confirm the system. The existing systems cover the full length of the project limits. Depending on the proposed improvements designed in future phases, the system will need to be analyzed for inlet spread and pipe capacity. Since the grades are relatively flat, it may be necessary to upsize some of the pipes if significant impervious areas are added to the roadway. Although there are no public records available that indicate any flooding issues within the project limits, existing inlets, pipes, and bridge scuppers should be cleaned to allow the existing drainage system to function properly. During field observations, numerous blocked inlets were noted on the bridge and surrounding corridor. Storm inlet locations, based on GIS data, were shown on the previous utility map in bicycle.

It would be prudent to inspect any portions of the storm drain system that are to remain for proposed improvements. Inlets/manholes can be visually inspected and video inspection of the pipe systems should be conducted. Many of the existing inlets are likely brick – high traffic loads can cause the mortar to give way. Consideration should be given to replacing such inlets even if they are to remain in place.

The existing roads were likely constructed prior to water quality regulations and because the outfalls discharge to the Patapsco River, quantity control was likely not needed. In the future, any major reconstruction of the roadways will require quality control at a minimum. There are some median areas that may be useful for small bio retention type facilities.

Any proposed design will be in conformance with Baltimore City design standards for both drainage (inlet spacing and pipe sizes) and stormwater management for quality control (treat a minimum of one inch of rainfall for all reconstructed and new impervious areas).

Impact of Existing Roadway Conditions on Safety, Connectivity, and Accessibility

Safety

Based on the information discussed in this section, the roadway geometry in the corridor can be considered safe for the designed/posted speed limits. However, vehicular speed is always a safety concern and future evaluation should focus on the southern section of the study area where the posted speed limit increases to 40 mph to determine if this speed is appropriate for future conditions. The Hanover Street roadway was designed and constructed for easy vehicular movement, not for pedestrians and bicycles. Due to the confluence of various transportation modes in an area designed for vehicles, safety is of utmost importance. Even though no public records indicate flooding issues within the project limits, blocked inlets on the bridge and roadway could lead to safety concerns.

Connectivity

The Hanover Street corridor is currently designed for vehicular travel, with the Vietnam Veterans Memorial Bridge connecting origins and destinations. The existing roadway network sufficiently connects the neighborhoods in and around the Study Area, as long as a vehicle is used.

Accessibility

Hanover Street provides access to and from the interstate system (I-95) in the Study Area, as well as direct access to multiple commercial establishments. These access points are not currently causing problems based on crash data, but the number and spacing of direct access points from the roadway should be evaluated in the future from a safety standpoint.

Existing Pedestrian and Bicycle Facilities and Demand

Existing Pedestrian Facilities

Existing pedestrian facilities in the study area were previously shown in Chapter 2, **Figure 2-4**. Existing pedestrian facilities in the Hanover Street corridor were analyzed within the area, from Reedbird Avenue to the south to Wells Street to the north, as shown in the limits depicted in **Figure 4-19** (see end of chapter).

The analysis for the study area was performed in accordance with the City of Baltimore, Manual on Uniform Traffic Control Devices (MUTCD), American Association of State Highway and Transportation Officials (AASHTO), Americans with Disabilities Act (ADA), National Association of City of Transportation Officials (NACTO), and other guidelines and standards.

Review of prior studies and projects within and adjacent to the study area included the following:

- City of Baltimore Bicycle Master Plan
- Hanover Street Safety and Multimodal Access Study

A walkshed analysis was completed to evaluate pedestrian access and network connectivity linear to the project. The analysis of the walkshed uses a one-half mile distance that is generally accepted as easily accessible by pedestrians within a 30 minute walk time. In some of the locations of the study it is found that there is no well-connected condition, especially for Cherry Hill and Westport, where the actual radial distance covered by a pedestrian is much more.

Notable gaps in the pedestrian network within three miles of the Vietnam Veterans Memorial Bridge include:

- There is no connectivity to the Gwynns Falls Trail that is ADA compliant or currently suitable
- Connection of facilities to Light Rail stations at Cherry Hill and Westport

Pedestrian safety was assessed using a combination of examining crash data and conducting field observations. Intersections in the corridor do not meet the most current design standards including countdown indications and accessible pedestrian signals. Safety deficiencies for pedestrians and bicycles are shown in **Figure 4-20** (see end of chapter).

As noted in Chapter 2, crash data shows that sixty percent of the pedestrian crashes occurred at the intersection of Potee Street at Waterview Avenue. Along with the pedestrian signals not meeting the most current design standards, the crosswalk striping is very faded.

Unsignalized, channelized right-turns, shown in **Figure 4-21**, present a challenge for pedestrians trying to cross at intersections. Channelized right-turning lanes are separated from the rest of the intersection by painted lines or raised barriers, usually in the shape of a triangular island. With longer turning radii, vehicles are not required to slow down as much as they would at traditional intersections. The Federal Highway Administration has stated “a change in curb radius from 15’ to 50’ will increase the crossing distance from 62’ to 100’ and increase pedestrian crossing time by 16-25 seconds.” Pedestrians are also not provided a protected phase where vehicles are required to stop. Two of these instances exist in the study corridor on the northbound approach of Hanover Street at McComas Street and Hanover Street at Cromwell Street. In both instances, the northbound right turns are channelized and unsignalized. A marked crosswalk is located at Cromwell Street, but not at McComas Street.

FIGURE 4-21: CHANNELIZED RIGHT TURN EXAMPLE (HANOVER STREET AT CROMWELL STREET)

There are also numerous locations throughout the study area where the sidewalk has been encroached on by grass, trees, debris, etc. These obstacles can make it difficult to use the sidewalks causing pedestrians to walk in the road. **Photo 4-7** shows an example obstacle on Potee Street north of Reedbird Avenue.

PHOTO 4-7: OBSTACLES BLOCKING SIDEWALK

Field observations show pedestrians being uncomfortable walking on the sidewalks along the Vietnam Veterans Memorial Bridge. The Federal Highway Administration's "Part II of II: Best Practices Design Guide," *Designing Sidewalks and Trails for Access*, as well as the National Association of City Transportation Officials (NACTO) design guidelines, recommend a minimum buffer of 24 inches between the sidewalk and edge of traveled way. Currently, there is no buffer between the sidewalk and edge of the travel way for a majority of the corridor in the study area.

Existing Bicycle Facilities

A three-mile bikeshed analysis was prepared to review bicyclist access to the study area (centered on the bridge). The three-mile bikeshed is generally appropriate and considered the average distance that bicyclists will ride in a single local trip. A local trip is a safe and comfortable 10-to 15-minute bicycle ride. **Figure 4-19** also shows the limit of the three-mile bikeshed.

Analysis of existing facilities in the Hanover Street corridor revealed the following:

- Virtually all existing facilities for pedestrians and bicyclists are uncomfortable and perceived to be unsafe
- Hanover Street pedestrian facilities are not fully ADA compliant
- Hanover Street bike facilities / bike lanes are not protected

The bridge crossing is uncomfortable, not ADA-compliant, and perceived to be unsafe**.** Bicycle safety was assessed primarily using field observations due to the lack of detailed crash data. Due to the numerous gaps in the bicycle network, very few bicycles were observed along the corridor. Bicycle facilities currently do not exist on the Vietnam Veterans Memorial Bridge, leaving bicyclists with the choice of riding in a travel lane or on the sidewalk. Both options can present potential safety risks as there is potential for conflict with other vehicles or pedestrians and limited space to avoid potential hazards.

There is no direct connection from the Vietnam Veterans Memorial Bridge to the Gwynns Falls Trail for cyclists, but there are two trailheads to access the trail from Middle Branch Park in the proximity of the study area – 3301 Waterview Avenue and the 3200 block of South Hanover Street (adjacent to MedStar Harbor Hospital).

Existing Pedestrian and Bicycle Facilities Inventory

The following tables provide an inventory of typical features found in the Hanover Street corridor. The tables present information for each intersection and segments between intersections. Features included in the review are as follows:

- Sidewalks
- Crosswalks
- Pedestrian Signals / Push Buttons
- Pedestrian Refuge
- Curb Ramps (ADA compliant)
- Lighting
- Bike Lanes

Table 4-4 provides inventory for northbound Hanover Street from Reedbird Avenue to Wells Street.

Table 4-5 provides inventory for southbound Hanover Street from Wells Street to Reedbird Avenue.

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TABLE 4-4: EXISTING PEDESTRIAN AND BICYCLE FACILITIES – NORTHBOUND

Intersections and Segments	Sidewalks	Crosswalks	Pedestrian Signals / Push Buttons	Pedestrian Refuge	Curb Ramps (ADA Compliant)	Lighting	Bike Lanes
Reedbird Avenue and Hanover Street Intersection NB	NW – yes SW – yes NE – yes SE - yes	Yes	NW – yes for signal, no button SW – yes NE – yes for signal, no button SE – yes	Reedbird Ave only	NW – yes SW – yes NE – yes SE – yes	NW – yes SW – no NE – no SE - yes	Yes – NB east side with protective markings
Reedbird Avenue to Cherry Hill Road NB	East side – yes West side – yes However, many curb cuts affecting ADA. Cross slope on many driveway aprons not ADA compliant	Midblock crosswalk for MedStar Harbor Hospital	Yes – for mid-block crosswalk for MedStar Harbor Hospital	n/a	n/a	Yes – street lights staggered in corridor	NB east side of Hanover Street with protective markings; Ends prior to Cherry Hill Road
Cherry Hill Road and Hanover Street Intersection NB	NW – yes SW – yes NE – yes SE - yes	Yes	Yes	Median on Cherry Hill – not ADA compliant	NW – yes SW – yes NE – yes SE – yes	NW – no SW – no NE – no SE – yes	No
Cherry Hill Road to Waterview Avenue NB	East side – yes West side – yes MDOT MTA Bus Stop before Waterview Ave.	n/a	n/a	n/a	n/a	Yes	No
Waterview Avenue and Hanover Street Intersection NB	NW – yes SW – yes NE – yes SE – yes	Waterview Ave – yes Hanover St – yes	NW – yes SW – yes NE – yes SE – yes	No	NW – yes SW – yes NE – yes SE – yes	NW – yes SW – no NE – no SE – yes	No
Waterview Avenue to Cromwell Street NB	East side – yes West side – yes (to gore) Bridge – has sidewalk (damaged in some locations)	n/a	n/a	n/a	Commercial drive crossing not ADA compliant	Yes; bridge has lighting	No
Cromwell Street and Hanover Street Intersection NB	NE – yes SE – yes MDOT MTA bus stop in SB lane	Yes – but worn and in need of maintenance	Yes. No push button for crossing eastbound ramp to Cromwell	Yes	East side – yes, with recently installed ramps	SE – yes NE – yes	No

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Intersections and Segments	Sidewalks	Crosswalks	Pedestrian Signals / Push Buttons	Pedestrian Refuge	Curb Ramps (ADA Compliant)	Lighting	Bike Lanes
Cromwell Street to McComas Street NB	Yes – NB east side Commercial driveway not ADA compliant; sidewalks in need of maintenance	n/a	n/a	n/a	n/a	Yes – street lights	No
McComas Street and Hanover Street Intersection NB	NE – no SE – yes	No	NE – no SE – no	No	NE – not compliant SE – not compliant	No	No
McComas Street to Wells Street NB	▪ Sidewalk exists between McComas Street and SB ramp to I-95 ▪ Ramp to Wells Street – yes ▪ Some segments of sidewalk not ADA complaint	n/a	n/a	n/a	n/a	No	No
Wells Street and Hanover Street Intersection NB	NE – yes SE – yes	No	SE – yes for signal, no button NE – yes for signal and button	n/a	Yes	Yes	No

TABLE 4-5: EXISTING PEDESTRIAN AND BICYCLE FACILITIES – SOUTHBOUND

Intersections and Segments	Sidewalks	Crosswalks	Pedestrian Signals / Push Buttons	Pedestrian Refuge	Curb Ramps (ADA Compliant)	Lighting	Bike Lanes
Wells Street and Hanover Street Intersection SB	Yes	No	NW – yes for signal, no button SW – n/a	No	Yes	Yes	No
Wells Street to McComas Street SB	Yes. Some segments of sidewalk are not ADA complaint. MDOT MTA bus stop at McComas	n/a	n/a	n/a	n/a	No	No
McComas Street and Hanover Street Intersection SB	NW leg – yes SW leg – yes	No	No	No	NW – yes SW – yes	NW – yes SW – no	No
McComas Street to Cromwell Street SB	No	n/a	n/a	n/a	n/a	Yes – street lights	No

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Intersections and Segments	Sidewalks	Crosswalks	Pedestrian Signals / Push Buttons	Pedestrian Refuge	Curb Ramps (ADA Compliant)	Lighting	Bike Lanes
West Cromwell and Hanover Street Intersection SB	NW – yes SW – yes	No	NW – no SW – no	No	NW – yes SW – yes	NW – no SW – yes, street light	
Cromwell Street to Waterview Avenue SB	Yes. Bridge has sidewalk. Segments of sidewalk off the bridge may be narrow due to vegetation.	n/a	n/a	n/a	n/a	Yes	No
Waterview Avenue and Hanover / Potee Street Intersection SB	NW – yes SW – yes NE – yes SE – yes	Yes – all legs (worn and in need of re-striping)	NW – yes SW – yes NE – yes SE – yes	No	NW – yes SW – yes NE – yes SE – yes	NW – no SW – yes NE – no SE – yes	No
Waterview Avenue to Cherry Hill Road SB	Yes	Yes	Yes	No		Yes – street lights	No
Cherry Hill Road and Potee Street Intersection SB	NW – yes SW – yes NE – yes SE – yes	Yes – all legs	NW – yes SW – yes for signal, no button NE – yes SE – no	No	NW – yes SW – yes NE – yes SE – yes	Some roadway street lights nearby	No
Cherry Hill Road to Reedbird Avenue SB	West side – yes East side – yes Some segments may have obstructions or are not ADA complaint	n/a	n/a	n/a	n/a	Some roadway lights	No. A SB designated bike lane begins just before Reedbird Ave intersection.

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Topography

The bikeshed's topographic change in elevation ranges from zero, or near water level, to elevation 410.0 in Gwynns Falls to the northwest (see **Figure 4-22**, see end of chapter). Generally, the three-mile bikeshed has a very comfortable topographic change that does not pose any significant issues affecting bicyclist level of comfort.

Impact of Existing Bicycle/Pedestrian Facility Conditions on Safety, Connectivity, and Accessibility

Safety

Based on the findings above, safety within the ½-mile pedestrian walkshed is found to be reasonable with high-level street lighting provided for the majority of the northbound and southbound connections, although no low-level pedestrian lighting is present. Pedestrian signals are provided at the mid-block crossing and intersections but do not meet the most current design standards, including countdown indications and accessible pedestrian signals. Crosswalks are typically found at all intersections, but are in need of maintenance.

The three-mile bikeshed, due to narrow streets and minimal protected bike lanes, does not provide a high level of comfort for bicyclists.

The primary issue associated with pedestrian/bicycle safety and the Vietnam Veterans Memorial Bridge structure is that the sidewalks are not wide enough to accommodate both modes and are not protected by any sort of buffer, making it extremely uncomfortable being in close proximity to large vehicles and traffic moving at higher speeds.

Connectivity

Primary destinations, such as MedStar Harbor Hospital, limited commercial locations, and residential neighborhoods are generally provided with connectivity via sidewalks. The Cherry Hill and Westport neighborhoods do not have desirable connectivity to key destinations, lacking sidewalks in some areas.

The three-mile bikeshed does not currently provide full connectivity throughout the corridor and within the bikeshed except via use of existing streets and sidewalks. There is no direct connection to the Gwynns Fallls Trail from the bridge, but there are two trailheads in the proximity of the study area.

Accessibility

A significant amount of the corridor is ADA compliant. Curb ramps are provided throughout the corridor at intersections. Some curb ramps and segments of sidewalk possess non-compliant conditions due to slopes and some lack of maintenance.

Existing Freight Operations

As presented in Chapter 2, Hanover Street is classified as a *restricted route* (no trucks from 7:00pm to 7:00am) from Wells Street to I-95 and a *through truck route* from I-95 to Reedbird Avenue and points south on Baltimore City's Official Truck Routes map. Members of the Community Advisory Panel (CAP) and Interagency Advisory Group (IAG) provided input on existing freight operations in the corridor.

Anecdotally, the majority of truck traffic currently using the corridor and bridge is domestic freight (local deliveries, fuel trucks, etc.) and not international freight traveling to and from the Port. However, the Hanover Street corridor is critical if there are any tunnel closures. For example, if the Baltimore Harbor Tunnel/I-895 is closed, car carrier trucks will instead use Hanover Street and the bridge to access northbound I-95

Tolls on the interstates have pushed maritime-related truckers onto Baltimore City neighborhood streets. Diverted trucks are not using the Hanover Street corridor as much as other downtown City streets, but the issue exists. An example of toll avoidance may be a truck leaving Fairfield/Masonville and instead of taking the Childs Street ramp to the southbound I-895 toll plaza, the truck driver may choose Frankfurst Avenue and Hanover Street to reach southbound I-95 instead.

Another freight issue is the ability of the Vietnam Veterans Memorial Bridge to continue to accommodate heavier loads/cargo, especially if the thresholds for oversize/overweight permits continue to increase and heavier trucks drive through the corridor. Also, the long-term plan to realign I-95 access as part of the Port Covington development, and currently being evaluated by the MDTA I-95 Access Improvements Study, is a big issue and could impact freight traffic. Similarly, the intersection of McComas Street and Hanover Street needs to be upgraded for truck traffic.

Impact of Existing Freight Movement Conditions on Safety, Connectivity, and Accessibility

Safety

As mentioned previously, the Hanover Street roadway was designed and constructed for primarily vehicular movement, not for pedestrians and bicycles. While wide travel lanes and adequate turning radii allow trucks to move safely through the corridor, a safety issue exists in the corridor and on the Vietnam Veterans Memorial Bridge with pedestrians and bicycles in close proximity to trucks and other high-speed traffic since sidewalks are not protected. Additional truck safety is discussed in the Existing Traffic Operations section of this chapter.

Connectivity

The existing roadway network sufficiently connects the neighborhoods in and around the Study Area, as well as the Port and points north, south, east, and west of the Study Area. For truck traffic, weight and height restrictions for permitted loads govern the routes currently used.

Accessibility

Hanover Street provides access to and from the interstate system (I-95) in the Study Area, as well as the Port and direct access to multiple commercial establishments. As with connectivity, weight and height restrictions for permitted loads govern the routes currently used and the ease of access. South of the Study Area, trucks are impacted by the constrained geometry at the intersection of Hanover Street at Frankfurst Avenue and the lack of a direct connection from Frankfurst Avenue to Potee Street – this will be further discussed in the Existing Traffic Operations section of this report.

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Existing Transit Services and Operations

As previously discussed in Chapter 2, the study area is currently served by MDOT MTA local bus routes 27, 64, and express route 164. Three other local bus routes, 14, 29, and 51, serve the area south of the Vietnam Veterans Memorial Bridge without actually traveling across the bridge. The bus lines are described in further detail within this section. There are no other transit modes serving this area. The Westport Light Rail Station, located to the west of the study area, and the Cherry Hill Light Rail Station, to the south of the study area, are the two closest light rail stations. In Chapter 2, **Figure 2-7** shows stops and routes serving the study area.

Who Uses Transit Service?

Demographic indicators such as population growth and density, age profile, minority population, population with disability, household income, car ownership, and population in the work force were the primary indicators used to analyze the transit market in this study's socioeconomic study area, as defined in the Study Area Demographics section of Chapter 2. Additional information is also included in the Economic Market Analysis in Chapter 3.

In the study area, all of these factors contribute to a high reliance on the transit system. According to the recent report *The Transit Question: Baltimore Regional Transit Needs Assessment* prepared in 2015 by the Baltimore Metropolitan Council, the communities in the southern section of the study area have the highest transit propensity index in the Baltimore region. Block groups in the area score from 12 to 18 which is average for the Baltimore region, to up to 51, indicating a highly transit-dependent population.

While educational attainment might not directly influence transit demand, it can indicate workforce readiness for various types of industries and how they use transit to get to work. Overall, educational attainment in the study area is higher than Baltimore City at large. However, there is a large disparity within the study area. The southern and western regions of the study area have a much larger share of people without any college education. In the southern area, 29.1 percent, and in the western area, 33.9 percent of populations aged 25 and older have less than a high school education. Only 10.0 and 10.6 percent of this same population have a bachelors or associates degree. Only 1.9 percent of the 25 and older population in the southern region have a graduate or professional degree.

The unemployment rate of the workforce living in the socioeconomic study area is 17.5 percent. This might be an indicator of inadequate transit service that is preventing people from accessing jobs in other parts of the city and region.

Where Transit Users Want to Go

Transit plays an important role in the study area to provide access to employment opportunities. The southern portion of the study area relies heavily on public transit to get to work. Existing transit connects neighborhoods in the study area to major employers in downtown and Inner Harbor areas to the north, to industrial areas in Fairfield to the southeast, and the Carroll Park industrial area to the west. MedStar Harbor Hospital, Horseshoe Casino, and Under Armour are the three major employers in the socioeconomic study area that serve as destinations for people coming to the area. A majority of the largest employers are concentrated in and around downtown and the Inner Harbor. The City's top three employers are Johns Hopkins University, the Johns Hopkins Hospital Health System, and the University System of Maryland with over 9,000 employees each. These employers are located further away from the study area at the periphery of the central business district.

There is a disconnect between the major employment industries in the study area and the industries in which people in the study area actually work. This means residents in the study area have to leave their communities and travel to other parts of the city to get to work. About 48 percent of Cherry Hill residents work in the central business district and South Baltimore, 30.1 percent work in Anne Arundel County, and 20.9 percent work further north or east of the central business district. These employment centers east and north of the central business district currently have no direct transit connections to Cherry Hill. The increasing distance of work from home, compounded with the fact that the majority of the population does not have access to personal automobiles, indicates how critical public transportation is in this part of the study area for employment.

South of the bridge, the census tract with the highest percentage of households without any vehicles also lacks access to quality fresh food. This is known as a food desert, and food deserts are urban or rural areas where it is difficult to buy quality fresh food. The closest affordable grocery store from the study area is the Shoppers in Locust Point. Currently there is no route connecting the southern region of the study area to this grocery store.

MDOT MTA Bus Routes Serving the Study Area

Route 14: Route 14 connects the Patapsco Light Rail Station to Annapolis and does not normally serve the study area. However, a limited service that goes into downtown Baltimore via Waterview Avenue does travel through the study area for a small section of the route. This limited service operates only during early mornings and evenings on Sundays when light rail is not in operation.

Route 27: Route 27 serves a much larger area outside of the study area boundary. It connects Port Covington to the Reisterstown Plaza Metro Subway Station via Cherry Hill, Westport, Downtown, Remington, Hampden, and Mount Washington. It is a daily service spanning from 4:30 am to 2:30 am. Average headways are between 15 to 35 minutes in the peak period, 40 to 47 minutes during off-peak hours, and as long as 60 minutes late at night. The weekend headway is 24 to 40 minutes.

Route 29: Only a small section of Route 29 travels through the study area and thus has only two stops in the study area. Route 29 travels in a counterclockwise loop and connects neighborhoods in the larger Cherry Hill community with the Cherry Hill Light Rail Station. The span of service is from 5:00 am to 12:00 am. There is no service on Sundays. The average headway is 30 minutes during peaks and middays and 20 minutes during off-peaks and weekends.

Route 51: Route 51 is a crosstown service that connects the Rogers Avenue Metro Station to the Patapsco Light Rail Station via the West Baltimore MARC Station. The service span for this route is 4:00 am to 2:00 am. Average headways for the route are 15 to 17 minutes during peak hours and 20 minutes during off-peak hours. The average headway is as long as 48 minutes during late night and 31 to 45 minutes during the weekends. South of the Westport Light Rail Station, Route 51 splits into two branches to travel to the Patapsco Light Rail Station via either Cherry Hill or Baltimore Highlands. Only the Cherry Hill branch passes through the study area, and it offers limited weekday hourly service.

Route 64: This route connects Penn Station north of downtown Baltimore to the Brooklyn Homes, Marley Neck, or Riviera Beach areas south of the study area. The route travels through Port Covington, Federal Hill, and downtown Baltimore. The service spans from 4:30 am to 1:30 am. The average scheduled headway for the route is 15 to 17 minutes during peaks, 20 minutes during off-peaks, and up to 48 minutes during late nights. The average weekend headway is between 35 to 45 minutes.

Route 164: This is a southbound-only weekday express service making a single trip during the afternoon peak. The route originates at North Avenue and terminates at Riviera Beach south of the study area. Since it is an express route, Route 164 serves only two bus stops on Potee Street.

More detailed information on service span and scheduled headways for the routes is provided in **Table 4-6**. The information is obtained from the schedules posted on MDOT MTA website.

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TABLE 4-6: SERVICE SPAN AND AVERAGE SCHEDULED HEADWAYS FOR MDOT MTA ROUTES

Route	Service Span*	Average Scheduled Headways in Minutes
14	Weekday: 4:39AM – 1:14 AM Saturday: 5:58 AM – 12:17 AM Sunday: 6:30 AM – 10:37 AM	AM Peak: 20 Midday: 30 PM Peak: 20 Evening: 32 Late Night: 35 Saturday: 31 Sunday: 64
27	Weekday: 4:29 AM – 2:48 AM Saturday: 5:17 AM – 3:05 AM Sunday: 4:55 AM – 3:08 AM	AM Peak: 15 Midday: 40 PM Peak: 35 Evening: 47 Late Night: 60 Saturday: 40 Sunday: 24
29	Weekday: 4:43 AM – 12:19 AM Saturday: 4:45 AM – 12:19 AM Sunday: No Service	AM Peak: 30 Midday: 20 PM Peak: 30 Evening: 20 Late Night: 20 Saturday: 20 Sunday: No Service
51	Weekday: 4:16 AM – 2:24 AM Saturday: 4:35 AM – 1:53 AM Sunday: 5:08 AM – 1:07 AM	AM Peak: 17 Midday: 20 PM Peak: 15 Evening: 20 Late Night:48 Saturday: 41 Sunday: 35
64	Weekday: 4:29 AM – 2:20 AM Saturday: 5:01 AM – 2:29 AM Sunday: 5:02 AM 2:26 AM	AM Peak: 17 Midday: 20 PM Peak: 15 Evening: 20 Late Night: 48 Saturday: 41 Sunday: 35
164	Weekday: 5:04 PM – 6:12 PM	One Trip

Note: Time periods defined as AM Peak: 6am- 9am; Midday: 9am- 3pm; PM Peak: 3pm-6pm; Evening: 6pm – 10pm; Late Night: 10pm – 6am
**Span is from first departure to last arrival*

MDOT MTA Bus Stops

A desktop survey of the bus stops in the study area was performed to identify the location and type of the stop and to evaluate amenities. In addition to Hanover Street and Potee Street, bus stops on several side streets including Wells Street, Cromwell Street, Dickman Street, Waterview Avenue, and Reedbird Avenue were surveyed. Similarly, Seamon Avenue, a parallel street to one-way Potee Street, was also included in the survey. Additional information related to lighting and curb-type was obtained from GIS files provided by MDOT MTA that contained information gathered from the MDOT MTA Bus Stop Survey in 2015. **Table 4-7** provides an inventory of bus stops in the study area.

PHOTO 4-8: TYPICAL STUDY AREA BUS STOPS

Half of the 22 bus stops evaluated were near-side stops and picked up passengers before reaching the intersections. There were four mid-block stops and the remaining stops were far-side. The majority of the stops in the study area were identified with a sign mounted on a light pole. Some of the signs were mounted on a channel sign post or a utility pole. The majority of the stops had no additional pedestrian amenities or features other than the sign. Five bus stops had a shelter with benches for passengers and of those five bus stops, two on the northern side of the study area (Hanover Street/McComas Street and Hanover Street/Cromwell Street) were significantly underutilized. The average daily weekday ridership numbers for those stops were only five and one, respectively.

Although most of the bus stops evaluated were connected with sidewalks, not all sidewalks were in good condition or had adequate width for pedestrians to travel to the bus stops safely and comfortably. In several places, the sidewalks were obstructed by light poles or were discontinued. Two stops in the study area were on grass without any sidewalk access.

Some level of street lighting was present at the majority of the bus stops. In most cases, lighting was poor or barely adequate for riders to feel safe in absence of daylight. There were four stops without any lighting and one stop with pedestrian level lighting available.

PHOTO 4-9: HANOVER STREET/CROMWELL STREET BUS SHELTER (LOWEST RIDERSHIP)

PHOTO 4-10: POTEE STREET/CHERRY HILL ROAD (HIGHEST RIDERSHIP)

PHOTO 4-11: DICKMAN STREET/CROMWELL STREET (NO PEDESTRIAN ACCESS)

The bus stop located on Hanover Street at MedStar Harbor Hospital was the most complete bus stop in the study area with many pedestrian amenities, including a shelter, wide sidewalks, trash receptacles, pedestrian scale lighting, trees, and green areas.

PHOTO 4-12: HANOVER STREET AT MEDSTAR HARBOR HOSPITAL

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TABLE 4-7: MDOT MTA BUS STOP INVENTORY

	Stop Location	Direction	Stop Type	Route	Amenities	Curb Type	Lighting	Lighting Type
1	S Hanover St. @ E McComas St.	Southbound	Nearside	64	Shelter/ bench	Sidewalk	Yes	Streetlights
2	S Hanover St. @ W Cromwell St.	Southbound	Nearside	64	Shelter/ bench	Grass	No	N/A
3	Potee St. @ Waterview Ave.	Southbound	Nearside	27/64	Sign	Sidewalk	No	N/A
4	Potee St. @ Cherry Hill Rd.	Southbound	Farside	27/51/64/164	Sign	Sidewalk	Yes	Streetlights
5	Potee St. @ Reedbird Ave.	Southbound	Nearside	27/51/64/164	Sign	Sidewalk	Yes	Streetlights
6	S Hanover St. @ Reedbird Ave.	Northbound	Farside	14/27/64	Sign	Grass & Sidewalk	Yes	Streetlights
7	S Hanover St. bet. Reedbird Ave. & Cherry Hill Rd.	Northbound	Midblock	14/27/64	Shelter/ bench	Sidewalk	Yes	Pedestrian Lighting
8	S Hanover St. @ Waterview Ave.	Northbound	Nearside	14/27/29/64	Shelter/ bench	Sidewalk	Yes	Streetlights
9	Hanover Street @ Cromwell St	Northbound	Nearside	64	Sign	Sidewalk	Yes	Streetlights
10	W Wells St. @ Hanover St	Eastbound	Farside	64	Sign	Sidewalk	Yes	Streetlights
11	W Wells St. @ S Charles St.[2]	Eastbound	Nearside	64	Sign	Sidewalk	Yes	Streetlights
12	W Wells St. @ S Charles St.	Westbound	Nearside	64	Sign	Sidewalk	No	N/A
13	E Cromwell St @ Insulator Dr.	Westbound	Midblock	27/64	Sign	Sidewalk	Yes	Streetlights
14	E Cromwell St. @ Insulator Dr.	Eastbound	Farside	27/64	Sign	Sidewalk	Yes	Streetlights
15	E Cromwell St. bet. Insulator Dr. and Penninsula Dr.	Westbound	Midblock	27/64	Sign	Sidewalk	Yes	Streetlights
16	Hanover St. Ramp @ W Cromwell St.	Southbound	Nearside	64	Sign	Grass	Yes	Streetlights
17	Waterview Ave. @ Potee St.	Westbound	Farside	14/29	Sign	Grass	Yes	Streetlights
18	Cherry Hill Rd. @ Seamon Ave.	Eastbound	Nearside	27/29/51	Sign	Grass & Sidewalk	No	N/A
19	Cherry Hill Rd. @ Seamon Ave.	Westbound	Farside	27/29/51	Shelter/ bench	Sidewalk	Yes - Poor	Streetlights
20	Seamon Ave. @ Reedbird Ave.	Northbound	Farside	27/51	Sign	Sidewalk	Yes - Poor	Streetlights
21	Seamon Ave. @ Larue Square N	Northbound	Nearside	27/51	Sign	Sidewalk	Yes	Streetlights
22	Reedbird Ave. bet. S Hanover St. & Potee St.	Westbound	Midblock	51	Sign	Sidewalk	Yes - Poor	Streetlights

[2] This stop is labeled “Wells Street & Marshall Street” in MDOT MTA’s database, but is actually located eastbound at the intersection of Wells Street & Charles Street

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MDOT MTA Ridership

Average Daily Ridership for Fall 2016 was obtained for the bus stops in the study area from MDOT MTA. This information is summarized in **Table 4-8** and **Figure 4-23** below. The bus stops along Hanover Street, Potee Street, and Cherry Hill Road in the southern section of the study area show significantly higher ridership than the bus stops in the northern section. The ten most utilized stops (based on weekday ridership) are located in the southern section, indicating higher transit use in the southern section of the study area. The bus stop located on Potee Street at Cherry Hill Road has the highest ridership among the bus stops in the study area with an Average Daily Ridership of 278, 67, and 56 for weekdays, Saturdays, and Sundays, respectively.

TABLE 4-8: 2016 AVERAGE DAILY RIDERSHIP BY BUS STOP

	Stop Location	Route	Direction	Weekday	Saturday	Sunday	Weekday Rank
1	S Hanover St. @ E McComas St.	64	Southbound	5	3	1	19
2	S Hanover St. @ W Cromwell St.	64	Southbound	1	0	1	22
3	Potee St. @ Waterview Ave.	27/64	Southbound	72	27	22	7
4	Potee St. @ Cherry Hill Rd.	27/51/64/164	Southbound	278	67	56	1
5	Potee St. @ Reedbird Ave.	27/51/64/164	Southbound	99	28	21	6
6	S Hanover St. @ Reedbird Ave.	14/27/64	Northbound	43	14	11	9
7	S Hanover St. bet. Reedbird Ave. & Cherry Hill Rd.	14/27/64	Northbound	111	39	30	5
8	S Hanover St. @ Waterview Ave.	14/27/29/64	Northbound	145	50	37	3
9	S Hanover St. @ Cromwell St.	64	Northbound	2	2	2	21
10	W Wells St. @ S Hanover St.	64	Eastbound	3	1	0	20
11	W Wells St. @ S Charles St.	64	Eastbound	30	8	7	12
12	W Wells St. @ S Charles St.	64	Westbound	12	4	2	15
13	E Cromwell St @ Insulator Dr.	27/64	Westbound	17	6	10	14
14	E Cromwell St. @ Insulator Dr.	27/64	Eastbound	7	2	1	18
15	E Cromwell St. bet. Insulator Dr. and Peninsula Dr.	27/64	Westbound	8	2	2	17
16	Hanover St. Ramp @ W Cromwell St.	64	Southbound	43	1	3	9
17	Waterview Ave. @ Potee St.	14/29	Westbound	32	14	2	11
18	Cherry Hill Rd. @ Seamon Ave.	27/29/51	Eastbound	238	99	45	2
19	Cherry Hill Rd. @ Seamon Ave.	27/29/51	Westbound	130	29	21	4
20	Seamon Ave. @ Reedbird Ave.	27/51	Northbound	44	6	4	8
21	Seamon Ave. @ Larue Square N	27/51	Northbound	9	1	0	16
22	Reedbird Ave. bet. S Hanover St. & Potee St.	51	Westbound	18	0	0	13

Source: MDOT MTA

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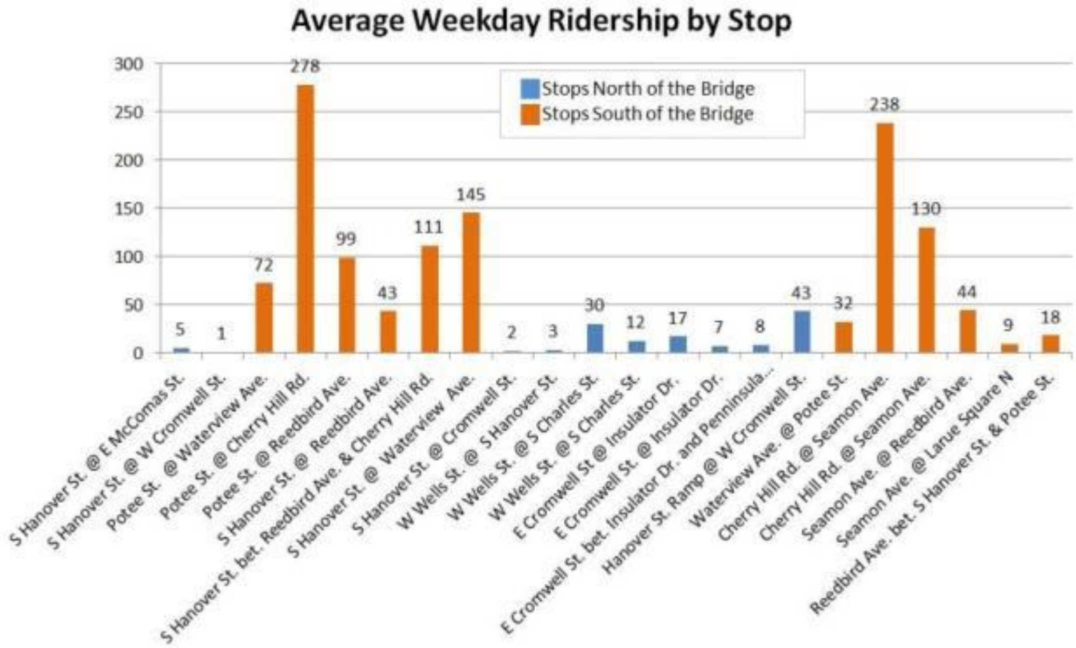

FIGURE 4-23: 2016 AVERAGE WEEKDAY RIDERSHIP BY BUS STOP

There is no uniform ridership standard that measures utilization rate of a bus stop. Ridership numbers are affected by many different factors. Transit agencies set their own ridership criteria to evaluate bus stops for service and infrastructure improvement needs. These criteria are based on the agency's goals and objectives. In addition to ridership, several other factors which can be taken into account include frequency of service, number of transfers, surrounding land use, and characteristics of the population the bus stop serves. Transportation Research Board TRCP Report 19 suggests the following boarding numbers by area type that can be considered high enough to install an amenity such as a passenger shelter:

Location	Boardings per day
Rural	10
Suburban	25
Urban	50

The Washington Metropolitan Area Transit Service (WMATA) Guidelines for the Design and Placement of the Transit Stops (2009) also considers daily boardings of 50 or more to be high enough to recommend a passenger shelter for a bus stop. MDOT MTA uses average daily boardings of 100 or more, as well as other factors, to determine whether a bus stop warrants a shelter. Five out of the 12 bus stops evaluated in the southern section of the study area have an average weekday ridership of 100 or more, but three of those bus stops do not have a shelter.

Figure 4-24 (see end of chapter) shows the routes and the bus stops serving the study area along with Average Daily Ridership associated with each bus stop.

MDOT MTA Paratransit

MDOT MTA provides an on-demand mobility/paratransit service for disabled persons who are functionally unable to get to a bus stop, wait unassisted at a stop or station, or board or ride a bus or train by themselves. It is a shared-ride door-to-door service. Pre-certification is required to use this service.

MDOT MTA BaltimoreLink

MDOT MTA made significant changes to its bus transit system operating throughout the Baltimore metropolitan area and implemented BaltimoreLink on July 17, 2017. With the implementation of BaltimoreLink, the MDOT MTA's plan aims to improve service quality and reliability by restructuring every bus route in the system and redoing every route's schedule. BaltimoreLink also aims to align the bus network with emerging employment centers.

Charm City Circulator

The Charm City Circulator is a fare-free bus service operated by the Baltimore City Department of Transportation through Transdev, a private contractor. It operates four routes in the downtown area and connects to parking locations at the edges of downtown. The Charm City Circulator does not operate any routes in the study area. However, the contracted operator has a depot in Cherry Hill and all of the Charm City Circulator buses are stored at the depot during non-operating hours. The buses leave the depot in the morning to get to their specific stops before the start of service. In doing so, they travel through the study area. The buses deadhead towards the depot at night when service ends.

A large portion of the Circulator's operating budget comes from a tax on parking facilities in the downtown area, which is not sufficient to cover operating costs. Even though the service is very popular and the demand is rising, the City has been struggling to fund the free service and is unable to expand it. In fact, BCDOT has recently proposed to eliminate the Green and Banner Routes, and to cut the Purple Route's Northern Extension back to Penn Station, thereby cutting service in half. Because of the lack of funding, it seems unlikely that the Charm City Circulator routes will be expanded to serve the study area. The contracted operator is paid based on revenue hours that start only when the buses begin picking up patrons from specified stop locations where the services start. If the buses were to pick the residents up from the communities around the depot in Cherry Hill, it would be considered an expansion of service accruing additional cost to the City.

Other Transit Modes

Water Taxi

As previously mentioned in Chapter 2, the Baltimore Water Taxi currently operates north and east of the study area within the Inner Harbor and as far as Fort McHenry and Canton. There are no current water taxi routes in the study area. The 2015 Baltimore Water Transit Strategies Plan identifies Westport and

Cherry Hill as potential travel markets south of existing Inner Harbor routes. These areas were also noted in the Middle Branch Transportation Plans.

Impact of Existing Transit Conditions on Safety, Connectivity, and Accessibility

Safety

Lack of safety, both real and perceived, is a major factor in deterring people from using transit. Lack of adequate lighting, pedestrian signals, crosswalks, and sidewalks, and limited or no buffer between the waiting/queueing area and the traffic lanes are some of the safety issues observed at and around the bus stops in the study area.

Connectivity

Transit plays an important role in connecting the study area to employment and social opportunities in the region. It provides communities in the south direct connection to major employment centers in the City including downtown Baltimore and the Inner Harbor. It is also plays an important part in providing the communities in the study area with access to quality fresh food.

Accessibility

Though current ridership information indicates sufficient transit service for the demand, physical accessibility to bus stops greatly influences the success of transit as a mode of transportation. Lack of sidewalks or obstructed sidewalks, lack of pedestrian signals, and lack of crosswalks or faded crosswalks at the intersections approaching the bus stops are some of the issues that discourage transit use in the study area. For wheelchair users and the elderly, steep grades, narrow sidewalks, uneven surface, and lack of pedestrian ramps pose serious challenges.

Existing Traffic Operations

The purpose of evaluating traffic operations is to understand how the existing roadway and intersection configurations and capacity currently accommodate the multimodal travel demand. The Study Team used several tools and technical methodologies to evaluate the exiting traffic facilities that were described in Chapter 2. The results of this analysis will allow the Study Team to identify improvements in the corridor to better accommodate existing and future demand.

The Hanover Street Corridor Study, led by the City of Baltimore, and the I-95 Access Improvements National Environmental Policy Act (NEPA)/Interstate Access Point Approval (IAPA) project, led by the Maryland Transportation Authority (MDTA) and the City of Baltimore, are being conducted concurrently and have overlapping traffic study areas on the Hanover Street corridor. These study areas were shown in Chapter 1, **Figure 1-2**. To ensure the two studies are coordinated, the City of Baltimore and MDTA agreed to adopt a single set of peak hour traffic volumes to use for existing conditions of both projects. Overlapping volumes between the two projects (Hanover Street between Wells Street and Waterview Avenue) were compared, and the generally higher volume set was adopted to be conservative. For this project, the non-overlapping study intersections on Hanover Street and Potee Street south of

Waterview Avenue (i.e. Hanover Street/Potee Street at Cherry Hill Road and Hanover Street/Potee Street at Reedbird Avenue) were balanced with the adopted volumes to the north (shown in Chapter 2, **Figure 2-16**).

The study intersection capacity analysis was performed with a software tool called Synchro which is a deterministic and macroscopic signal analysis computer software program that models street networks and traffic signal systems. Geometric data such as number of lanes, lane configuration, storage lengths, tapers, and distances between intersections were input into Synchro. Additionally, existing signal timings and phasing were obtained from the City of Baltimore and coded into the Synchro traffic model along with existing traffic volumes. Intersection capacity analyses were performed using the industry standard National Academy of Sciences Transportation Research Board's Highway Capacity Manual (HCM) methodology for all study intersections. Performance measures of effectiveness include level of service (LOS), volume-to-capacity (v/c) ratio, and average vehicle delay. Key performance measures are defined as follows:

Level of Service (LOS) is a qualitative measure describing operational conditions of an intersection or any other transportation facility. LOS measures the quality of traffic service, and may be determined for intersections, roadway segments, or arterial corridors on the basis of delay, congested speed, volume to capacity (v/c) ratio, or vehicle density by functional class. At intersections, LOS is a letter grade designation that corresponds to a certain range of roadway operating conditions. The levels of service range from 'A' to 'F', with 'A' indicating the best operating conditions and 'F' indicating the worst, or a failing, operating condition (**Table 4-9**).

The volume-to-capacity ratio (v/c ratio) is the ratio of current flow rate to the capacity of the intersection. This ratio is often used to determine how sufficient capacity is on a given roadway. Generally speaking, a ratio of 1.0 indicates that the roadway is operating at capacity. A ratio of greater than 1.0 indicates that the facility is operating above capacity as the number of vehicles exceeds the roadway capacity.

Control Delay is the portion of delay attributed to traffic signal operation for signalized intersections. Control delay can be categorized into deceleration delay, stopped delay, and acceleration delay.

Table 4-9 shows each Level of Service and its corresponding delay range for signalized intersections. An overall intersection Level of Service D or better is considered acceptable by Baltimore City DOT, though levels below D may be considered acceptable to ensure safe and sufficient accommodations are made for non-motorized modes of travel such as walking and biking.

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TABLE 4-9: INTERSECTION LEVEL OF SERVICE (LOS) DELAY RANGES

Signalized Intersections	
Level of Service	**Control Delay Range (sec)**
A	≤10
B	>10 and ≤20
C	>20 and ≤35
D	>35 and ≤55
E	>55 and ≤80
F	>80

As indicated previously, a Synchro model was used to perform the analyses. Synchro implements Highway Capacity Manual 2010 methods of analysis. National Electrical Manufacturers Association (NEMA) phasing, a specific numbering system for signal phases, is required for the HCM 2010 methodology. However, because many of the signals do not operate with standard NEMA phasing, HCM 2000 results were used. **Table 4-10** summarizes the HCM analysis performed under existing traffic conditions. **Figure 4-25** (see end of chapter) shows the existing LOS during the AM and PM peak hours for each study intersection.

TABLE 4-10: EXISTING INTERSECTION CAPACITY ANALYSIS RESULTS

Intersection	Existing (2016) Conditions					
	HCM					
	Delay (sec)		Level of Service		V/C Ratio	
	AM	PM	AM	PM	AM	PM
Hanover St & Wells St	30.7	31.0	C	C	1.00	0.91
Hanover St & McComas St	13.6	17.7	B	B	0.78	0.75
Hanover St & Cromwell St	18.8	37.7	B	D	0.62	0.77
Potee St and Waterview Ave	21.4	7.5	C	A	0.27	0.37
Hanover St & Waterview Ave	5.1	8.6	A	A	0.46	0.39
Potee St & Cherry Hill Rd	16.1	9.9	B	A	0.34	0.45
Hanover St & Cherry Hill Rd	5.5	10.5	A	B	0.57	0.39
Potee St and Reedbird Ave	8.6	8.4	A	A	0.29	0.44
Hanover St & Reedbird Ave	4.0	5.7	A	A	0.37	0.27

All intersections within the project study area limits (Wells Street to Reedbird Avenue) operate with an acceptable intersection LOS during the AM and PM peak hours.

CATHERINE E. PUGH
MAYOR
DEPARTMENT OF TRANSPORTATION
BALTIMORE CITY

South of the study area limits where additional counts were collected, the intersection of Hanover Street at Patapsco Avenue is the only intersection that does not meet the Baltimore City LOS standards. This intersection operates with a LOS F during both the AM and PM peak hours due to the westbound approach operating over capacity.

The acceptable level of service at all intersections within the project study area limits (Wells Street to Reedbird Avenue) suggests there may be excess roadway capacity throughout the corridor. To test whether the reversible lane is necessary under existing conditions, the constraining intersection of Hanover Street at Cromwell Street was modeled without the reversible lane (two lanes in each direction during the AM and PM peak hours). All existing signal timings were maintained. Although not necessary during the AM peak hour, the results show that during the PM peak hour the reversible lane is necessary to meet Baltimore City LOS standards.

Safety Assessment

Crash data along with field observations and inventory of infrastructure/facilities were used to determine operational and safety deficiencies for vehicles and trucks (pedestrians and bicycles were discussed earlier in this chapter). These deficiencies are shown in **Figure 4-26** (see end of chapter) and detailed in the following descriptions.

Vehicular Safety

Vehicular safety was assessed using a combination of crash data, field observations, and existing traffic operations analysis. Operational and safety deficiencies found at the following locations include:

Corridor Wide

- Pavement markings throughout most of the corridor show signs of wear and in some instances are not visible. Worn or non-visible pavement markings disrupt driver expectancy and do not provide appropriate lane guidance.
- All of the study intersections except Hanover Street at McComas Street and Hanover Street at Cromwell Street have span wire traffic signals. These signals have lower visibility than other available mounting options/designs.
- The reversible lane signal lighting and pavement markings do not utilize newer, higher visibility technologies/materials available.
- Poor pavement conditions and potholes, particularly on the Vietnam Veterans Memorial Bridge, can cause unexpected driver behavior (i.e. drivers swerving out of their lane). **Photo 4-13** shows the deck condition on the bridge.
- The age and condition of the Vietnam Veterans Memorial Bridge necessitates ongoing maintenance particularly for the deck and bascule span. This frequently causes lane closures which impact the study corridor.

PHOTO 4-13: POOR DECK CONDITION ON VIETNAM VETERANS MEMORIAL BRIDGE

Hanover Street at Wells Street

- There is a lack of street lighting on the northbound Hanover Street approach to Wells Street.
- Assessing movement by movement LOS shows that the westbound left turn from Wells Street to Hanover Street operates over capacity during the AM and PM peak hour.

Hanover Street at McComas Street

- The absence of a Hanover Street southbound to I-95 southbound ramp causes a variety of maneuvers at and around the McComas Street intersection that can cause safety risks and confusion. Drivers make these maneuvers to avoid using the jug handle at Cromwell Street. These maneuvers by southbound vehicles on Hanover Street to access I-95 southbound include:
    - U-turning just north of the McComas Street intersection
    - Turning right onto W. McComas Street and U-turning on McComas Street to make an eastbound left turn onto northbound Hanover Street
- Northbound and southbound left-turn movements are restricted during the AM and PM peak hours, some vehicles were observed making these movements.

Hanover Street at Cromwell Street

- The southbound left-turn movement is prohibited, some vehicles were observed making this movement.
- Assessing movement by movement LOS shows that the southbound approach of Hanover Street at Cromwell Street is approaching capacity during the PM peak hour.

Hanover Street at Waterview Avenue

- Clearly marked as a no stopping zone and hatched with yellow striping, the west side of the north leg of this intersection is utilized by some vehicles as a parking zone. During field observations, tractor trailers were observed parking in this area.

Hanover Street at Cherry Hill Road

- There are no pavement markings to separate travel lanes from parking lanes on Cherry Hill Road.

Potee Street at Cherry Hill Road

- The left turn only sign in the southbound Potee Street outer lane is not followed as the left lane does not end until Reedbird Avenue and there are no corresponding pavement markings.

Truck Safety

Truck safety was assessed using primarily field observations due to the lack of detailed crash data.

Just south of the study area, the combination of constrained geometry at the intersection of Hanover Street at Frankfurst Avenue and lack of a direct connection from Frankfurst Avenue to Potee Street has been well documented. Based on discussions with local business associations and industry groups, trucks traveling west on Frankfurst Avenue cannot turn left onto Potee Street to travel towards Anne Arundel County, so they instead travel north on Hanover Street to Waterview Avenue to access I-295 or I-95. The June 2014 *Hanover Street Safety and Multimodal Access Study* documented that truck drivers have difficulty turning to/from Frankfurst Street to Hanover Street and included concepts that were developed to connect westbound Frankfurst Avenue to Potee Street. Members of the Interagency Advisory Group (IAG) have also indicated that these deficiencies cause additional truck traffic to use Hanover Street and Potee Street north of Frankfurst Avenue to access Waterview Avenue. Allowing truck traffic that currently uses Waterview Avenue, a relatively low speed, minor roadway that divides the Cherry Hill neighborhood from Middle Branch Park, to more safely and efficiently access a higher classification roadway (i.e. Potee Street) would improve truck safety and circulation. **Figure 4-27** shows a map of these truck movements.

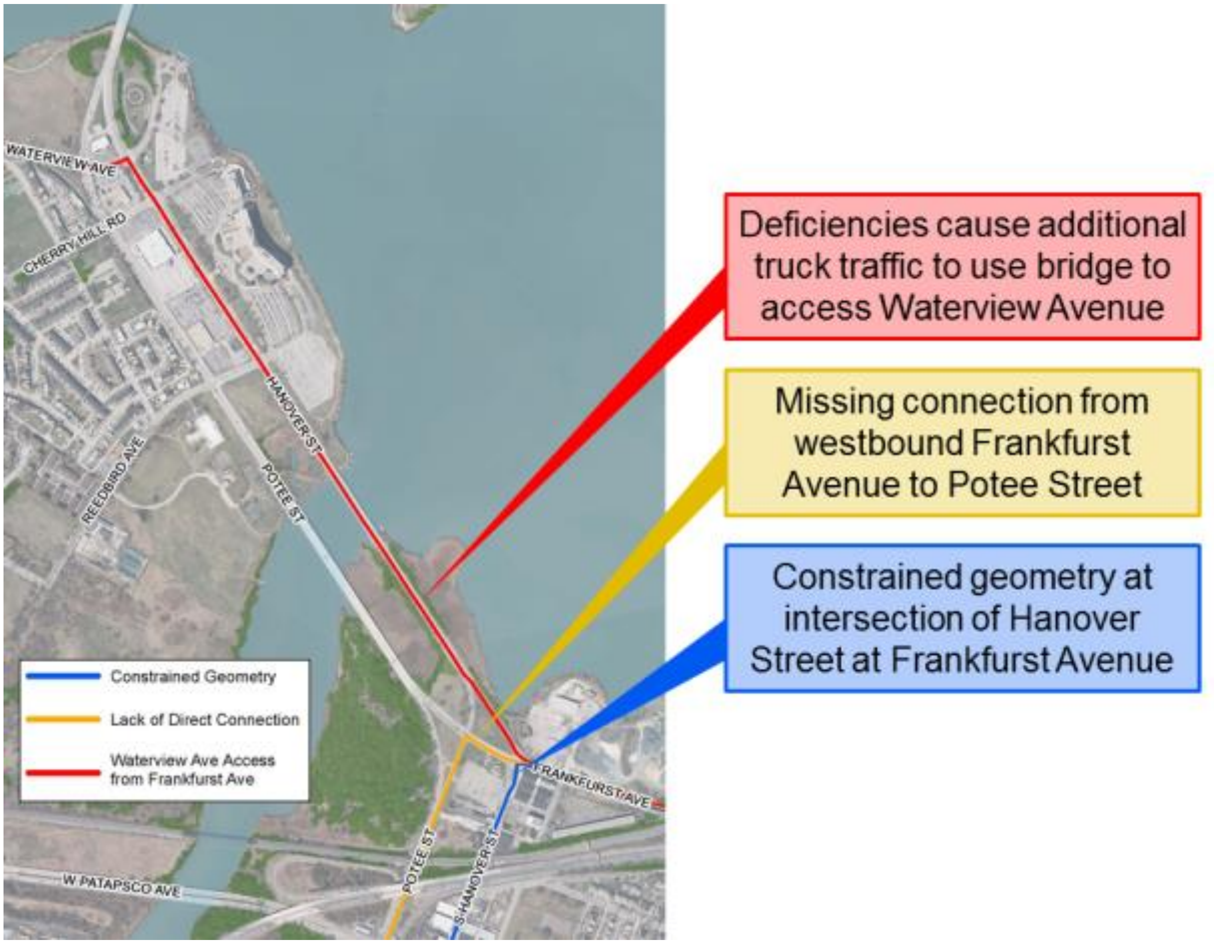


FIGURE 4-27: TRUCK CONSTRAINTS SOUTH OF THE STUDY AREA

Impact of Existing Traffic Operations on Safety, Connectivity, and Accessibility

The Hanover Street Corridor and Vietnam Veterans Memorial Bridge crosses the Middle Branch of the Patapsco River, connecting many South Baltimore neighborhoods and the Port to the City and providing access to job centers, grocery stores, and other necessary services. Adequate traffic operations and safety is critical for this corridor.

Safety

Safety along the corridor is essential for all modes of transportation, including cars and trucks. The safety assessment in this section detailed the safety deficiencies that may be problematic for vehicular users in the corridor, which include traffic control devices, condition of pavement and pavement markings, capacity constraints, geometric constraints/safety concerns, missing connections, and maintenance of facilities.

Connectivity

Since the bridge is the primary connection across the Middle Branch of the Patapsco River between many South Baltimore neighborhoods and the City, it is critical that this connection remains intact and performs acceptably. Existing conditions throughout the study corridor operate within the Baltimore City LOS standards.

Accessibility

The Hanover Street Corridor and Vietnam Veterans Memorial Bridge are used by all modes of transportation. Some residents rely on certain modes of transportation to access job centers, grocery stores, etc. It is important that the facilities throughout the corridor and on the bridge are adequate to carry the demand and accessible for all modes. Existing conditions indicate that the corridor is meeting current vehicular demands, but there is potential to improve facilities for pedestrians and bicycles throughout most of the corridor.

Public Outreach

For this phase of work, the Study Team met with the Interagency Advisory Group (IAG) and the Community Advisory Panel (CAP) to present the analysis of the existing transportation network and obtain feedback. The team met with both the IAG and CAP on January 18, 2017 to review the information presented in this chapter. Existing transportation network information was presented at a Public Meeting held on January 31, 2017 at MedStar Harbor Hospital. The Study Team reviewed the findings to date, provided an overview of the existing transportation facility conditions and an update on bridge condition information, and discussed barriers to multimodal safety, connectivity and accessibility, as well as next steps.

Summary

Building on the data collected and described in Chapter 2, the Study Team evaluated the existing transportation network in the study area to identify potential barriers to multimodal safety, connectivity, and accessibility, and how they are related to bridge structure conditions, roadway conditions, pedestrian and bicycle facilities and demand, freight operations, transit facilities and demand, traffic operations, and safety. Understanding how the corridor functions today, and the deficiencies of the existing transportation network, will allow the City and its stakeholders to establish a baseline for developing Design Opportunities and Constraints as well as potential improvements to the corridor.

Currently, travel can be challenging for pedestrians and bicyclists in South Baltimore attempting to connect with the many destinations around the Middle Branch of the Patapsco River, as other modes of transportation (vehicles, buses and trucks) tend to dominate the road network. Barriers to connectivity take two fundamental forms. In some cases a “wall” exists that blocks a desired movement. In other cases a “gap” separates people from their desired destinations. Both types of barriers exist in the corridor.

Additional Study Area features discussed in this chapter are briefly summarized below:

- The existing conditions of the five major bridge structures in the Study Area were assessed to ascertain their maintenance and operations needs to effectively function as an element of the corridor for long-term use. The assessments were based upon the information provided in the plans, reports and load ratings and revealed that three Hanover Street structures are candidates for major rehabilitation/replacement and two ramp structures only require continuing normal maintenance. The bridges are continuing to function with respect to current vehicular traffic access needs, but deficiencies related to pedestrian/bicycle access are present.
- The existing roadway is designed for vehicular travel with no major deficiencies present, although poor pavement conditions do exist throughout the corridor.
- A walkshed analysis (one-half mile distance) and bikeshed analysis (three-mile distance) was completed to evaluate pedestrian and bicycle access, deficiencies, and network connectivity. Notable gaps in the network within three miles of the Vietnam Veterans Memorial Bridge include lack of suitable connectivity to the Gwynns Falls Trail that is ADA compliant and connection of facilities to Light Rail stations in Cherry Hill and Westport. Virtually all existing facilities for pedestrians and bicyclists are uncomfortable and perceived to be unsafe, Hanover Street pedestrian facilities are not fully ADA compliant, and Hanover Street bike facilities / bike lanes are not protected.
- Based on stakeholder input, the majority of truck traffic currently using the corridor and bridge is domestic freight (local deliveries, fuel trucks, etc.) and not international freight traveling to and from the Port.
- MDOT MTA local and express bus routes serve the study area. The survey of bus stops in the corridor showed a varying range of amenities and level of accessibility among the stops. Average Daily Ridership for the bus stops also varies widely, with the bus stops along Hanover Street, Potee Street, and Cherry Hill Road in the southern section of the study area having significantly higher ridership than the bus stops in the northern section. The existing bus system in the study area is adequate for the current demand, but facilities could be improved for the accessibility and comfort of riders. Additional bus service will be critical to provide access to the Port Covington development.
- Traffic operations were evaluated to understand how the existing roadway and intersection configurations and capacity currently accommodate the multimodal travel demand. All intersections within the project study area limits (Wells Street to Reedbird Avenue) operate with an acceptable intersection Level of Service during the AM and PM peak hours, suggesting there may be excess roadway capacity throughout the corridor. The reversible lane on the bridge was evaluated under existing conditions and appears to be necessary for traffic capacity in the PM peak hour, but not the AM peak hour. Vehicular and truck safety was also examined using combination of crash data, field observations, and existing traffic operations analysis.

Common themes emerged as safety, connectivity, and accessibility under existing conditions were analyzed for each element of the Hanover Street corridor, as highlighted below:

Safety

- The safety issues with bridge structures are related to pedestrian/bicycle access on Hanover Street/Vietnam Veterans Memorial Bridge. Sidewalks are not protected and are in close proximity to large vehicles and traffic moving at higher speeds. Additionally, there are relatively large joints in the existing bridge decks which are potential pedestrian/bicycle hazards and there is insufficient pedestrian type lighting for such a lengthy structure as the Vietnam Veterans Memorial Bridge. The poor condition of the bridge decks is a safety concern due to the susceptibility for potential traffic accidents and vehicle damage associated with the severity of the deterioration of the deck surfaces.
- The roadway geometry in the corridor can be considered safe for the designed/posted speed limits. The Hanover Street roadway was designed and constructed for easy vehicular movement, not for pedestrians and bicycles. Due to the confluence of various transportation modes in an area designed for vehicles, safety is of utmost importance.
- Safety within the half-mile pedestrian walkshed is found to be reasonable with street lighting provided for the majority of the northbound and southbound connections. Pedestrian signals are provided at the mid-block crossing and intersections but do not meet the most current design standards, including countdown indications and accessible pedestrian signals. Crosswalks are typically found at all intersections, but are in need of maintenance. The three-mile bikeshed, due to narrow streets and minimal protected bike lanes, does not provide a high level of comfort for bicyclists.
- Lack of safety, both real and perceived, is a major factor in deterring people from using transit. Lack of adequate lighting, pedestrian signals, crosswalks, and sidewalks, and limited or no buffer between the waiting/queueing area and the traffic lanes are some of the safety issues observed at and around the bus stops in the study area.
- Vehicular safety deficiencies in the corridor include worn or non-visible pavement markings, poor pavement conditions, span wire traffic signals (which have lower visibility than other designs), and the reversible lane signal lighting system.

Connectivity

- The Hanover Street corridor is currently designed for vehicular travel, with the Vietnam Veterans Memorial Bridge connecting origins and destinations. The existing roadway network sufficiently connects the neighborhoods in and around the Study Area for vehicular traffic.
- Primary destinations, such as MedStar Harbor Hospital, limited commercial locations, and residential neighborhoods are provided with connectivity via sidewalks. The Cherry Hill and

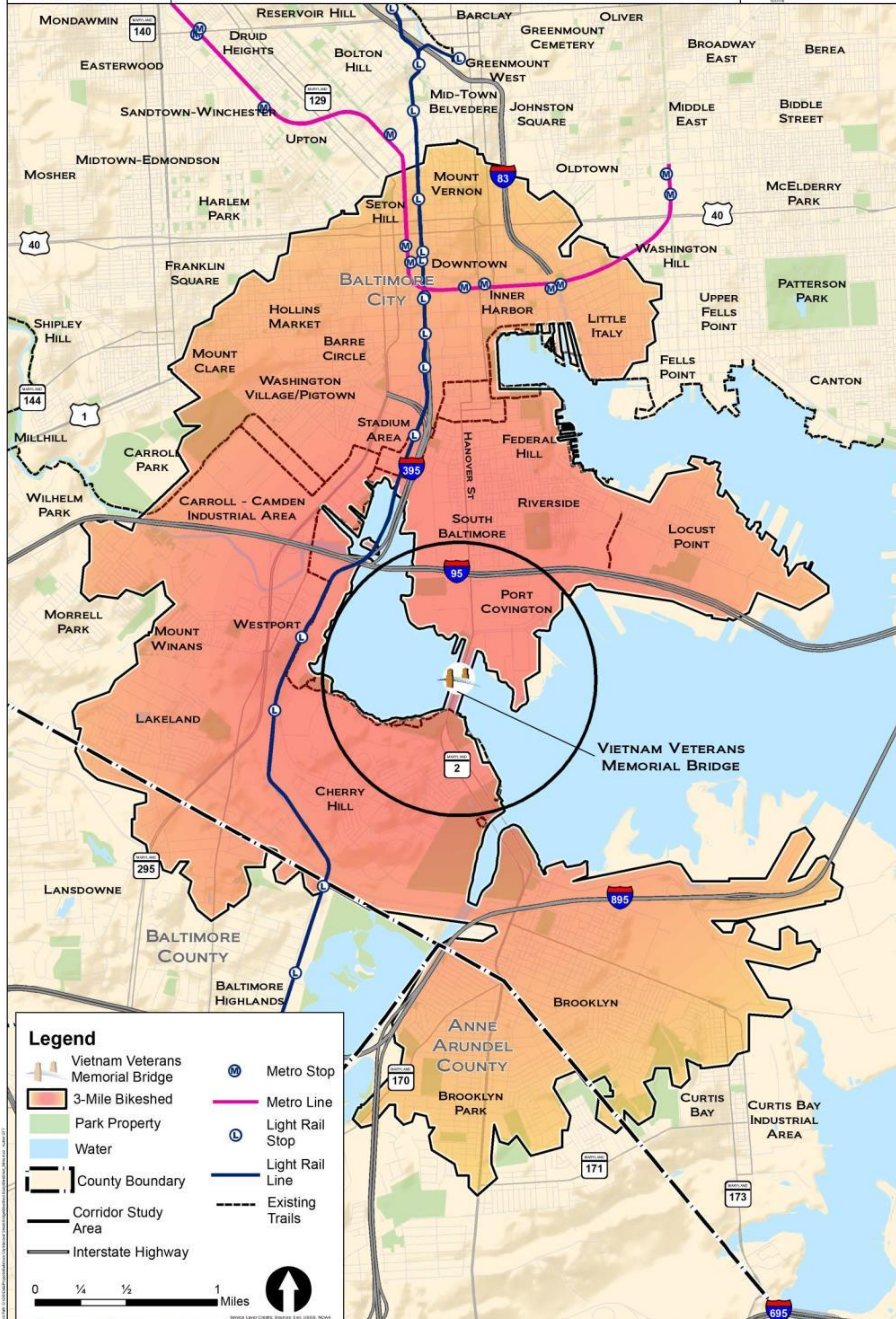
Westport neighborhoods do not have desirable connectivity to areas of Baltimore City north of those neighborhoods.

- The three-mile bikeshed does not currently provide full connectivity throughout the corridor and within the bikeshed except via use of existing streets and sidewalks. There is a connection to the Gwynns Fallls Trail.
- Transit plays an important role in connecting the study area to employment and social opportunities in the region. It provides communities in the south direct connection to major employment centers in the City including downtown Baltimore and the Inner Harbor.
- Since the bridge is the primary connection across the Middle Branch of the Patapsco River between many South Baltimore neighborhoods and the City, it is critical that this connection remains intact and performs acceptably. Existing traffic conditions throughout the study corridor operate within the Baltimore City Level of Service standards.

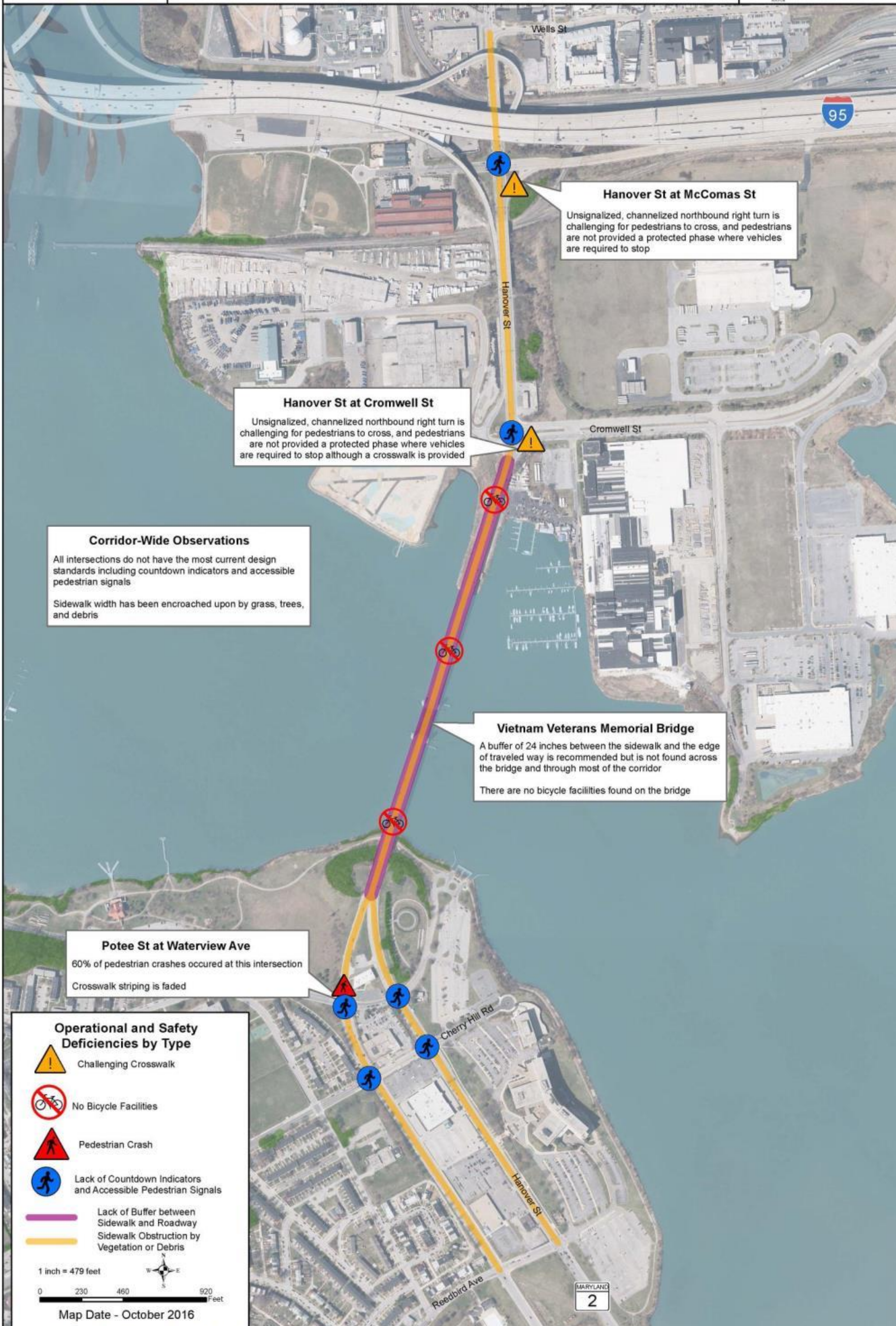
Accessibility

- Existing conditions indicate that the corridor is meeting current vehicular accessibility demands, but there is potential to improve facilities for pedestrians and bicycles throughout most of the corridor.
- The lack of operational efficiency of the movable span operating systems at the Vietnam Veterans Memorial Bridge creates challenges with maritime access that requires bridge openings, even though there have been no recreational sailboat openings since 2015.
- Even though the roadway and structures are primarily equipped to handle vehicular traffic, a significant amount of the corridor is ADA compliant for pedestrians and bicycles. Curb ramps are provided throughout the corridor at intersections. Some curb ramps and segments of sidewalk possess non-compliant conditions due to slopes and some lack of maintenance.
- Physical accessibility to bus stops greatly influences the success of transit as a mode of transportation. Lack of sidewalks or obstructed sidewalks, lack of pedestrian signals, and lack of crosswalks or faded crosswalks at the intersections approaching the bus stops are some of the issues that discourage transit use in the study area.

Hanover Street Multimodal Corridor Study
Figure 4-19: 1/2-Mile Walkshed and 3-Mile Bikeshed



Hanover Street Corridor Study
Figure 4-20: Pedestrian and Bicycle Safety Assessment



Hanover Street Multimodal Corridor Study
Figure 4-22: Bikeshed Study Area Topography

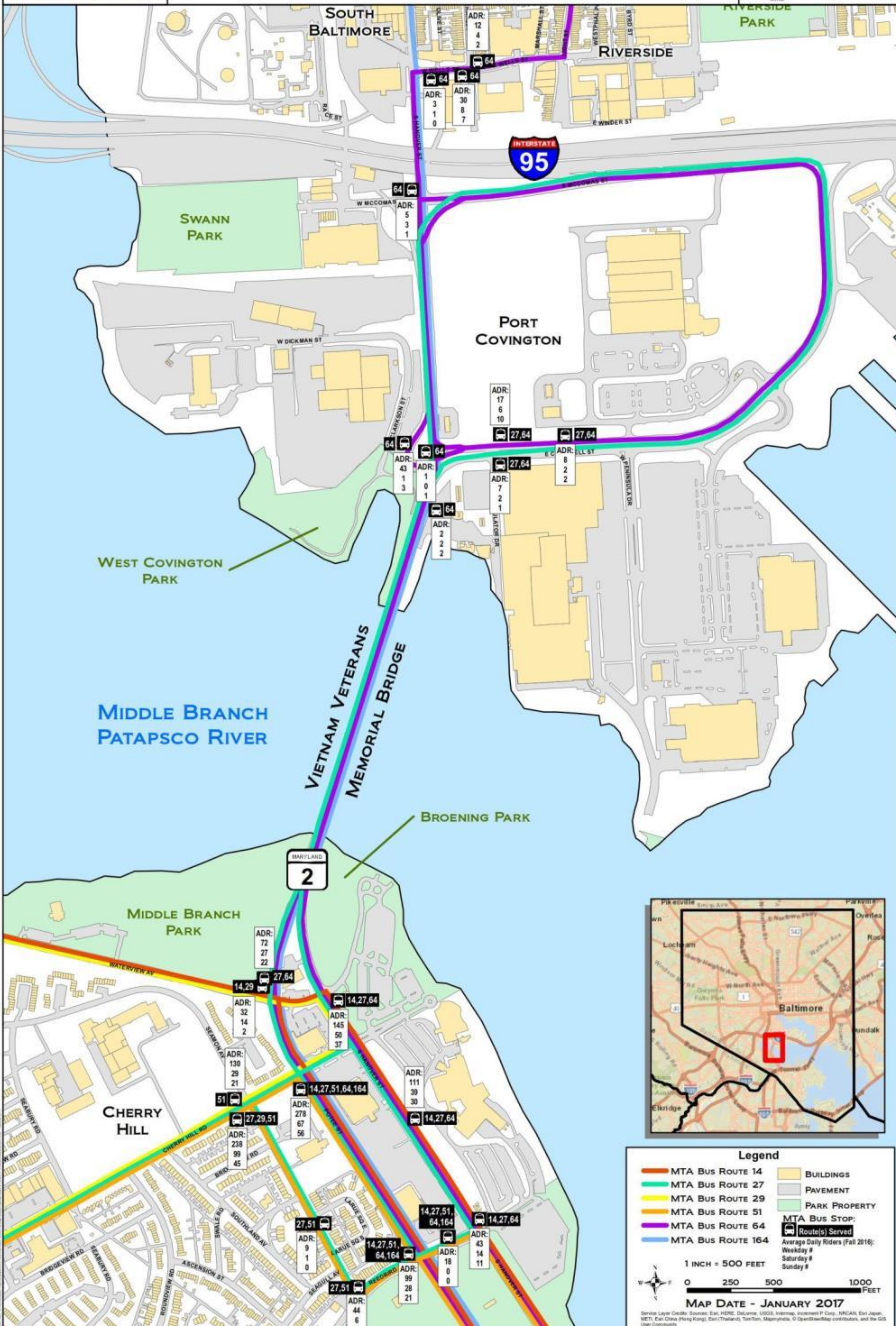
Hanover Street Corridor Study

Figure 4-24: Existing Transit Routes, Facilities, and Ridership

Hanover Street Corridor Study
Includes the Vietnam Veterans Memorial Bridge

City of Baltimore
Catherine E. Pugh, Mayor

dot
Department of Transportation
Baltimore City



Hanover Street Corridor Study

Figure 4-25: Existing Level of Service

Hanover Street Corridor Study
Figure 4-26: Vehicle and Truck Safety Assessment