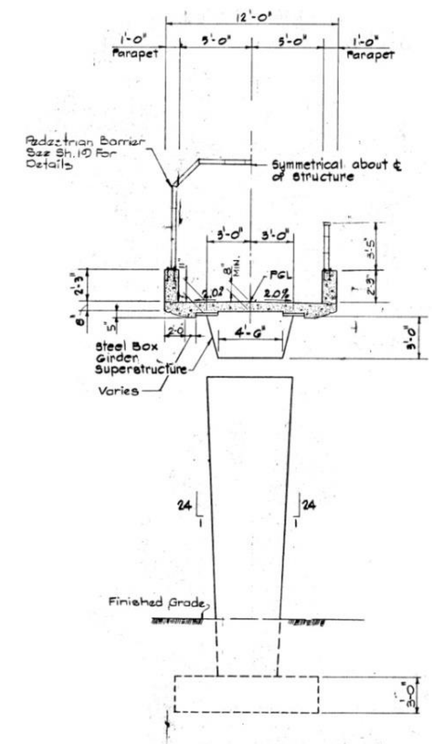
Howard County, Maryland

DOWNTOWN COLUMBIA BRIDGE FEASIBILITY STUDY

RFP No. 20-2014



SECTION
BRIDGE TRANSVERSE SECTION
Scale: 1/4"=1'-0"

Prepared by:

URS

4 North Park Drive, Suite 300
Hunt Valley, MD 21030

February 2, 2015

TABLE OF CONTENTS

List of Tables

List of Maps

List of Figures

List of Photos

1. EXECUTIVE SUMMARY

1.1 Background

Since the completion of the limited access highway (US-29) separating the east side of Columbia with the west side of Columbia, access between the Village of Oakland Mills and Downtown Columbia has been centered on a northern connector (Route 175), a southern connection (Broken Land Parkway), and a central connection (a 10-foot wide pedestrian bridge). The northern and southern connections provide full vehicle access. However, the bridge is restricted to pedestrian and bicycle traffic only. Moreover, the pathways connecting the bridge to the two communities need to be modernized with a focus on safety and security.

While the pedestrian bridge opened three decades ago with the promise of connecting the Columbia's commercial center with the residential communities to the east, the underused structure is poorly lit, enclosed by an unattractive chain-link fence barrier and connected through a pathway that is closely bordered by forest and underbrush. The result is a connection that is uninviting to residents looking for a way to cross the five-lane (and soon to be six-lane) expressway.

The limitations of the existing bridge, along with concerns involving the pathways connecting to the bridge encouraged the development of a proposal to construct a new and more inviting connection between Oakland Mills and downtown Columbia. In concept, the new bridge (referred to as Bridge Columbia) would provide improved connectivity between east and west Columbia through dedicated pedestrian and bicycle lanes and public transit-only access.

Although many people might support the Bridge Columbia proposal its potential cost in both dollars and time led to an inevitable question: what can or should be done with the existing bridge? Stated another way, it would be difficult to justify the building of a new bridge if no one had completed an assessment of the existing bridge.

In January, 2014 Howard County, through a competitive bid process, selected URS Corporation to complete an assessment of the existing bridge. In summary, URS was asked to determine what needed to be done to improve the existing bridge and the pathway connections as well as provide options for including transit. A cost and time estimate for completion was required for each option.

It is important to note that the bridge feasibility study is to provide options and not to provide a recommendation.

1.2 Process

The “Downtown Columbia Bridge Feasibility Study” was approached through a review of relevant plans and studies, numerous meetings with stakeholders and County officials, analysis of the existing structure and stakeholder ideas, development of options and report.

Representatives from URS and their subcontractors reviewed a number of existing documents including, but not limited to:

- Downtown Columbia Plan
- Part 1: Downtown Columbia: Downtown Transit Center and Circulator Study(part of CEPPA #5)
- Part 2: Downtown Columbia to Oakland Mills Multimodal Connection (part of CEPPA #3)
- Broken Land Parkway / US 29 North – South Connector Road
- Little Patuxent Parkway / US 29 Interchange
- PlanHoward 2030, the County’s adopted General Plan
- The “Bridge Columbia” Proposal
- Howard Hughes Corporation proposed path

Representatives from URS and the Office of Transportation participated in numerous stakeholder meetings included, but not limited to:

- Oakland Mills Village Association
- Town Center Village Association
- Bridge Columbia
- Columbia Association
- County Council Representatives (District 2 and District 4)
- Howard Hughes Corporation
- Howard County Department of Public Works
- Howard County Police Department
- Howard County Department of Planning and Zoning

Finally, the analysis followed a specific structure required by the Request for Proposals. Specifically, URS was directed to provide costs and schedule for renovation of the existing bridge as well as the design and construction of a new bridge. For the existing bridge, URS was responsible for determining costs and schedule for the:

- Refurbishment of the existing bridge at existing multimodal levels
- Refurbishment (if possible) of the existing bridge to accommodate a single lane of transit service along with bicycle and pedestrians
- Refurbishment (if possible) of the existing bridge to accommodate two lanes of transit service along with bicycle and pedestrians

- Modernization of the pathway (east side) focusing on safety and security approximately 500 yards from the bridge.
- Modernization of the pathway (west side) focusing on safety and security approximately 500 yards from the bridge.

For a new bridge, URS was responsible for determining costs and schedule for the:

- Construction of a new traditional bridge to accommodate bicycle and pedestrian use only.
- Construction of a new traditional bridge to accommodate bicycle, pedestrian, and a single lane of transit service (which should include associated costs that may be required to safely manage the single lane crossing).
- Construction of a new traditional bridge to accommodate bicycle, pedestrian, and two lanes of transit service.
- Design of a pathway (east side) focusing on safety and security.
- Design of a pathway (west side) focusing on safety and security.

As URS and Howard County proceeded through the project, the specific report requirements changed. Through the stakeholder meetings a number of suggestions were made that were included in the analysis. More importantly, once it was determined that the existing bridge was structurally sound, some of the options (such as constructing a new bridge to accommodate bicycle, pedestrian and transit at the existing location) were replaced by other options (such as constructing a new bridge over the lake) as it was clear that the existing bridge and pathway system can be used.

1.3 Findings

1.3.1 Review of Existing Structure

Prior to reviewing a number of options, the existing 6-span bridge was evaluated to determine its structural integrity. This analysis focused on a design load that would permit a typical small transit bus (an H20 vehicle with a GVWR of up to 40,000 lbs.). The structural system was also analyzed using a uniform 85psf pedestrian loading to compare the vehicle response to a uniform pedestrian loading response and determine which governs.

In addition to analysis of the structure for weight, the width of the bridge, and the ability to extend this width, was reviewed. Currently, the bridge has a 10-foot inside clear width. Based on the review, the existing bridge would be able to support loads due to transit vehicles, however, the ease of use and comfort level of occupants is low due to the relatively small inside clearance. It is clear that the existing bridge could be expanded to a 12-foot inside clear width, however, the additional space would not change the conflict between pedestrians/bicyclists and transit vehicles.

As a result, although the existing bridge can handle transit vehicles, the inability for pedestrians and bicyclists to share the bridge at the same time mandates that any option involving transit require a new bridge. Therefore, with the exception of Option-1, which involves only the retrofit of the existing bridge and Option-5a that involves a bridge over the lake, all other options involve the retrofit of the existing bridge along with the construction of a new bridge.

1.3.2 Summary of Bridge Options

A total of nine bridge options/alternatives were analyzed as follows:

1. Option 1 – Retrofit Existing Bridge

   The option with the lowest cost and the shortest completion time is to retrofit the existing bridge for pedestrian and bicycle use only. This option minimizes environmental impact and also permits integration with the proposed pathway system, without modifications, currently being developed by the Howard Hughes Corporation as part of the Downtown Columbia Plan.

2. Option 2 – Complementary Bridge with Single Transit Lane

   This option provides the lowest cost and the shortest completion time while creating a transit lane option. In addition to retrofitting the existing bridge a second bridge with a complementary design would be constructed just to the south of the existing bridge. A complementary bridge would basically match the existing bridge's pier, superstructure and deck design.

   The shared use paths to the east and west would be modified from the planned 10 ft. shared-use trail section to a trail separated by a barrier with a single-lane transit road. The transit lane would have two or three pull-off areas spaced intermittently along the travel way to allow for transit vehicles to pass.

3. Option 3a – Cable Stayed with a Single Transit Lane

   A cable stayed bridge with a single transit lane results in a more costly and time intensive option to provide public transit in concert with the pedestrian/bicycle bridge.

   A cable-stayed bridge has one or more *towers* (or *pylons*), from which cables support the bridge deck. There are two major classes of cable-stayed bridges: *harp* and *fan*. In the *harp* or *parallel* design, the cables are nearly parallel so that the height of their attachment to the tower is proportional to the distance from the tower to their mounting on the deck. In the *fan* design, the cables all connect to or pass over the top of the towers.

The cable-stayed bridge is optimal for spans longer than cantilever bridges, and shorter than suspension bridges. This is the range where cantilever bridges would rapidly grow heavier if the span were lengthened, and suspension bridge cabling would not be more economical if the span were shortened.

As with Option 2, the transit lanes each side would have two or three pull-off areas spaced intermittently along the travel way to allow for transit vehicles to pass.

4. Option 3b – Cable Stayed with Dual Transit Lanes

A cable stayed bridge with dual transit lanes results in a more costly option; however, the time to completion would be about the same as with a single transit lane. Due to restrictions along the pathway a single lane would continue to be used with the vehicle by-pass areas.

The shared use path each side would need to be modified or reconstructed to handle the transit vehicle's weight and the new design for dual transit lanes.

5. Option 4a – Iconic Bridge with a Single Transit Lane

An iconic bridge with a single transit lane results in a slightly higher cost (as compared to a cable-stayed bridge) and a similar time estimate option to provide public transit in concert with the pedestrian/bicycle bridge. An iconic bridge involves the use of both concrete and steel and provides the iconic look that the proposal from Bridge Columbia recommends.

The transit lanes each side would have two or three pull-off areas spaced intermittently along the travel way to allow for transit vehicles to pass.

6. Option 4b – Iconic Bridge with Dual Transit Lanes

An iconic bridge with a single transit lane results in a slightly higher cost (as compared to a cable-stayed bridge) and a similar time estimate option to provide public transit in concert with the pedestrian/bicycle bridge.

The shared use path each side would need to be modified or reconstructed to handle the transit vehicle's weight and the new design for dual transit lanes.

7. Option 5a – Lake Bridge with Pedestrian, Bicycle and Dual Transit Lanes

This option is the most expensive of any of the options as it would require construction over Lake Kittamaqundi. The bridge would permit joint use by pedestrians, bicycles, and transit.

Because of the terrain, the need to avoid floodplains and potential environmental impacts and the need to meet ADA requirements, the alignment for this option would likely require bridging the entire distance from Little Patuxent Parkway to Stevens Forest Road.

It is possible that the bridge will require pier or tower placement in the lake. The shared use path each side would be limited in length due to the amount of structure required to span the lake and ravines each side.

8. Option 5b – Lake Bridge with Dual Transit Lanes

This option is the second most expensive of any of the options as it would require construction over Lake Kittamaqundi. However, the bridge would be accessible to transit only. This option would include the retrofit of the existing pedestrian bridge for bicycle and pedestrian use only.

Because of the terrain, the need to avoid floodplains and potential environmental impacts, the alignment for this option would likely require bridging nearly the entire distance from Little Patuxent Parkway to Stevens Forest Road. Since ADA compliance would not be required, a steeper running slope for the bridge profile could be implemented from 5% maximum to 6% to 7% maximum in accordance with policies of AASHTO (American Association of State Highway and Transportation) for this urban condition. Also, exceeding 5% would potentially be problematic for future use of the bridge for pedestrians.

It is possible that the bridge will require pier or tower placement in the lake. The shared use path each side would be limited in length due to the amount of structure required to span the lake and ravines each side.

9. Option 6 - Personal Rapid Transit

One of the more interesting options involves the construction of a dedicated transit way referred to as a Personal Rapid Transit (PRT). Also called podcars, PRT is a public transport mode featuring small automated vehicles operating on a network of specially built guideways. PRT is a type of automated guideway transit, a class of system which also includes larger vehicles all the way to small subway systems. PRT vehicles are sized for individual or small group travel, typically carrying no more than 3 to 6 passengers per vehicle. Guideways are arranged in a network topology; with all stations located on sidings, and with frequent merge/diverge points. This allows for nonstop, point-to-point travel, bypassing all intermediate stations.

This option would include the renovation of the existing bridge for bicycle and pedestrian use only. As the vehicle(s) would operate on a dedicated tramway, typically elevated, modifications to the majority of pathway system would not be required. Stations would be required at each terminus.

The time and cost to design and construct this PRT option is substantial due to lack of similar project knowledge in Maryland and the need for specialized designers and contractor(s). The majority of PRT systems are located internationally. Technology is also advancing rapidly making selection of a PRT type a feasibility study of its own.

1.3.3 Comparison of Options

Based on the analysis, and including the engineering, overhead and administrative costs, inflation and contingencies, along with environmental resource impact and permitting process, the estimated costs and schedules for the various options are shown (including shared use paths and transit lanes where proposed):

Summary of Costs and Implementation Schedule

Option Number / Description	*NEAT Cost	Eng. / Admin.	15% Inflation / 40% Contingency	Total Cost	Time
1 - Retrofit Existing Bridge	$914,692	$365,877	$781,147	$2,061,716	2.5-years
2 - Complementary Bridge w/Single Transit	$7,513,112	$3,005,245	$6,857,969	$17,376,325	7.5-years
3a - Cable Stayed w/Single Transit	$12,674,053	$7,604,432	$13,789,370	$34,067,854	9.2-years
3b - Cable Stayed w/Dual Transit	$14,274,559	$8,564,735	$15,530,720	$38,370,014	9.2-years
4a - Iconic Bridge w/Single Transit	$13,557,907	$8,134,744	$14,751,003	$36,443,655	9.2-years
4b - Iconic Bridge w/Dual Transit	$17,651,975	$10,591,185	$19,205,348	$47,448,508	9.2-years
5a - Lake Bridge w/Ped-Bike-Dual Transit	$60,097,978	$36,058,787	$65,386,600	$161,543,366	9.2-years
5b - Lake Bridge with Dual Transit	$45,439,822	$27,263,893	$49,438,527	$122,142,243	9.2-years
6 - Personal Rapid Transit	$37,332,723	$20,532,997	$39,348,690	$97,214,409	9.2-years

Notes:
*NEAT Cost excludes engineering, HOCO administrative costs, contingencies and ROW acquisition.
Unless otherwise noted, options include retrofit of existing bridge.

While the retrofit of existing bridge can be completed in a relatively short time period, the inclusion of a bridge for transit more than doubles the amount of time for Option 2 – Complementary Bridge with Single Transit Lane, and more than three-times for any other option. It is important to recognize that the time estimates are based on the approval of the option and securing the funding. Therefore, it is reasonable to assume that, with the exception of Option 1 – Retrofit of the Existing Bridge, any of the other options may take 9-years or more.

1.3.4 Pathway Options

The pathway system currently under development by the Howard Hughes Corporation will provide the connections needed to support pedestrian and bicycle use. The proposed pathway has been designed by HHC to include significant lighting throughout the length of the pathway between Little Patuxent Parkway and Stevens Forest Road. More importantly, to significantly reduce concerns over safety and security, the forest paralleling the pathway on both the east and west side of the bridge needs to be selectively pruned and underbrush removed where needed to provide adequate sightlines for trail users.

There is only one other option for the pathway; construct a boardwalk. The boardwalk would be proposed on the east side only from Stevens Forest Road to the bridge. This option would elevate the pathway onto a limited-access boardwalk for pedestrians and bicyclists only that would dynamically improve the perception and/or reality of safety and security. Concerns regarding this option, however, would include limited access from neighboring properties, people jumping off the boardwalk and slippery conditions in wet weather.

A boardwalk would also include, but not be limited to, the proposed use of cameras, relocation and number of lights, removal of trees and understory brush, and the inclusion of call receptacles. Should a boardwalk be constructed, the Howard Hughes Corporation path on the east side would either be integrated into the transit option or would become unusable as it pertains to the pedestrian and bicycle bridge.

The cost for the boardwalk option is as follows:

Option Number / Description	*NEAT Cost	Eng. / Admin.	15% Inflation / 40% Contingency	Total Cost	Time
7– Raised Boardwalk– East Side	$766,050	$306,420	$654,207	$1,726,677	2.5-years

Note: *NEAT Cost excludes engineering, HOCO administrative costs, contingencies and ROW acquisition.

The west side is more open with more activities and does not benefit from a boardwalk. A path connection to the Little Patuxent Parkway will be problematic due to terrain and a boardwalk will not be the solution.

1.4 Conclusion

The purpose of the Downtown Columbia Bridge Feasibility Study is to provide options to improve connectivity between Downtown Columbia and Oakland Mills. The findings provide a number of choices ranging from the renovation of the existing bridge to the construction of a multi-use bridge spanning Lake Kittamaqundi. While not specified in the Howard County Request for Proposal, the modification to the existing bridge with the construction of a Personal Rapid Transit presents an interesting option.

The modification to the existing bridge, in coordination with Howard Hughes Corporation, and implementing the suggestions that are made as it pertains to the pathways, are short-term solutions to the concerns that exist regarding the safety and security of the bridge and the connections to the bridge. While this study does not provide any recommendations, it should be clear that there are two primary choices that can be made; renovate the existing bridge to improve the pedestrian and bicycle experience within a relatively short period of time or construct a second bridge (or Personal Rapid Transit) that will provide transit connectivity between Downtown Columbia and Oakland Mills and will take a decade or more to complete.

There is a great deal of interest to improve the safety and security of the bridge connecting Downtown Columbia and Oakland Mills along with an interest to provide a transit connection. This study does not evaluate the need for the transit option. However, it is critical to recognize that short-term improvements can be made while the long-term transit options are evaluated.

2. INTRODUCTION

The purpose of the Downtown Columbia Bridge Feasibility Study is to develop several options and conceptual cost estimates for providing an improved bridge connection between Downtown Columbia and the Village of Oakland Mills in Howard County, Maryland as shown in **Figure 1** below.

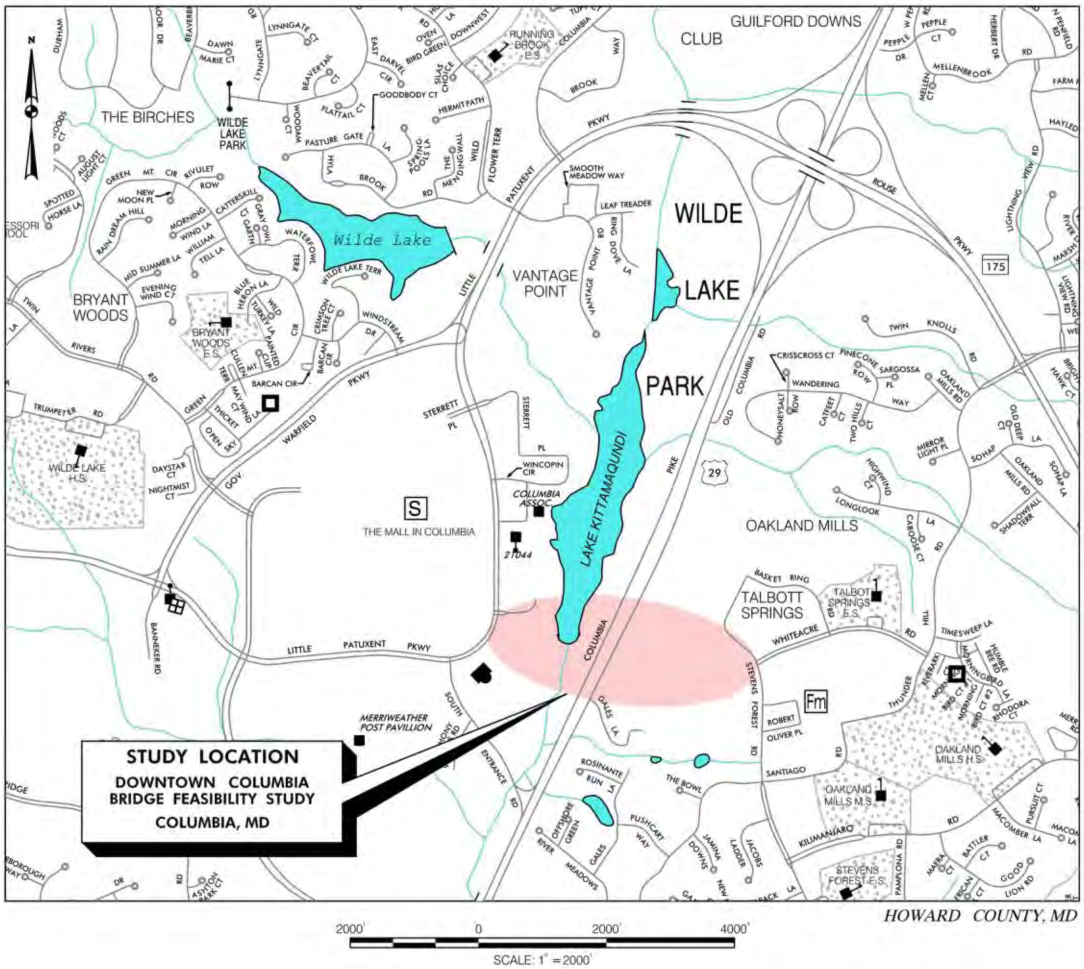


Figure 1: Study Area

Since the completion of the limited access highway (US-29) separating the east side of Columbia with the west side of Columbia, access between the Village of Oakland Mills and Downtown Columbia has been centered on a northern connector (Route 175), a southern connection (Broken Land Parkway), and a central connection (a 10 foot wide pedestrian/bicycle bridge). The northern and southern connections provide full vehicle access. However, the bridge itself is restricted to pedestrian and bicycle traffic only.

The pedestrian/bicycle bridge opened three decades ago with the promise of connecting the town's commercial center with the residential communities to the east. Today, the underused structure is poorly lit, encircled in chain-link fence, and uninviting to residents looking for a way to cross the five-lane expressway. Moreover, the shared-use trails connecting the bridge to the two communities need to be modernized with a focus on safety and security.

2.1 Related Plans and Projects

Local planning documents support the desire for improved transportation connections to and from Downtown Columbia. In 2010 the *Downtown Columbia Plan* was developed as an amendment to the *Howard County General Plan* to serve as a 30-year master plan for the revitalization and redevelopment of Downtown Columbia. The Plan is a guide to Downtown Columbia's continued evolution as Howard County's economic and cultural center through increasing the number of people living downtown by adding more residences, shops and recreational and cultural amenities in Downtown Columbia, while also making downtown more attractive and easier to navigate. The Plan describes a vision that would link Howard Community College and the nearby villages of Wilde Lake and Oakland Mills with Downtown Columbia via "new or improved muti-purpose paths for pedestrians and bicyclists," and specifically calls for an upgraded walkway to and from Downtown Columbia and Oakland Mills. The 2007 report *Downtown Columbia: A Community Vision* also supports a desire for greater connectivity, noting the need to "improve pedestrian connections throughout downtown, to surrounding villages and to nearby destinations to encourage strolling and human interaction."

An improved bridge connection between Downtown Columbia and Oakland Mills is integral to and consistent with the community vision. The limitations of the existing bridge, along with concerns involving the shared-use trails connecting to the bridge, encouraged the development of a proposal, by Bridge Columbia, to construct a new and more inviting connection between east and west Columbia through dedicated pedestrian and bicycle lanes and public transit only access. A local citizen's group, Bridge Columbia, has actively worked to help promote the implementation of this new pedestrian and public transit bridge, further underscoring community support for the project.

As part of the planning to transform Downtown Columbia, the community's developer, the Howard Hughes Corporation, undertook a feasibility study of the proposed Downtown Transit Center and Circulator. Entitled *Downtown Columbia: Downtown Transit Center and Circulator Feasibility Study*, the effort included the evaluation of options for connecting Downtown Columbia to Oakland Mills over Route 29, including potential bicycle, transit and multimodal improvements. The transit, bicycle, and pedestrian connection could either be a replacement or enhancement of the existing pedestrian/bicycle bridge and trail network or the construction of a new multimodal bridge. A shared-use trail system from the Howard County General Hospital (on the west side of U.S. 29) to Blandair Park (a 298-acre regional park located in the eastern region of Oakland Mills) is in the process of design by Howard Hughes Corporation. A typical section of the improved shared-use trail is shown below in **Figure 2**.

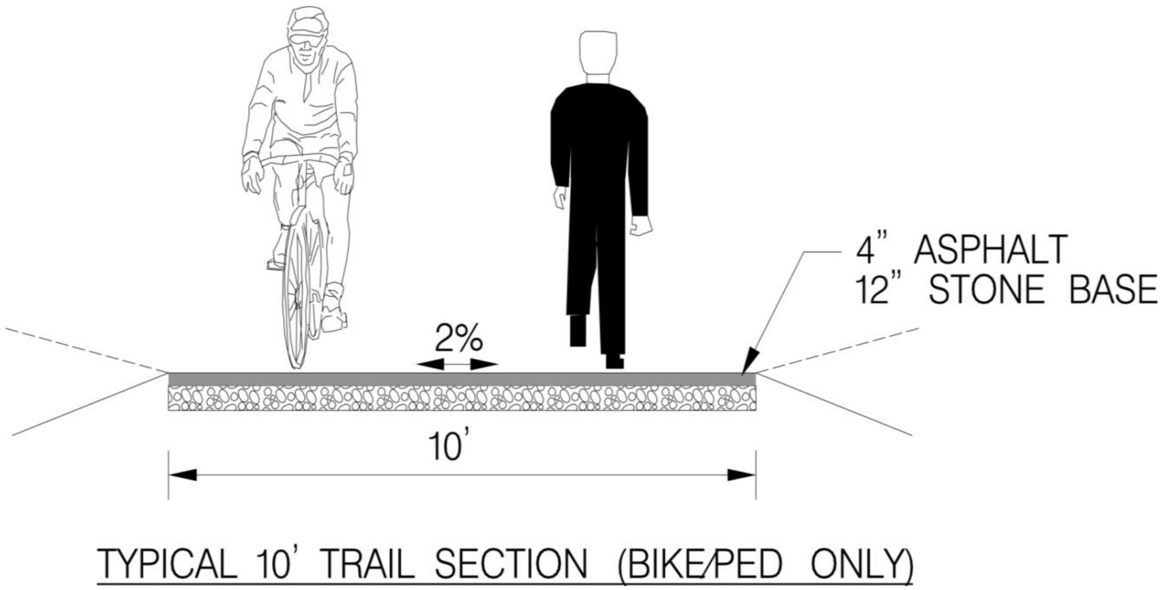


Figure 2: Typical Section for the Improved Shared-Use Trail
(Under Design by Howard Hughes Corporation)

An inviting and accessible bridge and shared-use trail would act as a catalyst for encouraging use of the connection between Oakland Mills and Blandair Park with Downtown Columbia (and the Columbia Mall), Symphony Woods (one of the initial redevelopment efforts in the Downtown Columbia Plan), Howard Community College and Howard County General Hospital. Over the past several years, Howard County has also been developing short- and long-range bicycle and pedestrian plans. *Bike Howard* and *Walk Howard* emphasize the changing nature of commuters in the area. Given the commercial activities expected from the Downtown Columbia Plan, encouraging walking and biking from Oakland Mills and east Columbia has the potential to spur redevelopment on the Oakland Mills side.

3. REVIEW OF PROJECT AND METHODOLOGY

The purpose of this report is to describe several options for a multimodal bridge connection between east and west Columbia to accommodate pedestrians, bicyclists, and transit users. The report also details options for improvements to the shared-use trails on either side of the bridge, and includes conceptual cost estimates of what it might cost to implement bridge and shared-use trail improvements.

The Feasibility Study process included the following elements:

Project Mobilization – A kickoff meeting for the project was held by meeting with Howard County staff, which included a review of relevant prior studies. A site visit meeting was also held with key staff.

Stakeholder's Meetings – URS and Howard County scheduled and conducted meetings with a variety of project stakeholders, including Howard County elected officials and the following representative groups:

- Oakland Mills Village Association
- Town Center Village Association
- Bridge Columbia
- Columbia Association
- County Council Representatives (District 2 and District 4)
- Howard Hughes Corporation
- Howard County Department of Public Works
- Howard County Police Department
- Howard County Department of Planning and Zoning

Project Plan – The study team composed an overall project plan and methodology to identify bridge and shared-use trail options, develop conceptual cost estimates, and identify possible sources of funding for implementing improvements.

Documentation of Existing Conditions – The study team conducted and evaluation of the structural capacity and serviceability of the existing pedestrian/bicycle bridge to establish a baseline for development of possible improvement options. The team also conducted a field review to assess the existing conditions of the shared-use trail on either side of the bridge.

Identification of Improvement Options – Several possible bridge and shared-use trail improvement options were identified to meet the County's desire for an improved multimodal connection between east and west Columbia. During this stage, the team also conducted an initial screening to determine which potential improvement options should not be studied, and which options should be retained for further study.

Development of Bridge and Shared Use Trail Improvement Options and Cost Estimates – Several possible multimodal bridge and shared-use trail improvement options were developed to evaluate the relevant challenges and benefits and to estimate concept-level costs.

Identification of Possible Funding Sources – The study team documented a variety of federal, state and local sources of funds that could be used to support the various improvement options.

4. STAKEHOLDER OUTREACH AND PUBLIC INVOLVEMENT

Several public review sessions were scheduled with review, discussion, and feedback regarding the bridge's conceptual design options and connectivity between Columbia and Oakland Mills.

Preliminary Estimates of Probable Cost were developed and discussed. Stakeholders included:

- Howard County
- The Village of Oakland Mills
- Columbia Town Center
- The Howard Hughes Corporation
- Columbia Association
- Bridge Columbia

As URS and Howard County proceeded through the project, the specific report requirements changed. Through the stakeholder meetings a number of suggestions were made that were included in the analysis. More importantly, once it was determined that the existing bridge was structurally sound, some of the options (such as constructing a new bridge to accommodate bicycle, pedestrian and transit at the existing location) were replaced by other options (such as constructing a new bridge over the lake) as it was clear that the existing bridge and pathway system can be retained and used.

Public comments are welcomed regarding the Downtown Columbia Bridge Feasibility. Written comments may be delivered to:

John W. Powell, Jr.
Department of County Administration
Office of Transportation
3430 Court House Drive
Ellicott City, MD 21043
410-313-0702 (Direct)

5. EXISTING CONDITIONS

5.1 Existing Pedestrian/Bicycle Bridge over US 29:

URS completed analyses to determine if the existing pedestrian/bicycle bridge, *HOCO-133*, can accommodate transit loads, such as light to medium-duty buses, as-is. The goal was to determine if the existing bridge would be able to accommodate transit loading in terms of both structural capacity and serviceability. Photos of the existing bridge are shown below.

Photo 1: Existing Pedestrian/Bicycle Bridge, Looking South

Photo 2: Existing Pedestrian/Bicycle Bridge, Looking North

5.1.1 Structural Capacity

A structural model of the six span, single steel box girder system was modeled using the steel bridge girder design and analysis software MDX. All geometric, material, and boundary condition properties were taken from the design plans and specified in the software. A transverse section of the existing pedestrian/bicycle bridge is shown in **Figure 3**.

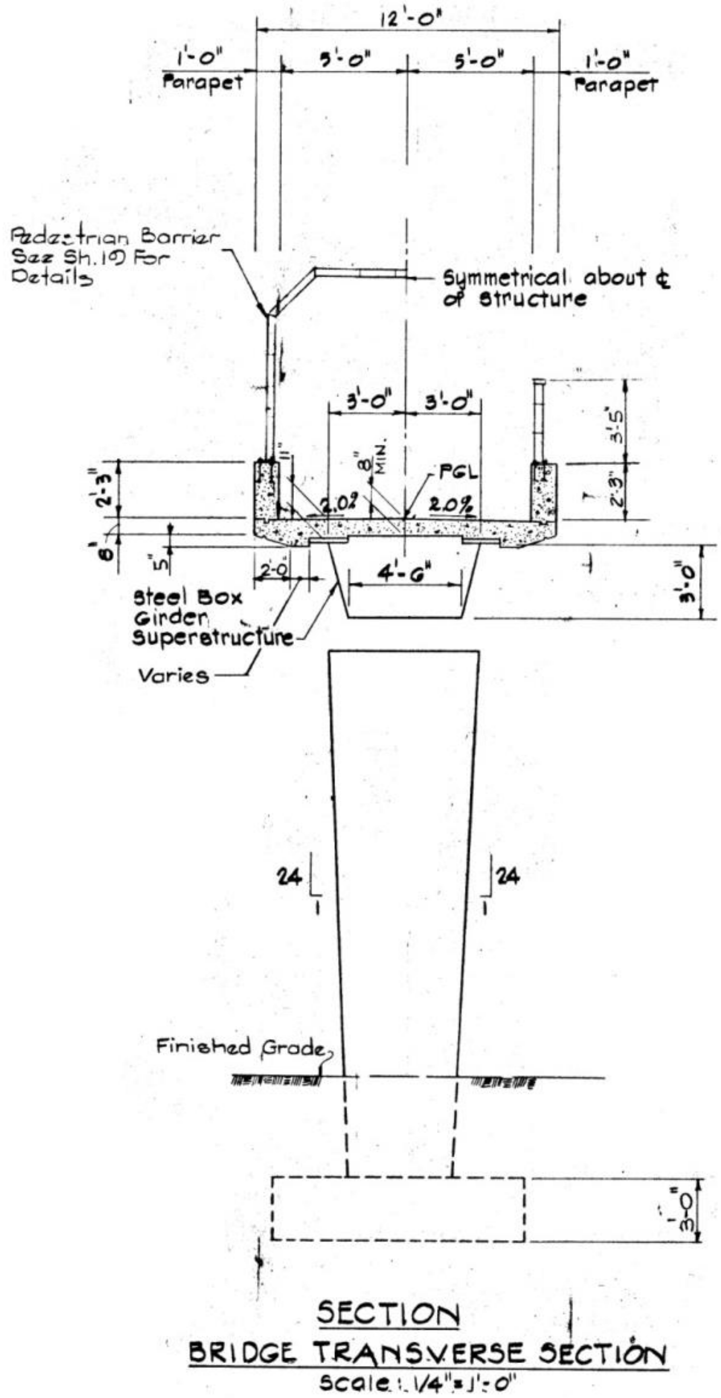


Figure 3: Transverse Section of Existing Pedestrian/Bicycle Bridge

The design load specified in the bridge plans was an H-10 vehicle or 85 psf pedestrian loading, whichever governs. The Gross Vehicle Weight Rating (GVWR) for an H-10 vehicle is 20,000 lbs., which classifies it as a Class 6 Medium-Duty vehicle (GVWR 19,501 lbs. to 26,000 lbs.) according to FHWA Vehicle Class Designations. However, since some Medium-Duty transit vehicles might have a GVWR exceeding 20,000 lbs., this analysis was completed using an H-20 vehicle with a GVWR of 40,000 lbs. The structural system was also analyzed using a uniform 85 psf pedestrian loading to compare the vehicle response to a uniform pedestrian loading response and determine which governs.

The most current bridge inspection report (from 2012) was consulted to determine if any defects in the geometry or material properties needed to be considered in the model. The findings of the 2012 inspection follow:

The deck is in good condition with minor hairline transverse cracks and light efflorescence on the underside of the slab overhang.
The coating on the parapet is peeling in a few locations.
The joint seals are in good condition at all locations, though there was evidence of moderate rust staining on the underside of the fascia concrete at Pier 2 indicating leakage from the joint above. The girder is in very good condition. Only flaking paint on the bottom of the steel box girder is noted.
The substructure (abutments and wingwalls) is in very good condition. The abutment coating is flaking in many locations and minor erosion was observed at the timber portion of the southwest wingwall.

After reviewing the above findings, no reduction in section due to corrosion, etc. was deemed necessary and the model was developed using the as-built dimensions and properties from the plans.

A bridge rating was completed to determine if the capacity provided by the bridge girder was large enough to support the self-weight of the structure and all of its parts (parapets, fence, railings, etc.) in addition to the load incurred due to a vehicle or group of pedestrians passing over the structure.

The analyses showed that the pedestrian load governed, not the H-20 vehicle, and is the load the bridge should have been designed for. This is as expected since the psf equivalent of an H-20 vehicle load, a Gross Vehicle Weight of 20 tons (as described in AASHTO Load Factor Design Figure 3.7.6B), is less than the assumed 85 psf pedestrian load. Because the bridge was designed to support loads which induce a higher level of force and stress than that caused by an H-20 vehicle, the current bridge will structurally accommodate light to medium-duty transit vehicles and pedestrians and bicyclists.

5.1.2 Serviceability

As shown in Figure 3, the clear distance between the parapets of the bridge is 10.0 ft. According to AASHTO Load Factor Design 3.7, the width of an H10 vehicle is 10.0 ft. The clear distance between the parapets of the bridge is 10.0 ft., but this distance does not account for a metal railing that slightly protrudes from the side of the bridge into the clear distance zone. In theory an H-10 vehicle will fit, but this tight squeeze over a relatively long distance (679.0 ft.) can cause both drivers and riders of the transit vehicle to feel uneasy. The short distance between the exterior of a transit vehicle and the parapet and barrier fence can also be considered a significant risk factor if passengers put their hands or other objects out the transit vehicle windows. This risk should be taken into consideration when deciding on a course of action.

Spans 4 and 5 over Route 29 have a barrier cage surrounding the deck to deter pedestrians from climbing over the side and walking on the parapet over the roadway, or from throwing objects onto the roadway. Depending on the type and size of transit vehicles driving over the bridge, replacement of this cage to allow for a higher vertical clearance is may be necessary.

5.2 Existing Trail – East Side

The existing trail approach from the bridge to Stevens Forest Road is an asphalt trail approximately 8 ft., 6 in. in width and 1,825 ft. in length. A grass shoulder typically exists along each side of trail. Several dirt paths are also present that connect to adjacent residential areas. **Photos 3-7** below show the existing conditions of the trail on the east side of the pedestrian/bicycle bridge.

Photo 3: East Side Trail From End of Bridge
(Facing East; Security Camera Poles Shown)

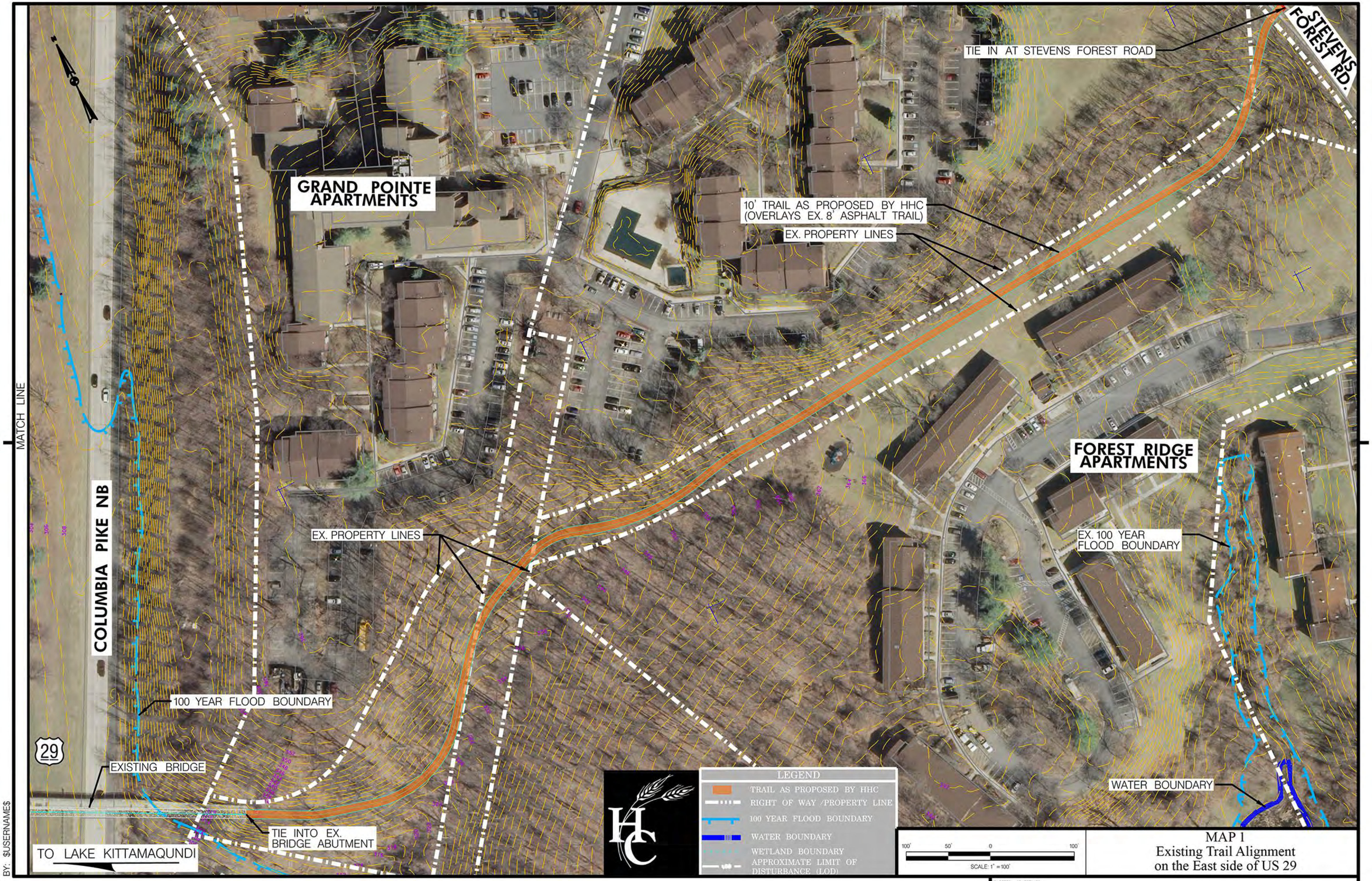
Photo 4: East Side Trail Steepens and Has Significant Cross-Slope
(Facing East)

Photo 5: East Side Trail at Forest Ridge Apartments (Facing East)

Photo 6: East Side Trail Approach Steepens to Stevens Forest Road (Facing East)

Photo 7: East Side Trail With Sidewalk Connection at Stevens Forest Road (Facing East)

Map 1 on the next page depicts the shared-use trail alignment on the east side of US 29.



MAP 1
Existing Trail Alignment
on the East side of US 29

5.3 Existing Trail – West Side

The existing trail from the west end of the pedestrian/bicycle bridge to the Columbia Lakefront Stage on the west side of Lake Kittamaqundi is also an asphalt trail approximately 8 ft., 6 in. in width and 1,525 ft. in length. There is no direct connection from the trail to Little Patuxent Parkway, but the trail is approximately 560 ft. from the parkway via an access road. A grass shoulder typically exists along each side of trail. **Photos 8-12** below show the existing conditions of the trail on the west side of the pedestrian/bicycle bridge.

Photo 8: West Side Trail Looking East Across Bridge

Photo 9: West Side Trail From West End of Pedestrian/Bicycle Bridge at Columbia Town Center Apartments (Facing West)

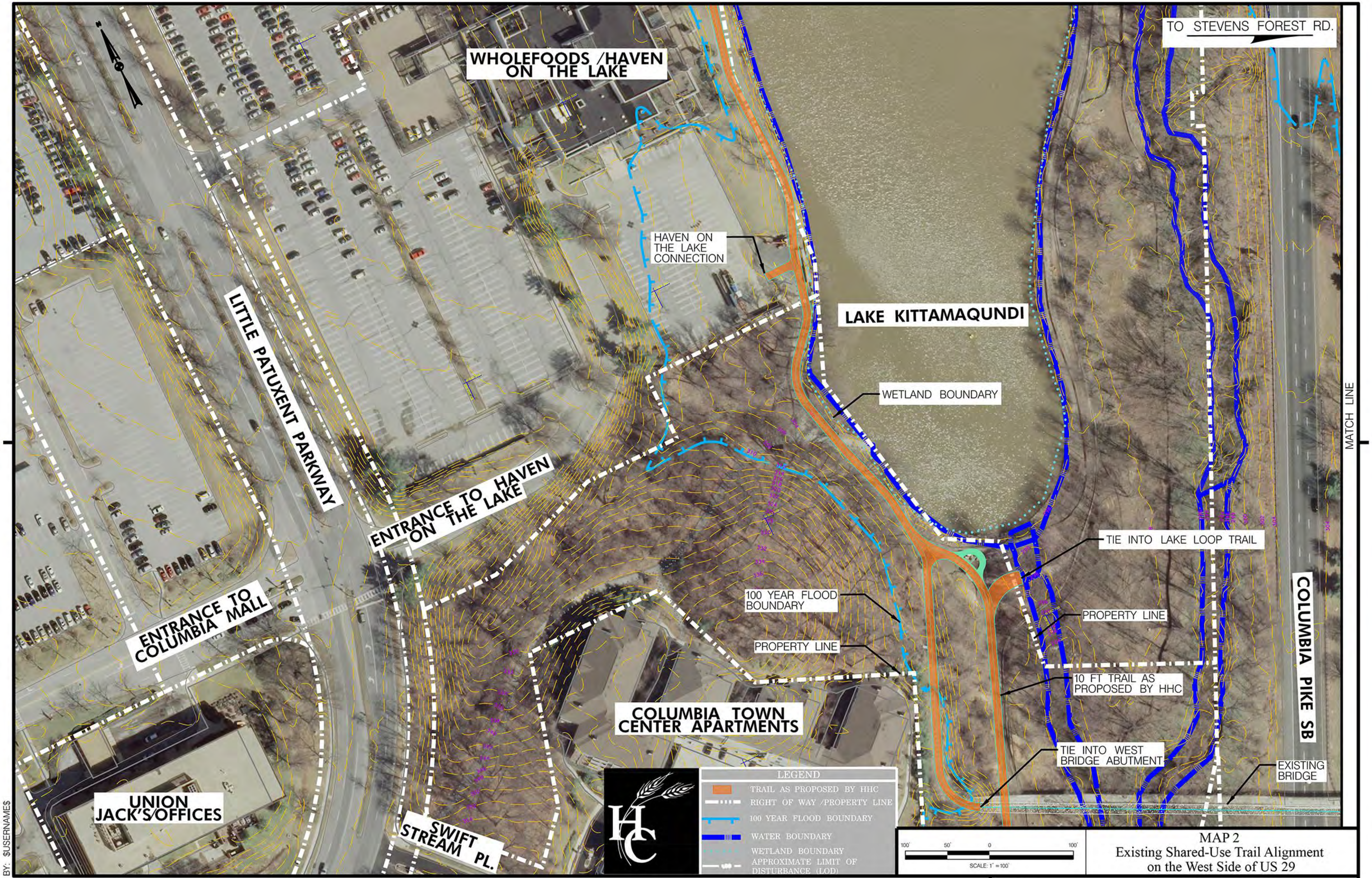
Photo 10: West Side Trail Approach to West End of Pedestrian/Bicycle Bridge (Facing South)

Photo 11: West Side Trail Along West Side of Lake Kittamaqundi (Facing South)

Photo 12: West Side Trail Connection to Columbia Lakefront Stage

Map 2 on the next page depicts the shared-use trail alignment on the east side of US 29.

Overall, the existing East and West Side Trail Connections total about 3,350 ft. in length from Stevens Forest Road to the Little Patuxent Parkway. Each connection is 8 ft., 6 in. in width. The East Side Trail is bordered by forest and understory growth and has dirt path connectors to adjacent residential areas. The areas of understory growth have limited sightlines for trail users and pose safety comfort level issues for many trail users, especially at night. Portions of each connector are not currently ADA compliant. There is no trail lighting, and cameras are located at each end of the existing pedestrian bridge, and there is lighting in the bridge parapets.



MAP 2
Existing Shared-Use Trail Alignment on the West Side of US 29

6. IDENTIFICATION OF POSSIBLE IMPROVEMENT OPTIONS

The study team identified several possible bridge and shared-use trail improvement options to meet the County's desire for an enhanced multimodal connection between east and west Columbia. During this stage, the team also conducted an initial screening to determine which potential improvement options should not be studied, and which options should be retained for further study. The following sections provide details on each of the improvement options the team considered.

Bridge Options Considered

This feasibility study reviewed the benefits and challenges associated with six bridge options and three alternatives, which are described in more detail in the sections that follow. As part of this analysis, the team considered a number of engineering, environmental and aesthetic factors and developed preliminary cost estimates for each option.

Beginning sometime in FYI5, the northbound lane of U.S. 29 south of 175 will be widened. This includes the area under the bridge. The impact of this widening was considered during the development of structure options and costs.

In terms of potential environmental impacts, new piers for bridge spans will likely be within the 100-year floodplain or possible wetlands, depending on the alignment. Temporary and potential permanent construction impacts to wetlands should be anticipated. Piers alone, when located within the floodplain or wetlands would have the least impact.
Mixed hardwood forest exists within the proposed alignment and potential limit of disturbance (LOD) of each new bridge and trail option. The corridor for each option will be very narrow, and locations for forest mitigation to address needed forest impacts may not be readily available. Offsite locations or a fee-in-lieu to the Forest Conservation Fund may be needed.

For federally-funded projects there will be many laws, regulations, and policies that drive the need for environmental documentation and permitting. These include:

- The National Environmental Policy Act of 1969 (as amended)
- FDOT 23 CFR 771: Environmental Impact and Related Procedures
- Maryland Environmental Policy Act
- Maryland DOT Order 11.01.06.02. Action Plan
- Section 404 and 401 of the Clean Water Act
- Executive Order 11990 (Protection of Wetlands)
- Section 10 of the Rivers and Harbors Act of 1899
- Maryland Nontidal Wetlands Protection Act
- Wild and Scenic Rivers Act

- Maryland Forest Conservation Act of 1991
- Endangered Species Act of 1973
- Section 4(f) of the USDOT Act of 1966
- Executive Order 12898 (Environmental Justice)
- Executive Order 11988 (Floodplain Management)
- Federal Clean Air Act and revisions
- Compliance with City and County noise ordinances
- Section 106 of the National Historic Preservation Act of 1966

Some examples of environmental services that may be required on federally-funded projects include:

- Environmental impact assessment
- Economic impact assessment
- Environmental justice evaluations
- Section 4(f) Evaluations
- Wetland jurisdictional determinations
- Wetland and stream mitigation site evaluations
- Forest stand delineations
- Endangered species coordination/surveys
- Air quality assessments
- Social (community) impact assessment
- Sustainability assessment (environmental, social, economic)
- NEPA compliance reporting
- Wetland delineations
- Wetland and stream mitigation planning and design
- Stream geomorphic assessments
- Forest conservation plans
- Noise and vibration analyses
- Permitting support, including regulatory agency coordination

Products for environmental evaluations and documentation will require technical reports in support of the Maryland Environmental Policy Act (MEPA) and the National Environmental Policy Act (NEPA) environmental documents, the MEPA and NEPA environmental documents themselves, and documentation in support of permit applications. During the planning stage of projects, Environmental Assessment Forms (EAF), Environmental Effects Reports (EER), Categorical Exclusions (CE), Environmental Assessments (EA), and Environmental Impact Statements (EIS) in accordance with the guidelines established by State and Federal regulations will be needed.

Concept-level cost estimates that were developed for each of the options assumed Preliminary Engineering costs to be approximately 25 percent of the construction costs, based on recent SHA recommendations. Howard County construction overhead costs (inspections, administration, etc.) were also estimated to be approximately 25 percent of construction costs. No right-of-way acquisition costs were assumed or included. Detailed cost estimates for each option are included in **Appendix A** of this report.

The transit options will accommodate public transit buses only. No other motor vehicles, except for public safety vehicles, would be allowed on a transit bridge.

6.1 Option 1: Retrofit the Existing Bridge

Retrofit or refurbishment of the existing bridge at existing multimodal levels (pedestrian and bicycle use) was considered once the structural and serviceability analyses of the existing bridge were completed. This option assumes a connection to the shared-use trail currently proposed by Howard Hughes Corporation for approaches to each end of the bridge, but does not provide accommodations for transit vehicles on the bridge. The clear width of the bridge deck remains 10 ft., which is not wide enough for a transit vehicle to comfortably drive across the bridge. The shared-use trail currently under development by the Howard Hughes Corporation will provide the connections needed to support pedestrian and bicycle use (but no transit use), and will include significant lighting throughout the length of the trail between Little Patuxent Parkway and Stevens Forest Road.

The Howard County Department of Planning and Zoning forwarded a letter and plan sketches to URS from an interested local stakeholder regarding the existing Oakland Mills pedestrian/bicycle bridge, *HOCO-133*, over Route 29 and Little Patuxent River. In the letter, the stakeholder expressed concern over the aesthetics of the current bridge and offered design alternatives for consideration with the goal of offering a signature feature of the surrounding shared-use trail crossing. The team considered possible mitigation strategies to address the concern over bridge aesthetics as part of Option 1.

Photo 13: Existing Bridge Barrier

AASHTO's *Roadside Design Guide* recommends a 54 in. railing height for use on pedestrian bridges when a shared use trail is designed. The need for a fully enclosed barrier is determined on a case-by-case basis, depending on the proximity of schools, urban areas, surveillance, history of vandalism, and other factors. SHA policy is to fully enclose pedestrian overpasses crossing high-speed roadways to deter pedestrians from dropping objects onto the roadway.

The typical inside clear width of pedestrian bridges is less than 14 ft. wide, making a full enclosure readily achievable without leaving a gap between the two barriers. On vehicular bridges (which are typically wider), a chamfer is employed at the top of the fence to deter objects from being thrown onto roadway (as shown in **Photo 14**). A fully enclosed trail section that is 10 ft. wide can create an uncomfortable tunnel effect for trail users.

Photo 14: Typical SHA Vehicular Bridge Sample Condition with Chamfered Fence to Deter Thrown Objects

One possible solution consists of removing the existing galvanized safety chain-link fence/ enclosure and replacing it with steel circular 'hoops' spaced along the length of the structure with varying profiles of welded wire mesh attached (see **Figure 8** and **Photo 15**). It should be noted that the existing superstructure is a single steel box beam, not three steel girders as depicted in **Figure 8**. This alternative utilizes the existing structure without adding significant load contributions. A rounded form as shown below helps reduce the tunnel effect. The maximum vertical clearance is 15 ft., 0 in. which exceeds the current barrier vertical clearance of 8 ft., 2 in. However, it is important to note that the 15 ft., 0 in. clearance is not constant due to the circular geometry of the proposed hoops. It should be noted that maintenance or emergency vehicles will remain able to access the bridge when needed via the shared-use trail.

Further analysis would be required to determine if the existing structure is able to support the additional weight of the steel hoops and wind load of the differing profiles of the wire mesh. Use of existing anchor bolts could be considered, but new anchors may be required.

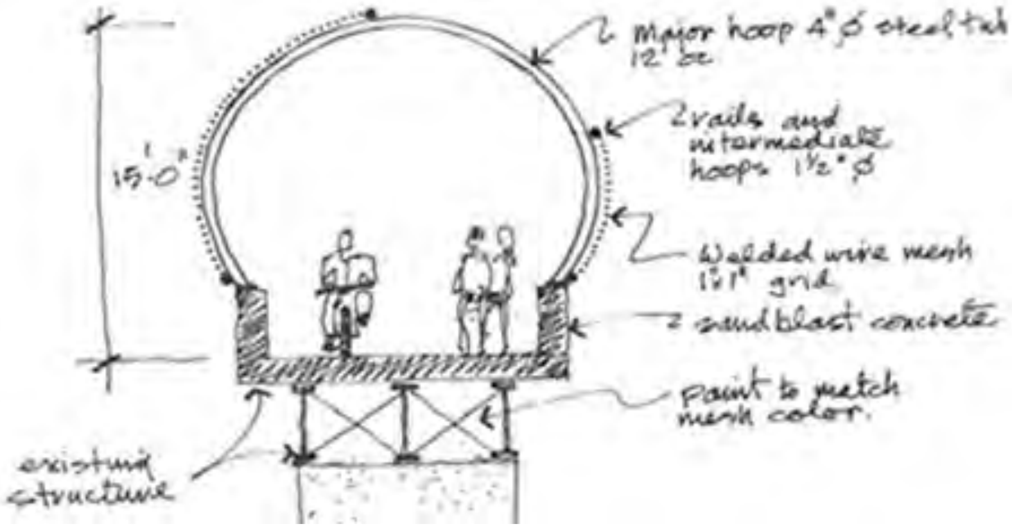


Figure 8: Steel Tube Enclosure Concept
(Source: Dorton Design)

Photo 15: Example of a Steel Tube Enclosure
(Source: Dorton Design)

There are many other enclosure designs that could be considered as well (see **Photos 16 – 21**) to suit the tastes and preferences of the community.

Photo 16: A Traditional Barrier Approved by SHA
(I-270 at MD 28 Bike & Ped Crossing in Rockville, MD; designed by URS Corporation)

Photo 17: Special Framing Shapes Using Chain Link Fabric to Mimic Mountains on a Bridge in Denver

Photo 18: A Bridge in California Featuring Artwork Bolted to the Barrier

Photo 19: Extensive Artwork Attached to the Bridge and Barrier for the Isaac Middle School in Phoenix

Photo 20: The Rock Creek Trail Bridge Utilizing an Artist's Design for Barrier and Railing (Designed by URS Corporation)

Photo 21: The Rock Creek Trail Bridge Utilizing an Artist's Design for Barrier and Railing (Designed by URS Corporation)

Other improvement options that could be considered as part of a retrofit of the existing bridge could include:

- **Painting of the steel box beam**: All spans, not just those over roadway, would be painted to coordinate with the color scheme of the steel enclosure. Weathering steel is an excellent choice to provide a low maintenance condition. Weathering steel can be readily painted or coated as regular carbon steel. A good wire brushing and solvent wash down is needed to remove loose material, dirt and contaminants before painting with a chromate oil-based paint. For synthetic resin paint (vinyl, epoxy, acrylic or alkyd) and inorganic zinc systems, blast cleaning is suggested.

  Painting of the steel box beam would require development of a Maintenance of Traffic plan to account for lane closure to perform the work, thereby adding significant cost to the retrofit.

- **Painting of inside parapet concrete:** Howard County has, during the time of this study, painted the interior of parapets on the bridge. This appears to have improved the nighttime lighting reflectivity as seen in **Photo 22** below, with the side benefit of covering graffiti:

Photo 22: Newly Painted Parapets and Nighttime Lighting

- **Parapet Lighting:** the existing parapet lighting would be retrofitted in coordination with the lighting of the proposed steel tube enclosure.

- **Outside parapet:** the outside parapet may be power washed during the painting of steel procedure, or, painted to integrate with the color schemes of the steel enclosure and steel box beam.

- **Deck treatments:** The existing bridge deck may be powerwashed to remove dirt and grime. Further, it may be stained (by acid stain, water based stain or dyes) to obtain a desired appearance or pattern. Also, decorative artwork may be incorporated. Appliques (such as the example shown in **Photo 23**) may also be feasible as add-ons to the deck, however, must be properly adhered to avoid vandalism and other issues. Designs for such appliques may be developed through award to a public artist, or even through design competitions of area residents or schoolchildren as a few ideas. Cementitious coatings would not be recommended because of freeze/thaw concerns.

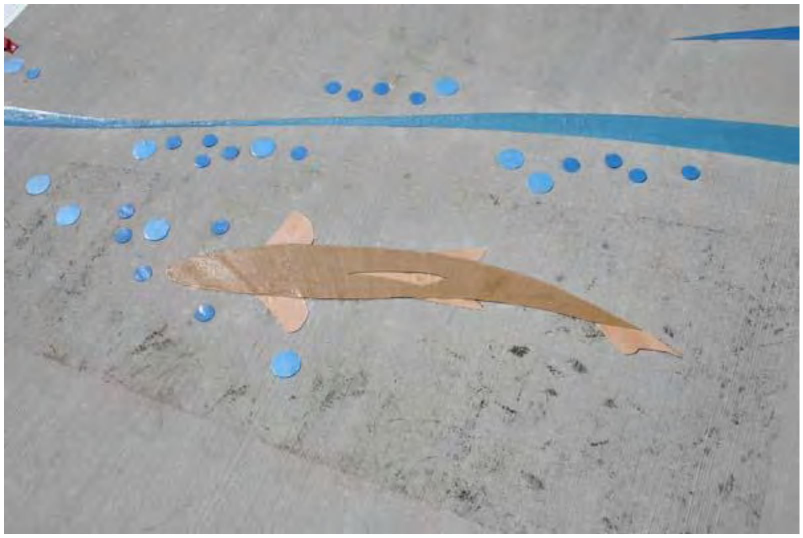


Photo 23: Artistic Appliques on a California Pedestrian Bridge

- **The Howard County Arts Council:** A potential approach to incorporation of public art is to involve The Howard County Arts Council. A competition could be held to solicit designs from the public and professional artist, or a shortlist of public artists could be interviewed with an artist selected to implement artwork for the retrofit.

- **Trail security:** Selective vegetative clearing and tree pruning to be performed along each side of trail connections on the east and west sides of the bridge to provide for improved sight lines and increase trail user level of comfort. This work should occur for at least 50 ft. off the edge of trail on each side to provide trail users with a comfortable sightline.

Figures 9-11 illustrate the proposed typical section and elevation view of the bridge under Option 1.

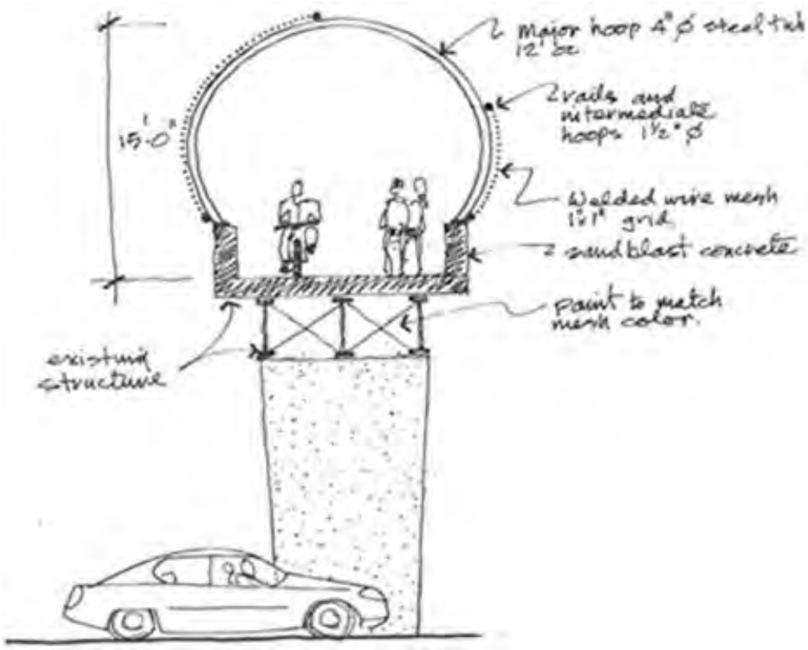


**Figure 9: Proposed Option 1 Typical Section
(Source: Dorton Design)**

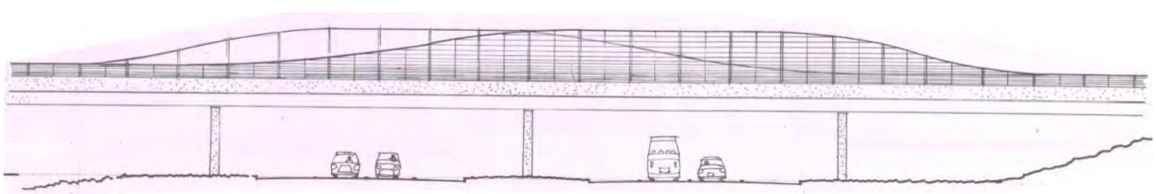


**Figure 10: Proposed Option 1 Elevation View
(Source: Dorton Design)**

Figure 11: Rendering of Proposed Option 1 with New Artistic Barrier and Paint Steel Box Beam (Looking North)

Benefits of this option, to retrofit the existing bridge, include the following:

- The proposed design would provide a landmark or gateway feature for Columbia and would be visible to northbound and southbound motorists.
- Maintenance of traffic on US 29 to perform portions of the work would be minimal.
- There are no environmental impacts associated with the bridge retrofit option, and minimal impacts for trail improvements.
- The time to design, permit and construct this option has the shortest duration of any option.
- Trail and safety improvements could occur with, or separately, from the bridge retrofit.

Challenges for this option are identified as follows:

- Use of the existing bridge during the retrofit would not be available to trail users for extended periods of time.
- Trail improvements will need to be coordinated with proposed improvements by others and currently under review by Howard County.
- The transit lane each side would require two or three pull-off areas spaced intermittently along the travel way to allow for transit vehicles to pass.

Potential Environmental Impacts: The improvements described under Option 1 are not anticipated to result in impacts to right-of-way, forest, floodplains, parkland, private properties, wetlands, streams, or specimen trees.

Project Estimated Cost and Timeline: The construction cost is estimated as follows.

Option Number / Description	*NEAT Cost	Eng. / Admin.	15% Inflation / 40% Contingency	Total Cost	Time
1 - Retrofit Existing Bridge	$914,692	$365,877	$781,147	$2,061,716	2.5-years

Note: *NEAT Cost excludes engineering, HOCO administrative costs, contingencies and ROW acquisition.

See **Appendix A** for detailed cost estimates and **Appendix B** for detailed timeline descriptions.

6.2 Option 2: Retrofit of Existing Bridge with Complementary Transit (Single Lane)

This option include includes the steel tube barrier and other retrofit items from Option 1, and considers the addition of a complementary single-lane transit bridge adjacent to, and south of, the existing pedestrian bridge as shown in **Figure 12**.

The shared-use trail approaches to the east and west of the bridge would be modified from the 10 ft. trail section being designed by Howard Hughes Corporation to a trail separated by a barrier from a single-lane transit road as shown in **Figure 13**. The transit lane would have two or three pull-off areas spaced intermittently along the travel way to allow for transit vehicles to pass.

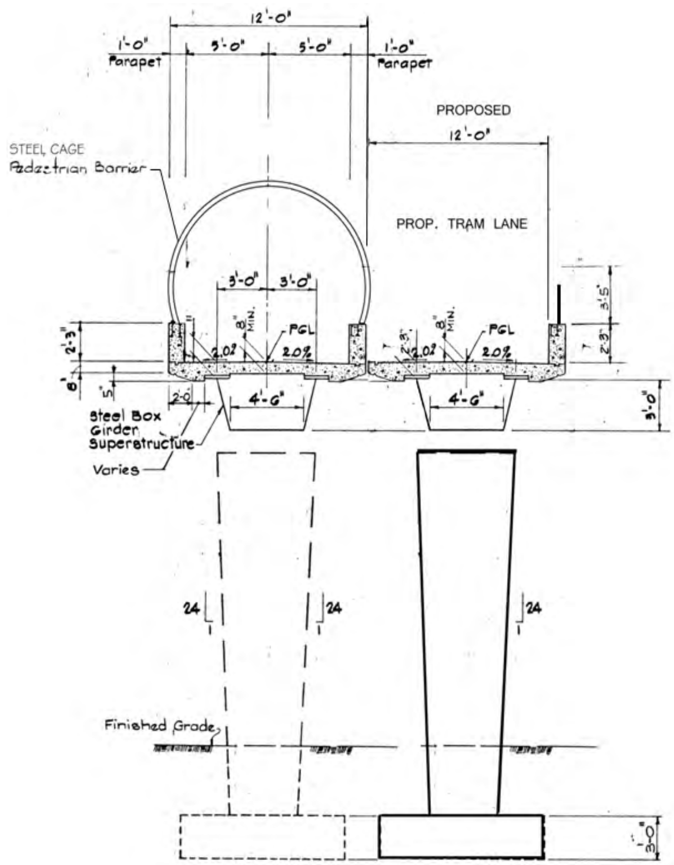


Figure 12: Option 2 - Retrofit of Existing Bridge with Complementary Transit (Single Lane Only)

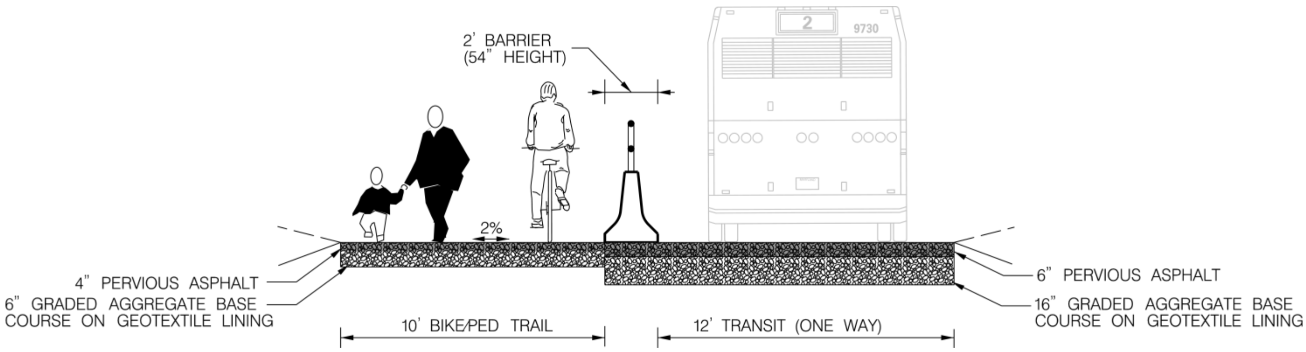


Figure 13: Single Lane of Transit with Trail

Dual Lane: A dual lane alternative for transit under Option 2 (as shown in **Figure 14**) was dismissed because the required 34 ft. wide minimum pavement section would result in an unacceptably high level of environmental impacts.

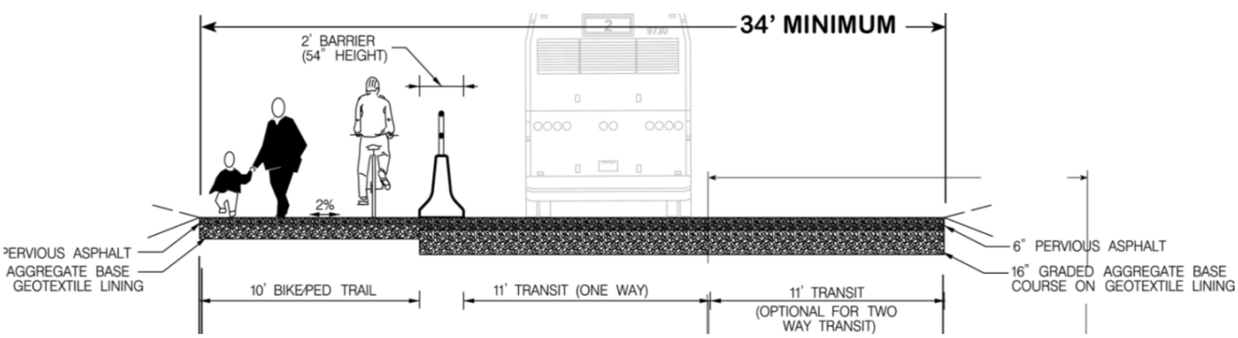


Figure 14: Dual Lanes of Transit with Trail

Benefits of this option, to retrofit the existing bridge and add a complementary single transit lane only, includes the following:

- The proposed design would provide a landmark or gateway feature for Columbia and would be visible to northbound and southbound motorists.
- There will be environmental impacts associated with the addition of the complementary bridge, but they would be the least of any new bridge option due to the proximity of complementary bridge adjacent to the existing bridge, thereby minimizing the footprint of new work and the limit of disturbance.
- The time to design, permit and construct this option has the shortest duration of any new bridge option.

Challenges identified for this alternate include the following:

- The trail / transit lane approaches either side of bridge would require matching trail and transit lane widths to accommodate the traffic. This option will have environmental impacts associated with construction due to a larger limit of disturbance.
- Maintenance of traffic will be required on US 29 to construct the new complementary bridge.
- Use of the existing bridge would not be available to trail users for extended periods of time.
- The transit lane each side would require two or three pull-off areas spaced intermittently along the travel way to allow for transit vehicles to pass.

Potential Environmental Impacts: The improvements described under Option 2 could impact approximately 5.5 acres of forest, 2.0 acres of floodplains, 1.2 acres of private properties, and approximately 0.5 acres of wetlands. No impacts to right-of-way, parkland, streams, or specimen trees are anticipated.

Project Estimated Cost and Timeline: The construction cost is estimated as follows.

Option Number / Description	*NEAT Cost	Eng. / Admin.	15% Inflation / 40% Contingency	Total Cost	Time
2 - Complementary Bridge w/Single Transit	$7,513,112	$3,005,245	$6,857,969	$17,376,325	7.5-years

Note: *NEAT Cost excludes engineering, HOCO administrative costs, contingencies and ROW acquisition.
Unless otherwise noted, options include retrofit of existing bridge.

See **Appendix A** for detailed cost estimates and **Appendix B** for detailed timeline descriptions.

6.3 Option 3, Alternative A: Cable-Stayed Bridge with One Transit Lane

To implement a bridge structure of high aesthetics, this option proposes replacement of the existing bridge with a new cable-stayed bridge utilizing a standard harp design. Harp refers to the cable layout extending from the tower to the bridge deck, and resembles the strings on a harp. The pylon (also commonly called a tower) would be located in the center median of US 29, and would rise to a height of about 135 ft. above the roadway. The pylon, would be constructed of pre-cast segments. The height of the pylon is necessary to maintain a 1:3 height to span ratio. The selected design incorporates a Delta H-Frame to meet the aesthetic and structural attributes required for the design. Also, bracing, or horizontal struts, would be incorporated to prevent movement of the pylon legs.

For the bridge deck a single pre-cast concrete box girder, with one intermediate web stiffener anticipated, is proposed in segments to support both the bike / ped and transit lane. The top flange of the girder acts as the wearing surface, thereby avoiding an overlay of asphalt or concrete which would be an added cost. The bike / ped lane would be 12 ft. inside clear width and the transit lane would also be 12 ft. in width. A concrete barrier would separate the bike / ped lane from the transit lane. Handrails would be placed on each side of deck for protection of pedestrians. The pylons's foundation would be supported by piles capped with a concrete footing. Approach spans, beyond the cable-stayed bridge, would be prosed as a continuation of the same pre-cast box girder system as described. The clearance above roadway for the bottom of a pedestrian bridge superstructure is 17'-6" minimum (typically a foot higher than a vehicular bridge). **Figures 15, 16**, and **17** show a typical section, elevation view, and rendering, respectively, of a cable-stayed bridge with one transit lane.

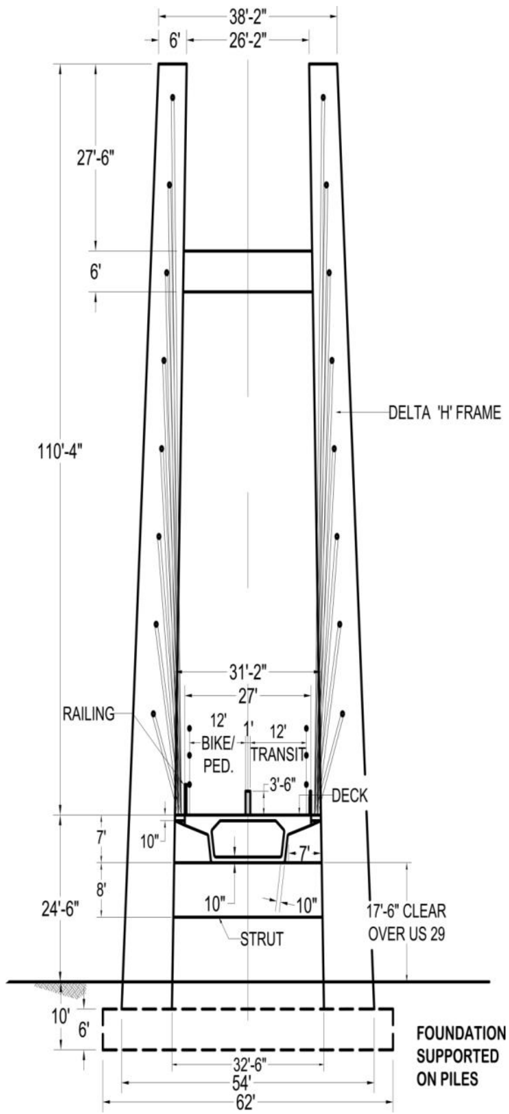


Figure 15: Typical Section of a Cable-Stayed Bridge with One Transit Lane

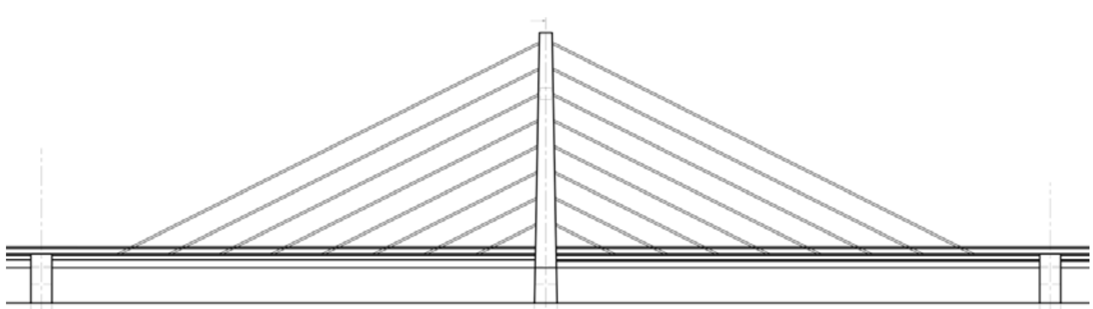


Figure 16: Elevation View of a Cable-Stayed Bridge

Figure 17: Rendering of a Cable-Stayed Bridge

Opportunities for enhancing aesthetics include the following:

- Use of concrete form liners to develop a theme for the pre-cast pylon and girder.
- Colorization of the cables and custom handrails and color theme.
- Nighttime lighting of the cables, pylon and deck.

Benefits of a cable-stayed bridge include the following:

- The proposed design provides a significant landmark, or gateway feature for Columbia, that would be visible to northbound and southbound motorists for a substantial distance.
- Trail and transit users would have a pleasant and safe experience in traversing the bridge.
- Nighttime lighting would also provide a landmark feature to motorists. Also, pedestrian lighting would provide for safety.
- Utilizing the alignment of the existing bridge assists in reducing environmental impacts to trees, wetlands, and the 100-year floodplain.
- The Howard County Arts Council and interested stakeholders would be involved in incorporating public art or development of the design themes for the bridge project.

Challenges of implementing this alternate include the following:

- Currently, there are no known cable-stayed bridges in Maryland to reference.
- Oncoming transit vehicles will have to wait for opposing vehicles to clear before proceeding. The transit lane each side would require two or three pull-off areas spaced intermittently along the travel way to allow for transit vehicles to pass.
- Keeping pedestrians off the transit lane will be difficult. Traffic control devices such as gates and lane markings would be neded to prevent private vehicles from using the bridge or tranist lanes.
- Contractor's experienced in building this type of structure may limited in Maryland.
- Inspectors familiar with precast concrete and cable-stayed construction may be limited.
- Constructability will be complex to start work in the median with the pylon construction, and closure of US 29 will be required to install the box girder segments in a symmetrical manner to balance loading on the cables and pylon.
- A form traveler to install the pre-cast and pre-stressed box girder segments would likely be necessary.
- Overall design, construction and Howard County administrative costs will be higher than a traditional bridge design.
- Long-term maintenance costs will be higher for periodic inspections, since it is a complex bridge, and the analysis is more involved. Inspection of, and painting of cables, for example, would require workers with special rigging to access the entire structure. It is likely that inspectors would also have to enter the precast box girder to perform routine inspections.
- Demolition of the existing bridge will be required.

Potential Environmental Impacts: The improvements described under Option 3, Alternative A could impact approximately 5.7 acres of forest, 2.1 acres of floodplains, 1.3 acres of private properties, and approximately 0.75 acres of wetlands. No impacts to right-of-way, parkland, streams, or specimen trees are anticipated.

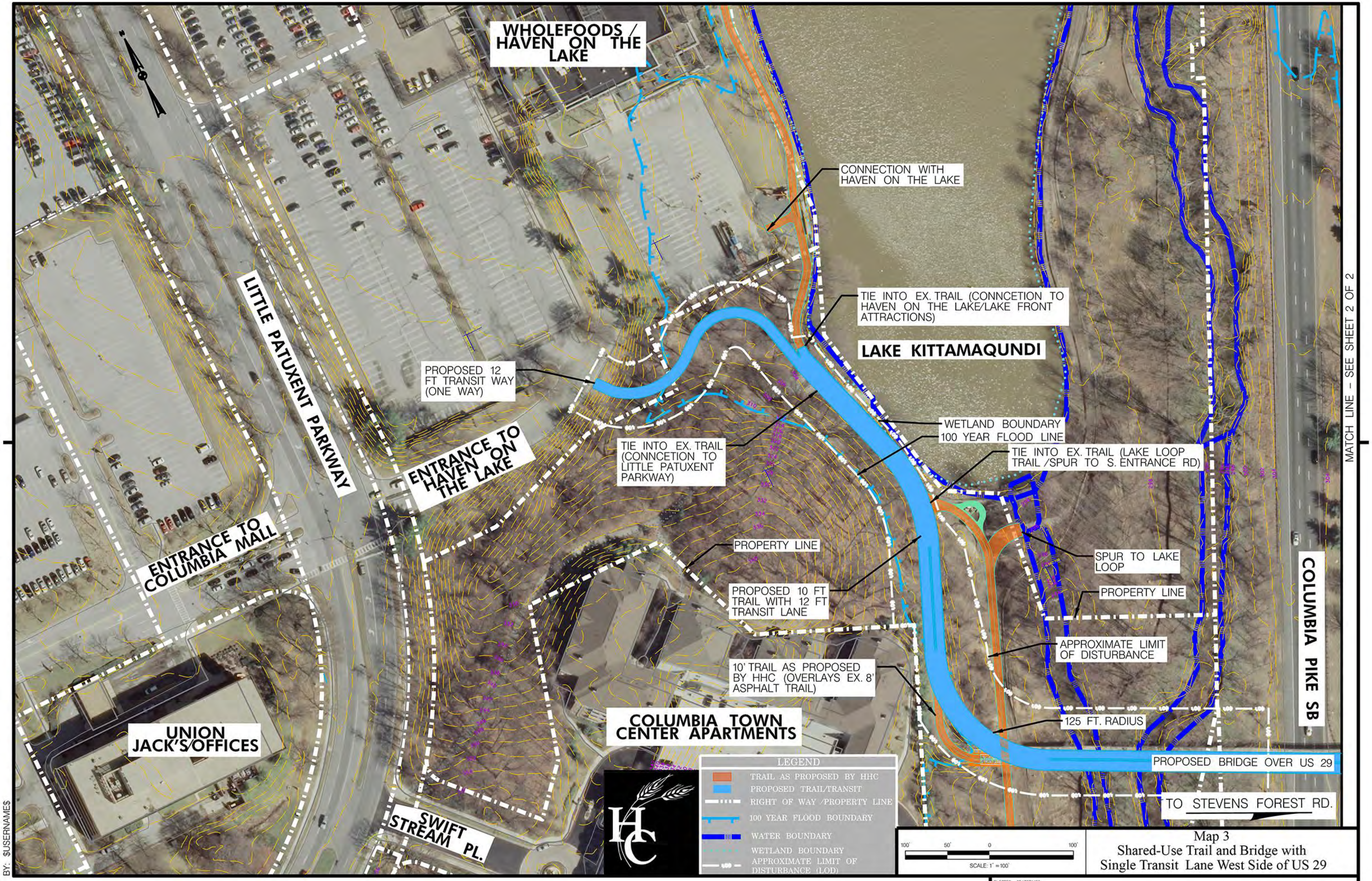
Project Estimated Cost and Timeline: The construction cost is estimated as follows.

Option Number / Description	*NEAT Cost	Eng. / Admin.	15% Inflation / 40% Contingency	Total Cost	Time
3a - Cable Stayed w/Single Transit	$12,674,053	$7,604,432	$13,789,370	$34,067,854	9.2-years

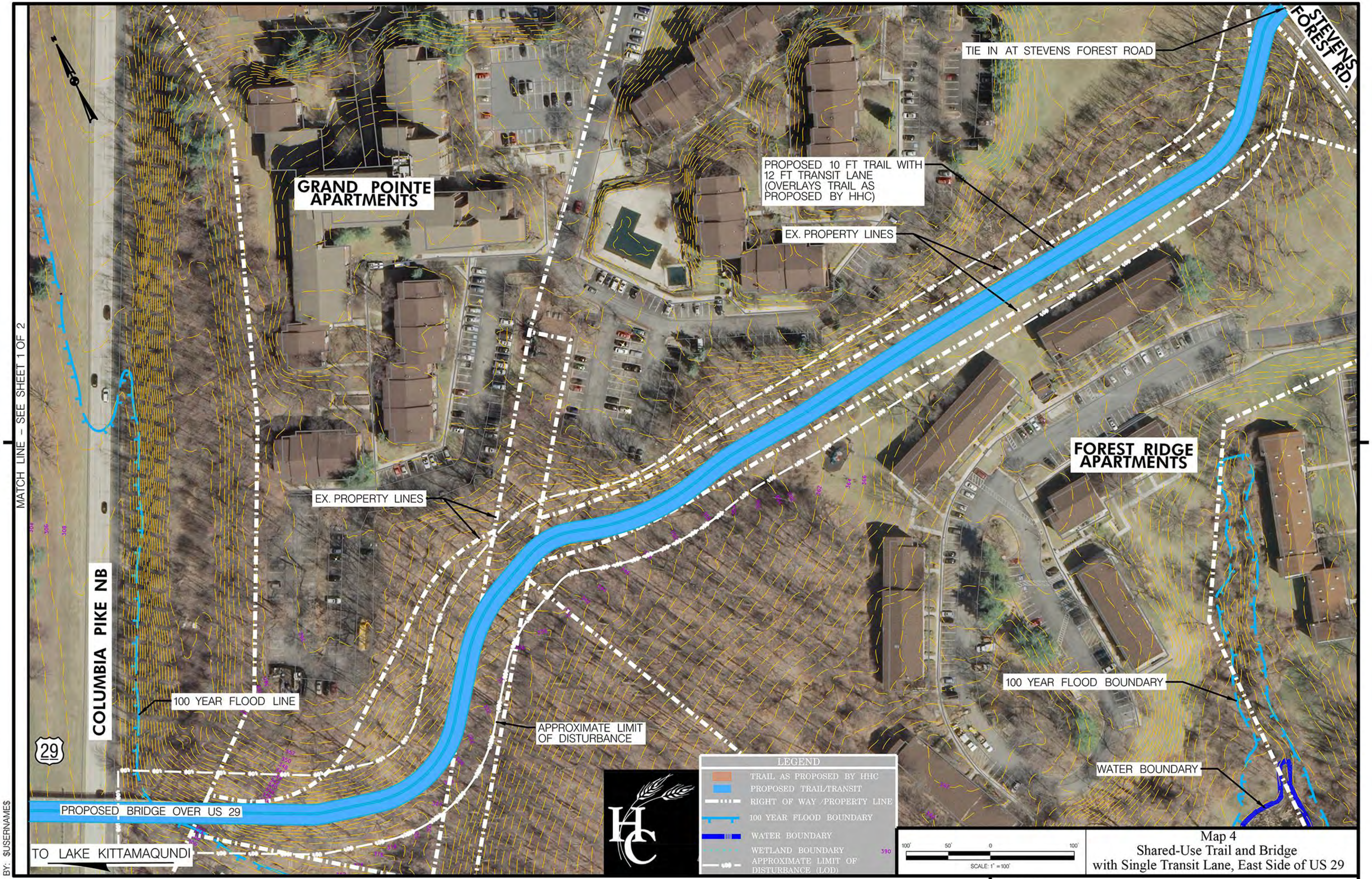
Note: *NEAT Cost excludes engineering, HOCO administrative costs, contingencies and ROW acquisition.

See **Appendix A** for detailed cost estimates and **Appendix B** for detailed timeline descriptions.

Maps 3 and **4** show the connections between the bridge proposed under Option 3, Alternative A and the shared-use trails on either side of the bridge.



Map 3
Shared-Use Trail and Bridge with Single Transit Lane West Side of US 29



Map 4
Shared-Use Trail and Bridge
with Single Transit Lane, East Side of US 29

6.4 Option 3, Alternative B: Cable-Stayed Bridge with Two Transit Lanes

Similar to Option 3, Alternative A, to implement a bridge structure of high aesthetics, this option proposes replacement of the existing bridge with a new cable-stayed bridge utilizing a standard harp with a bridge deck. A single pre-cast concrete box girder is proposed in segments to support the bike / ped and two transit lanes. The bike / ped lane would be 12 ft. inside clear width and the two 12 ft. transit lanes. A concrete barrier would separate the bike / ped lane from the transit lanes. Handrails would be placed on each side of deck for protection of pedestrians.

Benefits of a cable-stayed bridge include the following:

- The proposed design provides a significant landmark, or gateway feature for Columbia, that would be visible to northbound and southbound motorists for a substantial distance.
- Transit vehicles would have the added benefit of two-way transit traffic. This would eliminate the need for transit vehicles to wait at either end of the bridge approach for clearance of opposing vehicles in order to proceed.
- Trail and transit users would have a pleasant and safe experience in traversing the bridge.
- Nighttime lighting would also provide a landmark feature to motorists. Also, pedestrian lighting would provide for safety.
- Utilizing the alignment of the existing bridge assists in reducing environmental impacts to trees, wetlands, and the 100-year floodplain.
- The Howard County Arts Council and interested stakeholders would be involved in incorporating public art or development of the design themes for the bridge project.

Challenges of implementing this alternate include the following:

- Currently, there are no known cable-stayed bridges in Maryland to reference.
- Keeping pedestrians off the two transit lanes will be difficult.
- Contractor's experienced in building this type of structure may not be readily available.
- Inspectors familiar with precast concrete and cable-stayed construction may be limited within the region.
- Constructability will be complex to start work in the median with the pylon construction, and closure of US 29 will be required to install the box girder segments in a symmetrical manner to balance loading on the cables and pylon.
- A form traveler to install the pre-cast and pre-stressed box girder segments would likely be necessary.
- Overall design, construction and Howard County administrative costs will be higher than a traditional bridge design.
- Long-term maintenance costs will be higher for periodic inspections, since it is a complex bridge, and the analysis is more involved. Inspection of, and painting of cables,

for example, would require workers with special rigging to access the entire structure. It is likely that inspectors would also have to enter the precast box girder to perform routine inspections.

- Demolition of the existing bridge will be required.
- A significantly wider box girder system is required compared to Alternative A, thereby compounding complexity of design, constructability and cost.
- The trail / transit lane approaches either side of bridge would require matching lane widths to accommodate the traffic. This also results in greater environmental impacts associated with construction due to a larger limit of disturbance.
- Controlling bike and pedestrian traffic in the transit lanes will be more difficult due to the greater width.
- The pre-cast box girder would require multiple intermediate web stiffeners due to the width which increases cost.

Potential Environmental Impacts: The improvements described under Option 3, Alternative B could impact approximately 7.4 acres of forest, 2.7 acres of floodplains, 1.6 acres of private properties, and approximately 0.8 acres of wetlands. No impacts to right-of-way, parkland, streams, or specimen trees are anticipated.

Project Estimated Cost and Timeline: The construction cost is estimated as follows.

Option Number / Description	*NEAT Cost	Eng. / Admin.	15% Inflation / 40% Contingency	Total Cost	Time
3b - Cable Stayed w/Dual Transit	$14,274,559	$8,564,735	$15,530,720	$38,370,014	9.2-years

Note: *NEAT Cost excludes engineering, HOCO administrative costs, contingencies and ROW acquisition.

6.5 Option 4, Alternative A: Iconic Bridge with One Transit Lane

An iconic bridge structure of high aesthetics is the goal of this option to build upon a concept sketch prepared by Bridge Columbia (see **Figures 18** and **19**).

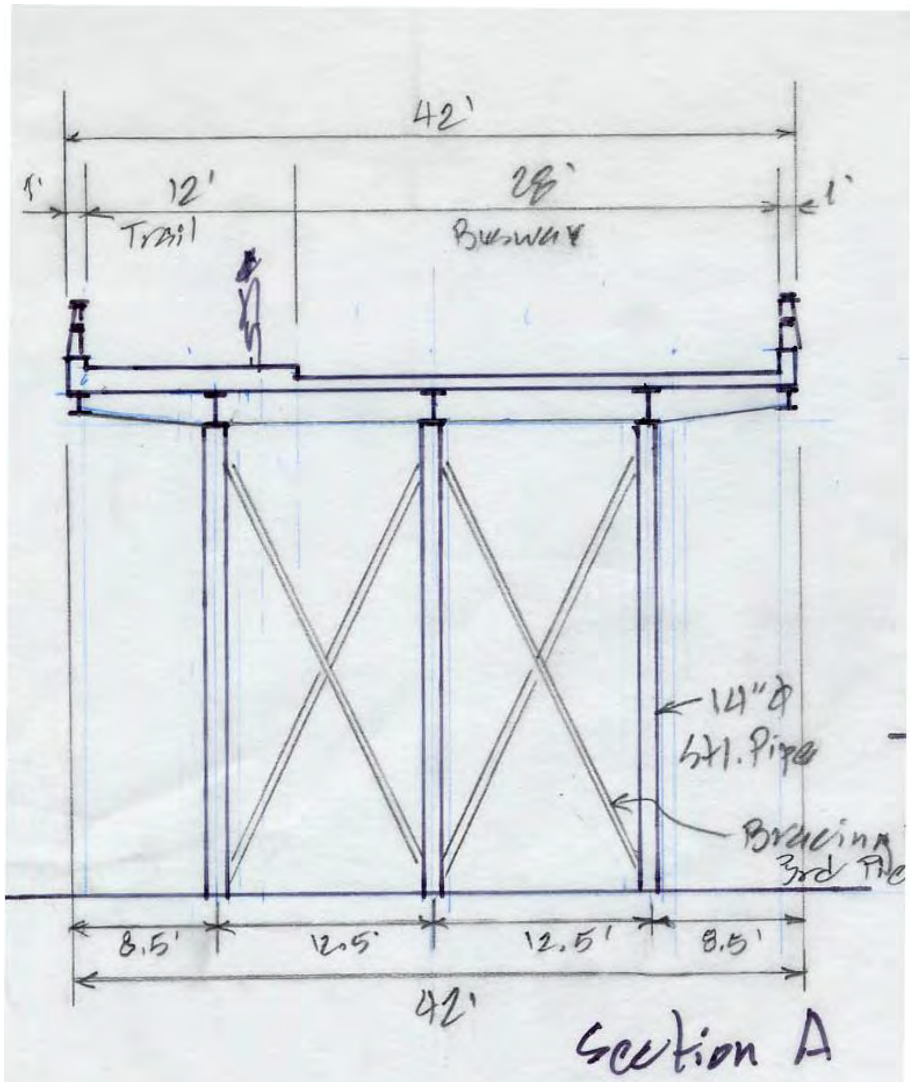


Figure 18: Sketch of Iconic Bridge Typical Section by Bridge Columbia

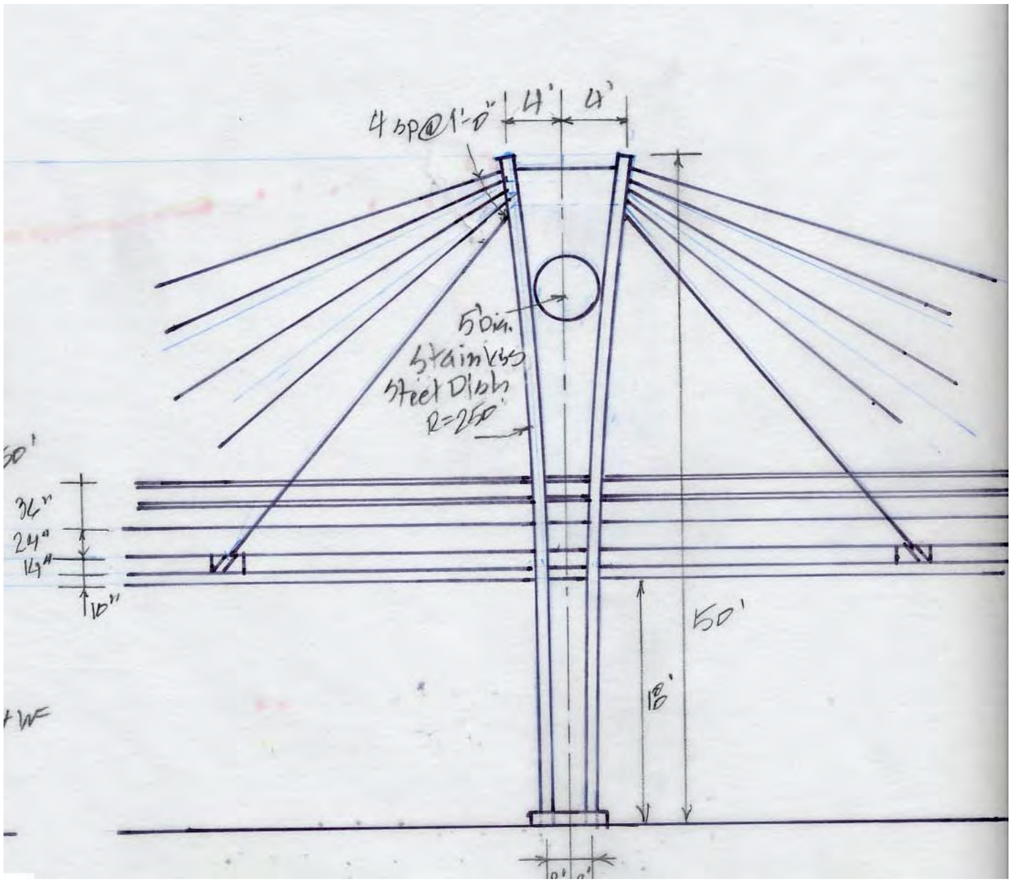


Figure 19: Elevation View Sketch of Iconic Bridge by Bridge Columbia

This option proposes replacement of the existing bridge with a new extradosed cable-stayed bridge. This type of bridge construction is a new bridge concept termed extradosed prestressed bridge design. This type of bridge uses the cables as prestressing tendons for the concrete deck which is directly supported by the tower. Shorter towers and longer spans are allowed, while minimizing the depth of the superstructure. This bridge type is not yet widely used in the United States, but has been gaining support in European and Asian applications.

Extradosed bridge design has unique characteristics that include the following:

- Shorter towers (or pylons) than cable-stayed
- Shallower box girder than a girder bridge, but deeper than a cable stayed bridge
- Flatter cables than a cable stayed bridge, and only over a portion of the span
- Cables sized to prestress the deck
- Low Fatigue Ranges for Cables
- Uniform Size Range for Cables
- Tower Height to Span Ratio: 1:10 to 1:15 (compared to a 1:3 for cable-stayed)
- Box girder with one intermediate web stiffener anticipated for this deck width

The design utilizes a cable layout extending from the tower at a lower angle to the bridge deck and resembles the strings on a harp, but with a much flatter orientation than Option 3. The towers would be located in the center median of US 29, and would rise to a height of about 50 ft. above the roadway. The pylon would be constructed of pre-cast segments. The height of the pylon is necessary to maintain a 1:10 height to span ratio. This design incorporates a unique tower design to meet the aesthetic and structural attributes as suggested by the sketch provided by Bridge Columbia. The tower's foundation would be supported by piles capped with a concrete footing.

For the bridge deck, a single pre-cast concrete box girder is proposed in segments to support both the bike / ped and transit lane. The top flange of the girder acts as the wearing surface, thereby avoiding an overlay of asphalt or concrete which would be an added cost. The bike / ped lane would be 12 ft. inside clear width and the transit lane would also be 12 ft. in width. A concrete barrier would separate the bike / ped lane from the transit lane. Handrails would be placed on each side of deck for protection of pedestrians.

Approach spans, beyond the extradosed bridge, would be proposed as a continuation of the same pre-cast and pre-stressed box girder system as described. The clearance above roadway for the bottom of a pedestrian bridge superstructure is 17'-6" minimum (typically a foot higher than a vehicular bridge). **Figures 20** and **21** show a typical section and elevation view of the proposed iconic bridge, and the rendering in **Figure 22** illustrates how the iconic bridge might look over US 29.

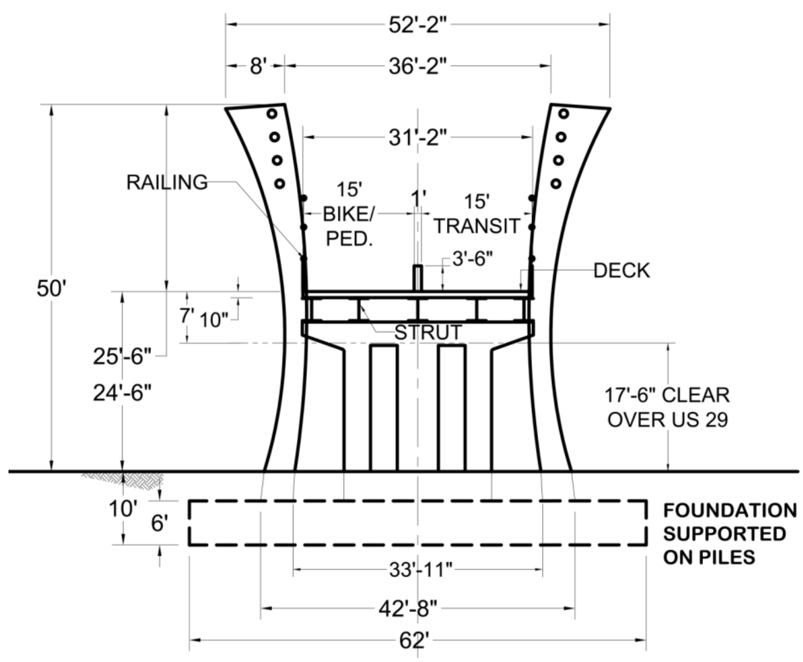


Figure 20: Typical Section of Iconic Bridge with One Transit Lane

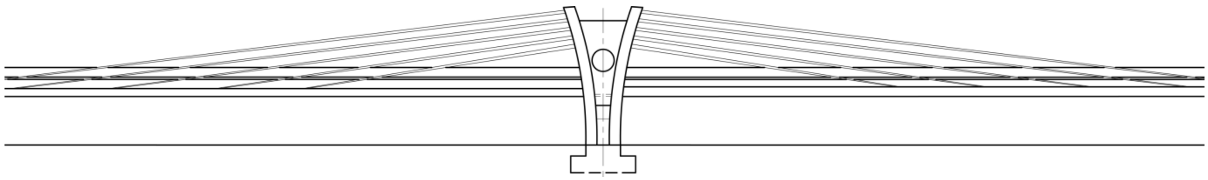


Figure 21: Elevation View of Iconic Bridge

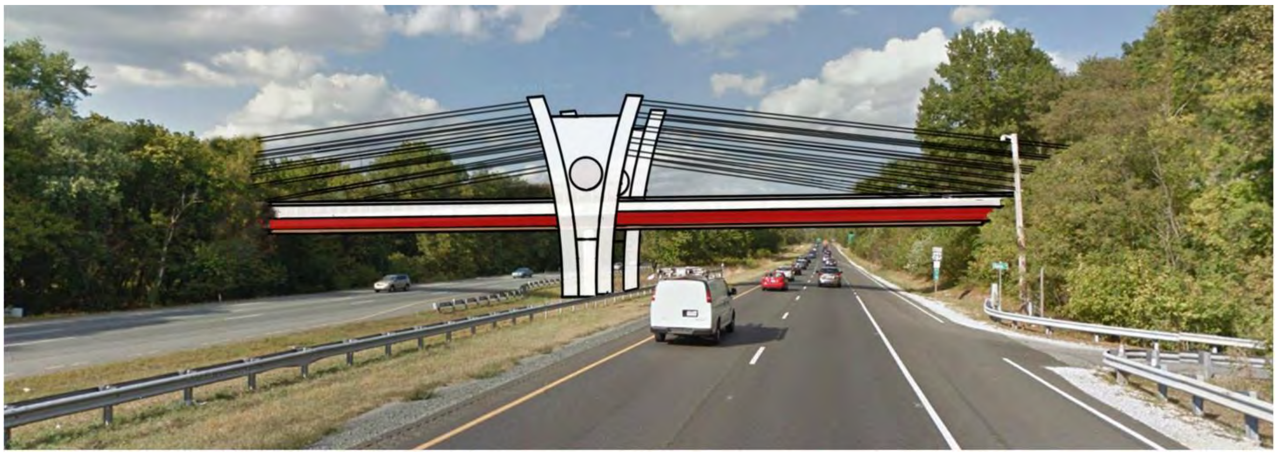


Figure 22: Rendering of Iconic Bridge Over US 29

Opportunities for enhancing aesthetics include the following:

- Use of concrete form liners to develop a theme for the pre-cast pylon and girder.
- Innovate and artistic design for the main tower allows for stakeholder involvement related to aesthetics.
- Colorization of the cables and custom handrails and color theme.
- Nighttime lighting of the cables, tower and deck.

Benefits of an extradosed bridge include the following:

- The proposed design provides an iconic gateway feature for Columbia that would be visible to northbound and southbound motorists for a substantial distance. It would satisfy stakeholder interest in provision of a safe and more aesthetically pleasing structure for all users.
- The extradosed bridge is midway between the cost of 6.2.3 Option 3, Alternative A (w/Single Transit) and 6.2.4 Option 3, Alternative B (w/DualTransit).
- Trail and transit users would have a pleasant and safe experience traversing the bridge.
- Nighttime lighting would also provide a landmark feature to motorists. Also, pedestrian lighting would provide for safety.

- Utilizing the alignment of the existing bridge assists in reducing environmental impacts to trees, wetlands, and the 100-year floodplain.
- The Howard County Arts Council and interested stakeholders would be involved in incorporating public art or development of the design themes for the bridge project.

Challenges of implementing this option include the following:

- There are about 60 extradosed bridges world-wide, with the bulk of those located in Asia. The United States has one known extradosed bridge (in Connecticut).
- Contractors experienced in this type of construction in the region may not be available.
- A form traveler, equipment to install the pre-cast and pre-stressed box girder segments, would likely be necessary.
- Oncoming transit vehicles must wait for opposing vehicles to clear before proceeding.
- Keeping pedestrians off the transit lane will be difficult.
- Inspectors familiar with this new extradosed bridge concept and construction will be limited within the region and further.
- Constructability will be complex to start work in the median with the tower construction, and closure of US 29 will be required to install the box girder segments in a symmetrical manner to balance loading on the cables and tower.
- Overall design, construction and Howard County administrative costs will be higher than a traditional bridge design.
- Maintenance of an extradosed bridge can be difficult due to the large number of connections compounded by the fact that a major design constraint for this type of structure is fatigue of the cables and anchorage systems at connections.
- Long-term maintenance costs will be higher for periodic inspections, since it is a complex bridge, and the analysis is more involved. Inspection of, and painting of cables, for example, would require workers with special rigging to access the entire structure. It is likely that inspectors would also have to enter the precast box girder to perform routine inspections.
- Demolition of the existing bridge will be required.

Potential Environmental Impacts: The improvements described under Option 4, Alternative A could impact approximately 5.5 acres of forest, 2.1 acres of floodplains, 1.2 acres of private properties, and approximately 0.5 acres of wetlands. No impacts to right-of-way, parkland, streams, or specimen trees are anticipated.

Project Estimated Cost and Timeline: The construction cost is estimated as follows.

Option Number / Description	*NEAT Cost	Eng. / Admin.	15% Inflation / 40% Contingency	Total Cost	Time
4a - Iconic Bridge w/Single Transit	$13,557,907	$8,134,744	$14,751,003	$36,443,655	9.2-years

Note: *NEAT Cost excludes engineering, HOCO administrative costs, contingencies and ROW acquisition.

6.6 Option 4, Alternative B: Iconic Bridge with Two Transit Lanes

Similar to Option 4, Alternative A, to implement a new extradosed bridge structure of high aesthetics this option proposes replacement of the existing bridge with a new extradosed bridge type utilizing a low-angle harp supporting the bridge deck, a single pre-cast and pre-stressed concrete box girder is proposed in segments to support both the bicycle and pedestrian traffic and two transit lanes. A deck width of 42 ft. minimum would be provided. The bicycle / pedestrian lane would be 12 feet inside clear width and the two 12 ft. transit lanes. A concrete barrier would separate the bicycle / pedestrian lane from the transit lanes. Handrails would be placed on each side of deck for protection of pedestrians.

Benefits of an extradosed bridge with two transit lanes are as follows:

- The proposed design provides an iconic gateway feature for Columbia that would be visible to northbound and southbound motorists for a substantial distance. It would satisfy stakeholder interest in provision of a safe and more aesthetically pleasing structure for all users.
- Transit vehicles would have the added benefit of two-way transit traffic. This would eliminate the need for transit vehicles to wait at either end of the bridge approach for clearance of opposing vehicles in order to proceed.
- The extradosed bridge with two transit lanes will be slightly higher in cost than Option 6.2.3 Option 3, Alternative A (w/Single Transit) due to the wider bridge section, but the same construction approach and equipment will be required.
- Trail and transit users would have a pleasant and safe experience traversing the bridge.
- Nighttime lighting would also provide a landmark feature to motorists. Also, pedestrian lighting would provide for safety.
- Utilizing the alignment of the existing bridge assists in reducing environmental impacts to trees, wetlands, and the 100-year floodplain.
- The Howard County Arts Council and interested stakeholders would be involved in incorporating public art or development of the design themes for the bridge project.

Challenges of implementing this alternate include the following:

- Contractors experienced in this type of construction in the region may not be available.
- A form traveler, equipment to install the pre-cast and pre-stressed box girder segments, would likely be necessary.
- Keeping pedestrians off the transit lanes will be difficult.
- Inspectors familiar with this new extradosed bridge concept and construction will be limited within the region and further.
- Constructability will be complex to start work in the median with the tower construction, and closure of US 29 will be required to install the box girder segments in a symmetrical manner to balance loading on the cables and tower.

- Overall design, construction and Howard County administrative costs will be higher with this more complex bridge design.
- Maintenance of an extradosed bridge can be difficult due to the large number of connections compounded by the fact that a major design constraint for this type of structure is fatigue of the cables and anchorage systems at connections.
- Long-term maintenance costs will be higher for periodic inspections, since it is a complex bridge, and the analysis is more involved. Inspection of, and painting of cables, for example, would require workers with special rigging to access the entire structure. It is likely that inspectors would also have to enter the precast box girder to perform routine inspections.
- A significantly wider prestressed box girder system is required, thereby compounding design, constructability and cost.
- The trail / transit lane approaches on either side will require matching widths to accommodate the traffic, and that will have greater environmental impacts associated with construction.
- The pre-cast box girder will require multiple intermediate web stiffeners due to the width which increases cost.

Potential Environmental Impacts: The improvements described under Option 4, Alternative B could impact approximately 7.1 acres of forest, 2.6 acres of floodplains, 1.5 acres of private properties, and approximately 0.7 acres of wetlands. No impacts to right-of-way, parkland, streams, or specimen trees are anticipated.

Project Estimated Cost and Timeline: The construction cost is estimated as follows.

Option Number / Description	*NEAT Cost	Eng. / Admin.	15% Inflation / 40% Contingency	Total Cost	Time
4b - Iconic Bridge w/Dual Transit	$17,651,975	$10,591,185	$19,205,348	$47,448,508	9.2-years

Note: *NEAT Cost excludes engineering, HOCO administrative costs, contingencies and ROW acquisition.

6.7 Option 5, Alternative A: Lake Bridge with Pedestrian and Bicycle Accommodations and Two Transit Lanes

This option proposes a direct connection from Little Patuxent Parkway to Stevens Forest Road. The total distance from Little Patuxent parkway, across Lake Kittamaqundi and US 29, to Stevens Forest Road is about 2,400 ft. The span of Lake Kittamaqundi is about 600 ft. **Figure 23** depicts a general iconic cable-stayed bridge elevation condition to span the lake.

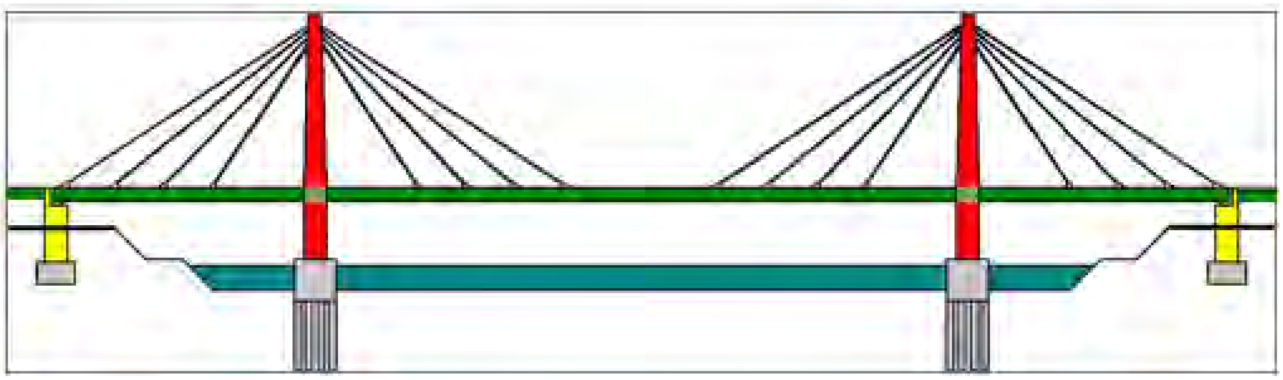


Figure 23: Lake Bridge with Cable-Stayed Iconic Appearance

This option assumes a new cable-stayed bridge utilizing a standard harp design to cross the lake and another to cross US 29. For the bridge deck, a single pre-cast concrete box girder, with multiple web stiffeners, is proposed in segments to support both the bike / ped and two transit lanes. The top flange of the girder acts as the wearing surface, thereby avoiding an overlay of asphalt or concrete which would be an added cost. The bike / ped lane would be 12 ft. inside clear width and the transit lane would also be 24 ft. in width. A concrete barrier would separate the bike / ped lane from the transit lane. Handrails would be placed on each side of deck for protection of pedestrians.

The tower foundations would be supported by piles capped with a concrete footing.

Approach spans, beyond the cable-stayed bridges, would be proposed as a continuation of the same pre-cast box girder system as described. This option and alignment will require bridging the entire distance from Little Patuxent Parkway to Stevens Forest Road due to difficult terrain to minimize or avoid floodplain and environmental impacts, and to meet ADA requirements.

The clearance above the US 29 roadway to the bottom of a bridge superstructure is 17 ft., 6 in. minimum (typically a foot higher than a vehicular bridge).

Opportunities for enhancing aesthetics include the following:

- Use of concrete formliners to develop a theme for the pre-cast pylon and girder.
- Colorization of the cables.
- Nighttime lighting of the cables, pylon and deck.
- Custom handrails and color themes.

Benefits of a cable-stayed bridge include the following:

- The proposed design provides a significant landmark, or gateway feature for Columbia, that would be visible to northbound and southbound motorists for a substantial distance.
- Trail and transit users would have a pleasant and safe experience in traversing the bridge.
- Nighttime lighting would also provide a landmark feature to motorists. Also, pedestrian lighting would provide for safety.
- Utilizing the alignment of the existing bridge assists in reducing environmental impacts to trees, wetlands, and the 100-year floodplain.
- The Howard County Arts Council and interested stakeholders would be involved in incorporating public art or development of the design themes for the bridge project.
- The existing bridge may remain for use with the shared-use trail connection. Impacts to the shared-use trail will be avoided.

Challenges of implementing this alternate include the following:

- Currently, there are no known cable-stayed bridges in Maryland to reference.
- Keeping pedestrians off the transit lanes will be difficult.
- It may be difficult to span the lake without pier placement in the lake, but this will need to be investigated further.
- Permitting may be difficult due to the significant potential environmental impacts.
- Contractor's experienced in building this type of structure in the region may not be readily available. Multiple contractors may be required due to the magnitude of work.
- Inspectors familiar with precast concrete and cable-stayed construction may be limited within the region.
- Constructability will be complex to start work in the median with the pylon construction, and closure of US 29 will be required to install the box girder segments in a symmetrical manner to balance loading on the cables and pylon. Pedestrian circulation around the lake perimeter and vicinity will be severely hampered for long periods of time.
- A form traveler to install the pre-cast and pre-stressed box girder segments would likely be necessary.

- Overall design, construction and Howard County administrative costs will be significantly higher than a traditional bridge design.
- Long-term maintenance costs will be higher for periodic inspections, since it is a complex bridge, and the analysis is more involved. Inspection of, and painting of cables, for example, would require workers with special rigging to access the entire structure. It is likely that inspectors would also have to enter the precast box girder to perform routine inspections.
- Demolition of the existing bridge will be required.

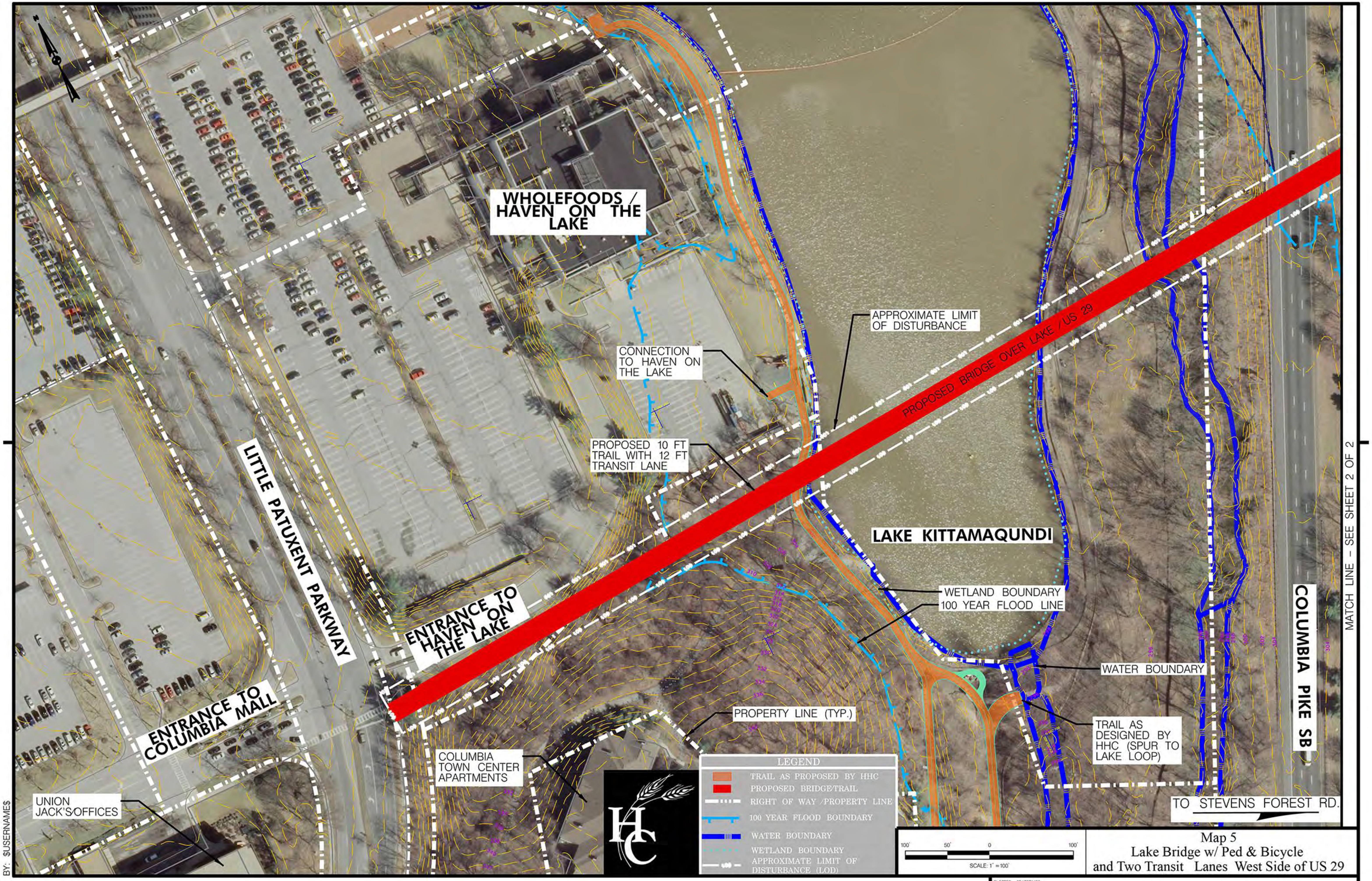
Potential Environmental Impacts: The improvements described under Option 5, Alternative A could impact approximately 2.1 acres of forest, 1.8 acres of floodplains, 1.1 acres of private properties, and approximately 1.0 acres of wetlands. No impacts to right-of-way, parkland, streams, or specimen trees are anticipated.

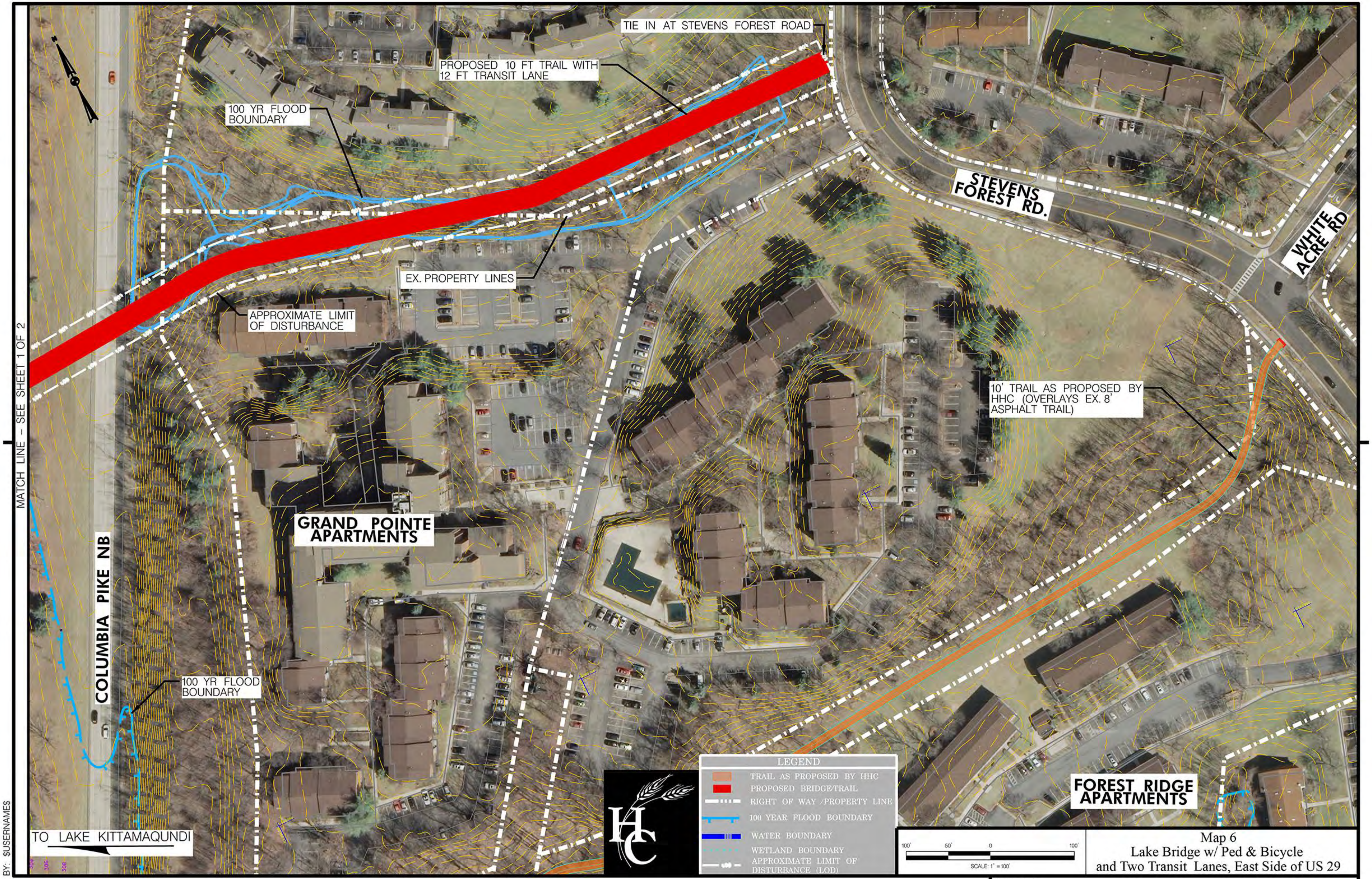
Project Estimated Cost and Timeline: The construction cost is estimated as follows.

Option Number / Description	*NEAT Cost	Eng. / Admin.	15% Inflation / 40% Contingency	Total Cost	Time
5a - Lake Bridge w/Ped-Bike-Dual Transit	$60,097,978	$36,058,787	$65,386,600	$161,543,366	9.2-years

Note: *NEAT Cost excludes engineering, HOCO administrative costs, contingencies and ROW acquisition.
Unless otherwise noted, options include retrofit of existing bridge.

Maps 5 and **6** show the location of the Lake Bridge with Pedestrian and Bicycle Accommodations and Two Transit Lanes.


WHOLEFOODS / HAVEN ON THE LAKE
APPROXIMATE LIMIT OF DISTURBANCE
CONNECTION TO HAVEN ON THE LAKE
PROPOSED BRIDGE OVER LAKE / US 29
PROPOSED 10 FT TRAIL WITH 12 FT TRANSIT LANE
LITTLE PATUXENT PARKWAY
LAKE KITTAMAQUNDI
WETLAND BOUNDARY
100 YEAR FLOOD LINE
ENTRANCE TO HAVEN ON THE LAKE
WATER BOUNDARY
ENTRANCE TO COLUMBIA MALL
PROPERTY LINE (TYP.)
TRAIL AS DESIGNED BY HHC (SPUR TO LAKE LOOP)
COLUMBIA TOWN CENTER APARTMENTS
COLUMBIA PIKE SB
MATCH LINE - SEE SHEET 2 OF 2
UNION JACK'S OFFICES
TO STEVENS FOREST RD.
LEGEND
TRAIL AS PROPOSED BY HHC
PROPOSED BRIDGE/TRAIL
RIGHT OF WAY /PROPERTY LINE
100 YEAR FLOOD BOUNDARY
WATER BOUNDARY
WETLAND BOUNDARY
APPROXIMATE LIMIT OF DISTURBANCE (LOD)
HC
100' 50' 0 100'
SCALE: 1" = 100'
Map 5
Lake Bridge w/ Ped & Bicycle
and Two Transit Lanes West Side of US 29
BY: $USERNAME$



Map 6
Lake Bridge w/ Ped & Bicycle
and Two Transit Lanes, East Side of US 29

PLOTTED: $DATETIME$
FILE: $FILE$
BY: $USERNAME$

6.8 Option 5, Alternative B: Lake Bridge with Two Transit Lanes (No Pedestrian or Bicycle Accommodations)

This option proposed a direct connection from Little Patuxent Parkway to Stevens Forest Road. As described under Option 5, Alternative A, the total distance from Little Patuxent parkway, across Lake Kittamaqundi and US 29, to Stevens Forest Road is about 2,400 ft. The span of Lake Kittamaqundi is about 600 ft.

This option assumes a new cable-stayed bridge utilizing a standard harp design to cross the lake and another to cross US 29. For the bridge deck, a single pre-cast concrete box girder, with multiple web stiffeners, is proposed in segments to support two transit lanes. Parapets would be placed on each side of deck for protection of transit vehicles. The tower foundations would be supported by piles capped with a concrete footing. This option also includes the retrofit of the existing bridge for pedestrian and bicycles as described in Option 1.

Approach spans, beyond the cable-stayed bridges, would be proposed as a continuation of the same pre-cast box girder system as described. This option and alignment will require bridging the entire distance from Little Patuxent Parkway to Stevens Forest Road due to difficult terrain to minimize or avoid floodplain and environmental impacts, and to meet ADA requirements. The clearance above the US 29 roadway to the bottom of a bridge superstructure is 16 ft., 6 in. minimum.

Opportunities for enhancing aesthetics include the following:

- Use of concrete form liners to develop a theme for the pre-cast pylon and girder.
- Colorization of the cables.
- Nighttime lighting of the cables, pylons and deck.
- Custom handrails and color themes.

Benefits of a cable-stayed bridge include the following:

- The proposed design provides a significant landmark, or gateway feature for Columbia, that would be visible to northbound and southbound motorists for a substantial distance.
- Trail and transit users would have a pleasant and safe experience in traversing the bridge.
- Nighttime lighting would also provide a landmark feature to motorists. Also, pedestrian lighting would provide for safety.
- Utilizing the alignment of the existing bridge assists in reducing environmental impacts to trees, wetlands, and the 100-year floodplain.

- The Howard County Arts Council and interested stakeholders would be involved in incorporating public art or development of the design themes for the bridge project.
- The existing bridge may remain for use with the shared-use trail connections. Impacts to the shared-use trail will be avoided.

Challenges of implementing this alternate include the following:

- Currently, there are no known cable-stayed bridges in Maryland to reference.
- Keeping pedestrians off the transit lanes will be difficult. That is, although no designated bike and pedestrian lane is identified, there will be great interest by the public in using this as a travel route.
- It may be difficult to span the lake without pier placement in the lake, further investigation will be required.
- Permitting may be difficult due to the significant potential environmental impacts.
- Contractor's experienced in building this type of structure in the region may not be readily available. Multiple contractors may be required due to the magnitude of work.
- Inspectors familiar with precast concrete and cable-stayed construction may be limited within the region.
- Constructability will be complex to start work in the median with the pylon construction, and closure of US 29 will be required to install the box girder segments in a symmetrical manner to balance loading on the cables and pylon. Pedestrian circulation around the lake perimeter and vicinity will be severely hampered for long periods of time.
- A form traveler to install the pre-cast box girder segments would likely be necessary
- Overall design, construction and Howard County administrative costs will be significantly higher than a traditional bridge design.
- Long-term maintenance costs will be higher for periodic inspections, since it is a complex bridge, and the analysis is more involved. Inspection of, and painting of cables, would require workers with special rigging to access the structure. Inspectors would also have to enter the precast box girder to perform routine inspections.

Potential Environmental Impacts: The improvements described under Option 5, Alternative B could impact approximately 2.8 acres of forest, 2.3 acres of floodplains, and approximately 1.2 acres of wetlands. No impacts to right-of-way, parkland, private properties, streams, or specimen trees are anticipated.

Project Estimated Cost and Timeline: The construction cost is estimated as follows.

Option Number / Description	*NEAT Cost	Eng. / Admin.	15% Inflation / 40% Contingency	Total Cost	Time
5b - Lake Bridge with Dual Transit	$45,439,822	$27,263,893	$49,438,527	$122,142,243	9.2-years

Note: *NEAT Cost excludes engineering, HOCO administrative costs, contingencies and ROW acquisition.
Unless otherwise noted, options include retrofit of existing bridge.

6.9 Option 6: Personal Rapid Transit (PRT)

In 1968, Columbia submitted an unsuccessful proposal to a federal grant competition to implement an alternative form of transit called Personal Rapid Transit (PRT). The proposed system would have allowed riders to board driverless cars, key in their destination and proceed nonstop along 17 miles of elevated guideways (see **Figure 24** below).

Figure 24: Columbia's Futuristic PRT System as Proposed in 1968
(Image courtesy of Columbia Archives)

Morgantown, West Virginia was the winner of that competition and subsequently constructed over 8 miles of track.

Photo 24: PRT System in Morgantown, WV

A PRT system would allow riders to board driverless cars, key in their destination and proceed nonstop along elevated guideways. Under Option 6, the PRT guideway would be one-way and would not accommodate two-way traffic. Therefore, pods will be operating in one direction at a time. If an additional guideway is desired to accommodate two-way traffic, the project costs would be significantly increased. Any future extensions of the PRT system would need to be considered as part of the local master planning process. **Figure 25** below depicts how a PRT system on an elevated guideway would be implemented along the trail corridor, with piers spaced approximately 100 ft. apart. A basic covered station along an elevated guideway would require a stairwell and elevator to meet Americans with Disabilities Act requirements.

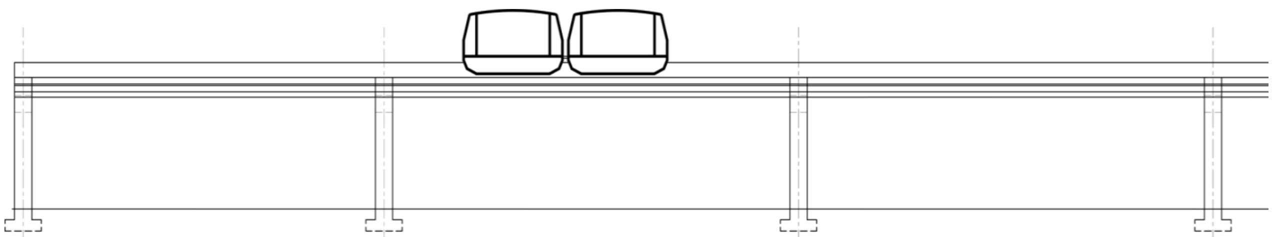


Figure 25: Conceptual Illustration of a PRT System on an Elevated Guideway

Examples of existing PRT systems around the world include:

- **South Korea Personal Rapid Transit System:** PRT is being commercially implemented on the Suncheon Bay VECTUS transit project in Suncheon Bay, South Korea (see **Photo 25** below). PRT vehicles can accommodate 6 to 8 passengers. The project is being implemented on a design, build, operate and maintain basis, and is expected to provide low noise, comfortable, and environmentally- friendly transport for three million tourists annually.

Photo 25: PRT System in Suncheon Bay, South Korea

- **ULTra (Urban Light Transit) PRT:** At Heathrow Airport in London, England, ULTra provides a series of computer-driven vehicles known as pods to provide transport for up to four passengers. The pods are rubber-tired and run on a track guideway. Small stations can be located at ground level (as shown in **Photo 26** below) or may be elevated.

Photo 26: PRT System at Heathrow Airport in London, England

Benefits of Personal Rapid Transit (PRT) include the following:

- PRT could depart on demand without any timetable.
- The system may be extended to additional stations and destinations.
- PRT offers a private trip alone or with passengers of choice. Safety is increased.
- The Howard County Arts Council and interested stakeholders would be involved in incorporating public art or development of the design themes for the project.

Challenges of implementing this alternate include the following:

- The proposed design may not provide a significant landmark, or gateway feature for Columbia.
- Initially, the flow is one-way, until a loop is established with extension of the system.
- Density of population may not provide sufficient ridership, and reduction in use of automobile may not be significant.
- Keeping individuals off the PRT structures may be difficult.

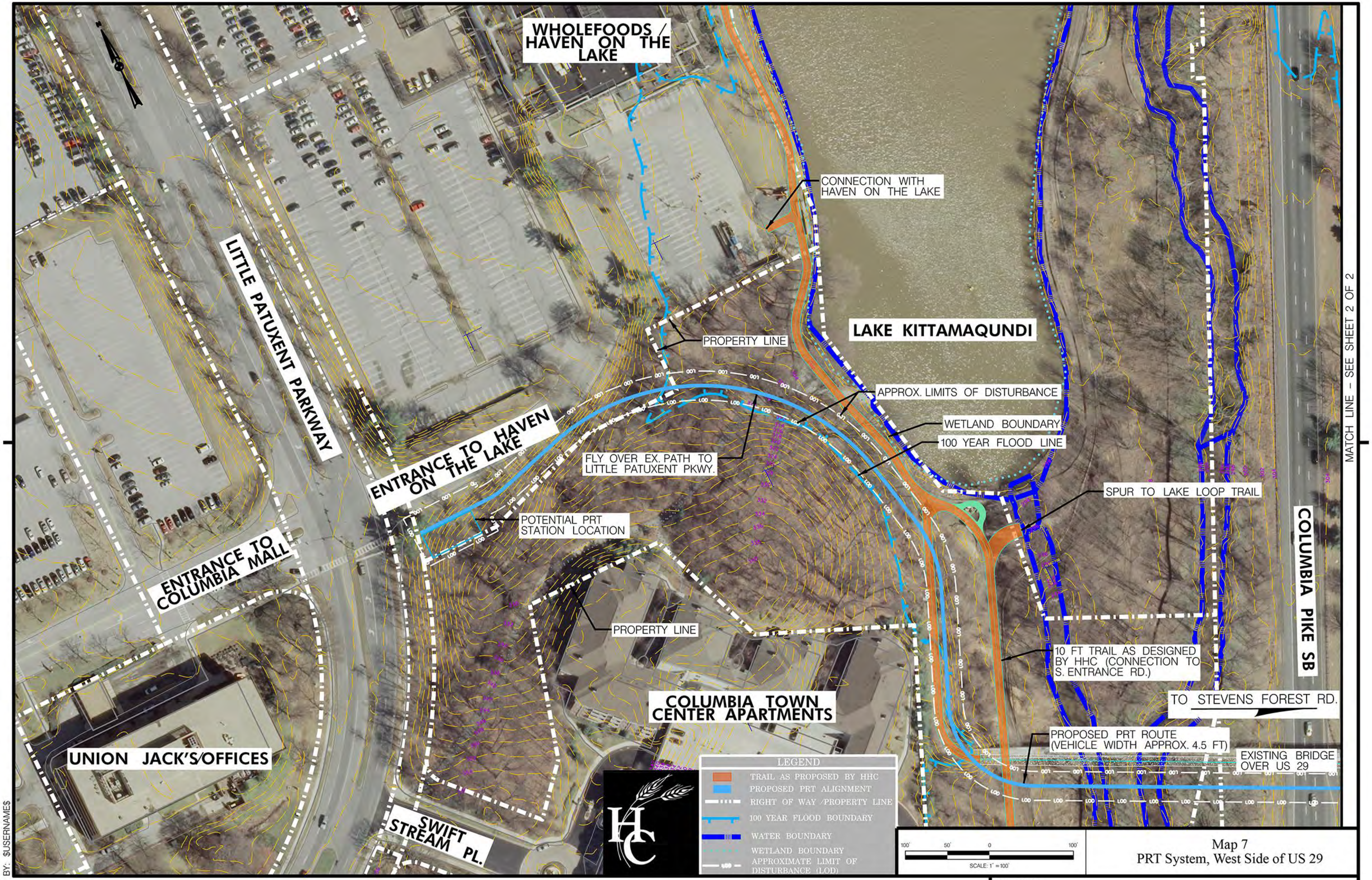
Potential Environmental Impacts: The improvements described under Option 6 could impact approximately 2.5 acres of forest, 1.0 acres of floodplains, 0.2 acres of private properties, and approximately 0.25 acres of wetlands. No impacts to right-of-way, parkland, streams, or specimen trees are anticipated.

Project Estimated Cost and Timeline: The construction cost is estimated as follows.

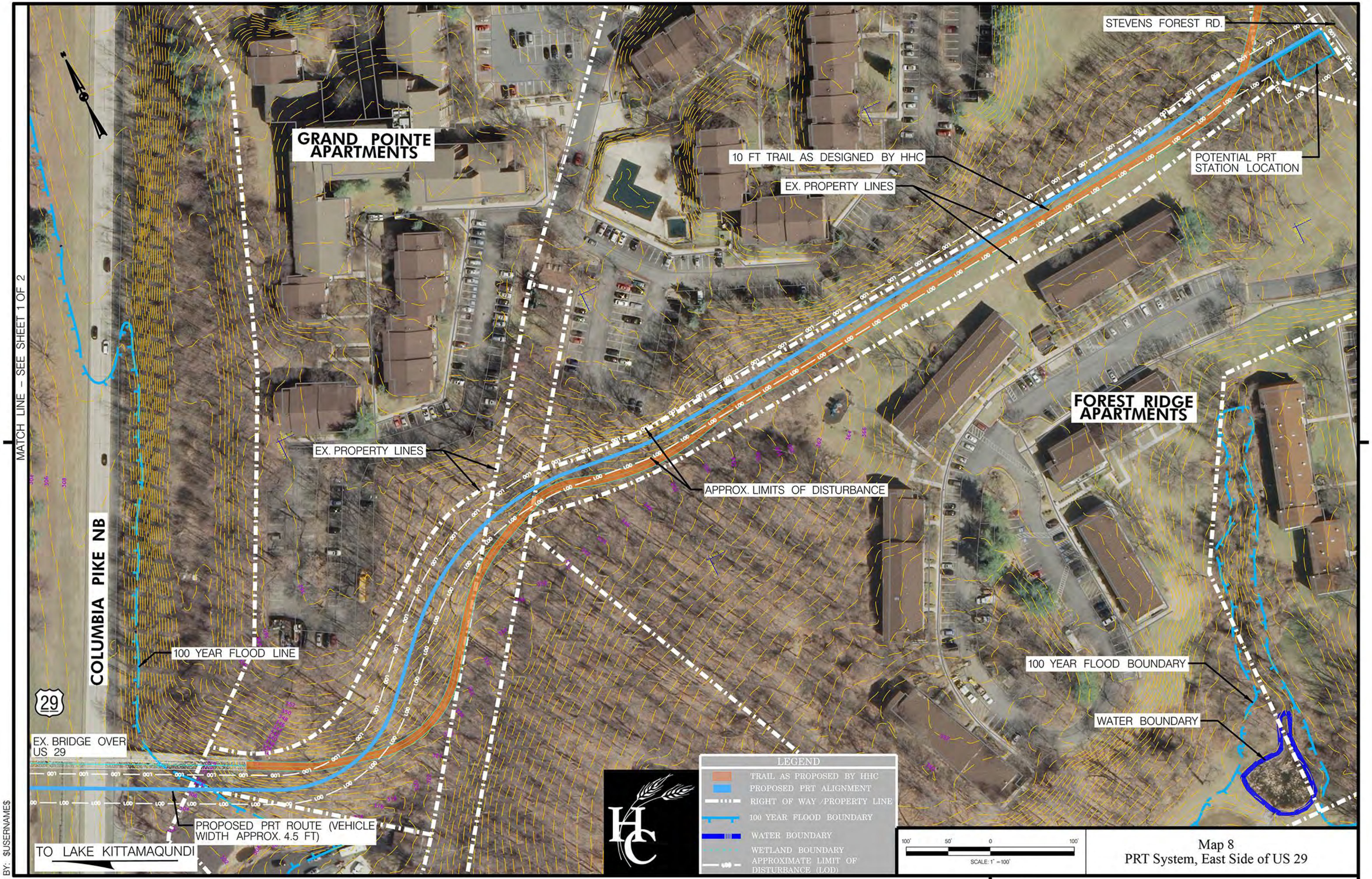
Option Number / Description	*NEAT Cost	Eng. / Admin.	15% Inflation / 40% Contingency	Total Cost	Time
6 - Personal Rapid Transit	$37,332,723	$20,532,997	$39,348,690	$97,214,409	9.2-years

Note: *NEAT Cost excludes engineering, HOCO administrative costs, contingencies and ROW acquisition.
Unless otherwise noted, options include retrofit of existing bridge.

Maps 7 and **8** show the location of the proposed PRT system over US 29.



Map 7
PRT System, West Side of US 29



Map 8
PRT System, East Side of US 29

6.10 Shared-Use Trail Options

The following sections describe potential improvement options for the shared-use trail. Pervious pavement is now used pervasively in Columbia for shared use trails for bicycle and pedestrian use, but is less often used for vehicular traffic. Given the low vehicular traffic volume anticipated and the design vehicle being a light duty transit bus or maintenance vehicle, pervious paving could be considered for this project if an option with transit is selected.

The Maryland Department of the Environment (MDE) requires approved treatment of stormwater for use of pervious pavement as well as traditional impervious pavement. Soil type and infiltration rate would need to be investigated prior to design of a pervious pavement to ensure a safe and functional pavement design.

If an impervious pavement is selected, or if infiltration rates of existing soil are insufficient, a possible approach to treat runoff for this project would be the use of bio-swales or micro-bioretention adjacent to the pavement section to safely convey stormwater. Potential methods to achieve additional treatment where feasible include promoting sheet flow to conservation areas or disconnection of non-rooftop runoff. Coordination with MDE is recommended upon design initiation in order to identify the best approach for the option selected and to ensure that all necessary permitting is determined.

Other types of Environmental Site Designs would also be considered depending on soil conditions, infiltration rates and available area to locate the facilities.

6.10.1 Trail Options on the East Side of US 29

- **Upgrade Existing East Side Trail:** this option would include any upgrades that are necessary to improve the existing shared-use trail connections to the bridge. This includes, but is not limited to, increase and/or change in the use of cameras, increase in the number of lights, removal of trees and understory vegetation, and the inclusion of call box receptacles as a few examples. The cost will vary depending on the work performed, but may range between $100,000 to $150,000.

- **Boardwalk – Option 7:** this option would include creating a boardwalk between the bridge and Stevens Forest Road. The purpose is to provide for a higher comfort level for trail visitors, especially through more densely forested areas with heavy undergrowth and to utilize Crime Prevention Through Environmental Design (CPTED) philosophy. This option would prevent individuals from accessing the boardwalk directly via dirt paths. The trail being designed by the Howard Hughes Corporation would then be utilized for transit. However, there would be a real concern over pedestrians and bicyclists avoiding the boardwalk and using the transit lane.

This may include, but is not limited to, increase and/or change in the use of cameras, relocation and number of lights, removal of trees, and the inclusion of call receptacles along the shared-use trail alignment. A boardwalk could result in impacts to 0.6 acres of forest and 0.25 acres of wetlands. No impacts to right-of-way, floodplains, parkland, private properties, streams or specimen trees are anticipated.

Project Estimated Cost and Timeline: The construction cost is estimated as follows.

Option Number / Description	*NEAT Cost	Eng. / Admin.	15% Inflation / 40% Contingency	Total Cost	Time
7– Raised Boardwalk– East Side	$766,050	$306,420	$654,207	$1,726,677	2.5-years

Note: *NEAT Cost excludes engineering, HOCO administrative costs, contingencies and ROW acquisition.

Figures 26 and **27** illustrate what a boardwalk in this area could look like, and **Photos 27** and **28** show examples of existing boardwalks.

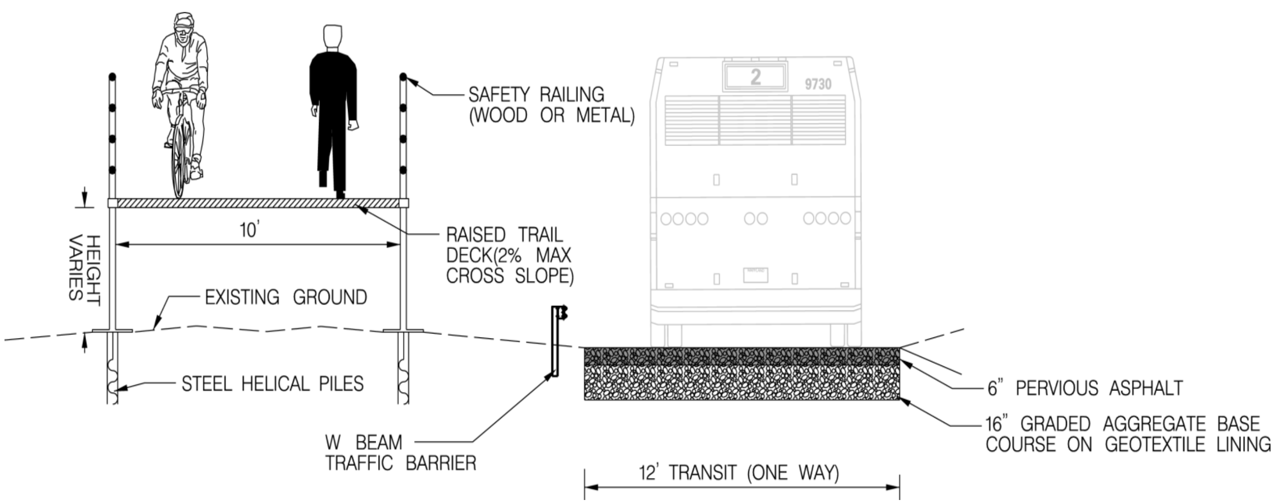


Figure 26: Typical Section of Boardwalk and Transit

Figure 27: Typical Boardwalk Construction

Photo 27: Boardwalk in Montgomery County on Matthew Henson Trail

Photo 28: Boardwalk Using Helical Piles

- **Single Lane Transit:** With a bridge option providing a single lane of transit, the East Side shared-use trail being designed by Howard Hughes Corporation will be impacted to some degree. The planned trail improvements closely follow the trail alignment that exists today. To add a single lane of transit (about 1,825 ft. in length from the bridge to Steven's Forest Road) will require either widening the trail pavement section or reconfiguring the alignment completely and planning for a new shared-use trail with a transit lane as needed. This will be most likely required to balance out the alignment of the new pavement horizontally to better minimize forest, wetland, and other environmental impacts. Two to three pull-offs for oncoming transit vehicles to pass would be located where available right-of-way will allow. Locations fronting the residential housing would be avoided, unless stakeholders agree that a transit stop is desired. Approximately 2.5 to 3.5 acres of forest may be impacted by implementing the transit lane, along with approximately 0.25 acres of wetland impact. Construction of walls may reduce the impacts slightly, but would need to be investigated at the time of design to determine the benefit.

  Estimated Cost: Adding a single lane of transit would cost approximately $150,000, without impact to the planned shared-use trail. Reconstructing the entire alignment for a shared-use trail and transit lane would increase the cost to $225,000. Since the planned shared-use trail utilizes pervious pavement that also serves as the stormwater management and water quality feature, replacement water quality features would also have to be designed and constructed assuming pervious pavement cannot be utilized for the transit lane due to loading.

- **Double Lane Transit:** With a bridge option providing double lanes of transit, the planned East Side shared-use trail being designed by Howard Hughes Corporation will be significantly impacted. To add a double lane for transit (about 1,200 ft. from the bridge to Little Patuxent Parkway) will require widening the shared-use trail pavement section or reconfiguring the alignment completely to plan for a new shared-use trail with two transit lanes. This will be required to balance the alignment to minimize forest, wetland, and other environmental impacts. No pull-offs for oncoming transit vehicles would be needed in this alternative. Approximately 4.0 to 5.0 acres of forest may be impacted to implement the double transit lanes, along with about 0.3 acres of wetland impacts. Construction of walls may reduce the impacts slightly, but would need to be investigated at the time of design to determine the benefit.

  Estimated Cost: Adding a double lane for transit would cost approximately $245,000. Since the planned shared-use trail utilizes pervious pavement that also serves as the stormwater management and water quality feature, replacement water quality features would also have to be designed and constructed assuming pervious pavement cannot be utilized for the transit lane due to loading.

6.10.2 Trail Options on the West Side of US 29

- **Upgrade Existing West Side Trail:** this option would include any upgrades that are necessary to improve the existing shared-use trail connections to the bridge. This includes, but is not limited to, increase and/or change in the use of cameras, increase in the number of lights, removal of trees and understory vegetation, and the inclusion of call box receptacles as a few examples.

  Estimated Cost: The cost will vary depending on the work performed, but may range between $85,000 to $125,000.

- **Single Lane Transit:** With a bridge option providing a single lane of transit, the West Side shared-use trail being designed by Howard Hughes Corporation will be impacted. The planned trail closely follows the trail alignment that exists today. To add a single lane of transit (about 1,200 ft. from the bridge to Little Patuxent Parkway) will require widening to the shared-use trail pavement section or reconfiguring the alignment completely to plan for a new shared-use trail with a transit lane. This will most likely be required to balance out the alignment of the new pavement horizontally to better minimize forest, wetland, and other environmental impacts. One or two pull-offs for oncoming transit vehicles to pass would be located where space will allow. Approximately 1.0 to 2.5 acres of forest will be impacted to implement the transit lane, along with about 0.25 acres of wetland impacts and 2.0 acres of floodplain impact. Construction of walls may reduce the impacts slightly, but would need to be investigated at the time of design to determine the benefit. The connection to Little Patuxent Parkway will be difficult, especially to meet ADA slope requirements, because of the elevation differential from the Little Patuxent Parkway to the lakeside (approximately 48 vertical feet).

Estimated Cost: Adding a single lane of transit would cost approximately $210,000. Since the shared-use trail currently being designed by Howard Hughes Corporation utilizes pervious pavement which also serves as the stormwater management and water quality feature, replacement water quality features would also have to be designed and constructed assuming pervious pavement cannot be utilized for the transit lane due to loading.

- **Double Lane Transit:** With a bridge option providing double lanes of transit, the West Side shared-use trail being designed by Howard Hughes Corporation will be completely impacted. To add two transit lanes (about 1,825 ft. in length from the bridge to Steven's Forest Road) will require reconfiguring the entire shared-use trail alignment to plan for a new shared-used trail with transit lanes as needed. This will be required to balance the alignment to minimize forest, wetland, and other environmental impacts. No pull-offs for oncoming transit vehicles would be needed in this alternative. Approximately 1.5 to 2.0 acres of forest may be impacted to implement the double transit lanes, along with about 0.5 acres of wetland impact. Construction of walls may reduce the impacts slightly, but would need to be investigated at the time of design to determine the benefit.

  Estimated Cost: Adding two transit lanes would cost approximately $175,000. Since the planned shared-use trail utilizes pervious pavement which also serves as the stormwater management and water quality feature, replacement water quality features would also have to be designed and constructed assuming pervious pavement cannot be utilized for the transit lane due to loading.

7. POTENTIAL FUNDING SOURCES

As part of this study, the team researched potential federal, state, and county funding sources that could support the proposed improvement options. Several potential funding sources were identified, and are discussed in the sections below.

7.1 Transportation Alternatives Program

As part of the Federal Highway Administration Surface Transportation Program, the Transportation Alternatives Program (TAP) is a reimbursable, federal aid funding program for transportation-related community projects designed to strengthen the intermodal transportation system. It provides funding for projects that enhance the cultural, aesthetic, historic, and environmental aspects of the intermodal transportation system. The program can assist in funding projects that create bicycle and pedestrian facilities, restore historic transportation buildings, convert abandoned railway corridors to pedestrian trails, mitigate highway runoff, and other transportation related enhancements

7.2 Grants

The Transportation Investment Generating Economic Recovery, or TIGER Discretionary Grant program, provides a unique opportunity for the U.S. Department of Transportation to invest in road, rail, transit and port projects that promise to achieve critical national objectives. Congress dedicated more than $4.1 billion to the program: $1.5 billion for TIGER I, $600 million for TIGER II, $526.944 million for FY 2011, $500 million for FY 2012, $473.847 million for FY2013, and $600 million for the FY 2014 round of TIGER Grants to fund projects that have a significant impact on the Nation, a region or a metropolitan area.

7.3 General Obligation Bonds

General Obligation Bonds or “GO” Bonds are municipal bonds or metropolitan district bonds issued to a municipality or county with the understanding that the municipality or county will be able to repay the debt through taxation or by revenue generated from projects. The municipality or county does not have to use any of their own assets as collateral.

7.4 General Funds

General funds are those generated from various payments to the County, such as property taxes and the sale of county-owned property. Although general funds are typically reserved as part of the County’s operating budget, there is a percentage of those revenues that is allocated towards the capital program each year.

7.5 Highway User Revenue (Formerly Motor Vehicle Revenue)

Highway User Revenue (HUR) is a formula-based revenue source provided by the State of Maryland to the counties, cities and municipalities. Many counties have seen significant decreases in HUR funds since the economic downturn. HUR funds have very strict usage eligibility. Projects eligible to use HUR funds include projects that help to maintain local roads or bridges.

7.6 Congestion Mitigation and Air Quality (CMAQ) Improvement Program

The Congestion Mitigation and Air Quality (CMAQ) Improvement Program was implemented to support surface transportation projects and other related efforts that contribute air quality improvements and provide congestion relief. CMAQ funds must be spent in regions that do not meet national air quality standards for ozone and carbon monoxide levels ("non-attainment" areas) or have recently become compliant ("maintenance" areas). There are seven major categories for eligible CMAQ projects including Traffic Flow Improvements, Transit, Demand Management, Interstate Maintenance, Bike/Pedestrian, Shared Ride, and STP/CMAQ. CMAQ funds have been used on a variety of capital projects including bike paths, bike lanes, bike racks but have also been used to produce marketing materials, public education and outreach and development of safety programs.

7.7 TIFIA

The Transportation Infrastructure Finance and Innovation Act (TIFIA) program was authorized in 1998 and provides Federal credit assistance with fixed rates to nationally or regionally significant surface transportation projects including highway, transit and rail. The program is designed to fill market gaps and leverage substantial private co-investment by providing projects with supplemental or subordinate debt. Eligible projects using TIFIA Funds that could be relevant include:

- Transit
- Highways
- Intelligent Transportation Systems (ITS)
- Projects eligible for assistance under title 23 or chapter 53 of title 49

8. OPTIONS NOT RETAINED FOR FURTHER STUDY

8.1 Widen Existing Bridge via Deck Replacement

Preliminary analysis indicates that the existing bridge deck could be removed and replaced with a new deck to provide an additional 2' of inside clearance. This would increase the clear distance between the parapets of the bridge from a 10 ft. horizontal clearance to a 12 ft. horizontal clearance, with a maximum 14 ft. outside bridge width. This would allow the bridge to comfortably accommodate an H-20 vehicle (40,000) pounds, but would not provide sufficient clearance for simultaneous transit, bicycle, and pedestrian usage and separation.

The steel box beam could also be replaced with a larger box beam or steel girders to achieve a horizontal clearance of 18 ft. or more, but this would require a number of other upgrades to the structure including additional pier support. These changes would result in a bridge with a very non-traditional appearance that may not be desirable and may generate difficulties in securing approvals from Maryland State Highway Administration (SHA) or funding agencies. Therefore, it was determined that widening the existing bridge via deck replacement is not a feasible improvement option.

8.2 Widen Existing Bridge to Provide Dual-Lane Transit

The addition of two complementary bridge sections adjacent to the existing bridge to provide for dual-lane transit (as shown in Figure 4) was considered. The approval process with SHA would likely yield negative support of this approach since it does not represent the best engineering solution. It is anticipated that the solution would be better achieved by demolishing the existing bridge structure and replacing the crossing with a new bridge integrated with the capabilities to handle the anticipated transit usage and the pedestrian and bicycle shared-use trail.

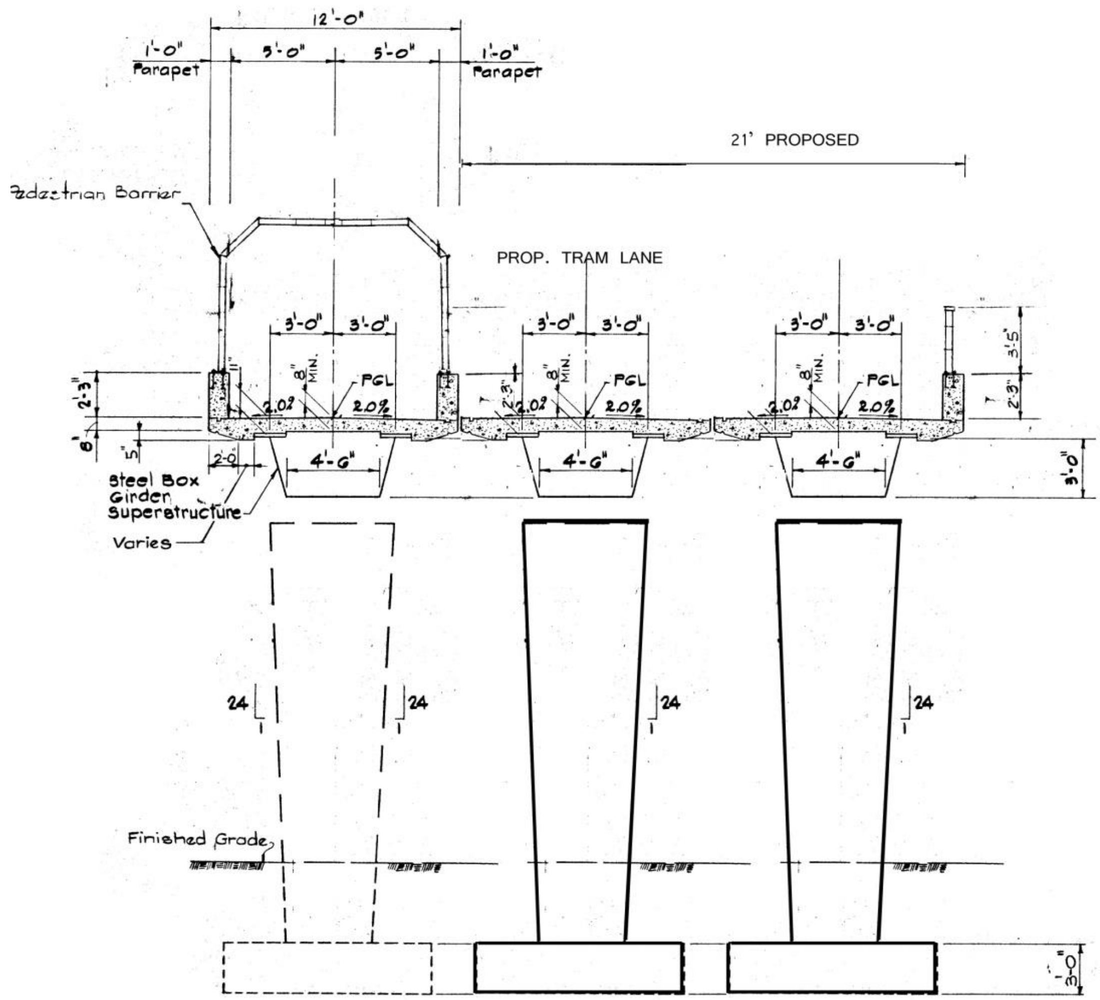


Figure 4: Dual-Lane Transit Added to Existing Bridge

Approaches: Related trail approaches on each side of the bridge would require a wide, 35 ft. minimum, paving section (see Figure 5). This would require a wider limit of disturbance, additional property acquisition, and more environmental impact.

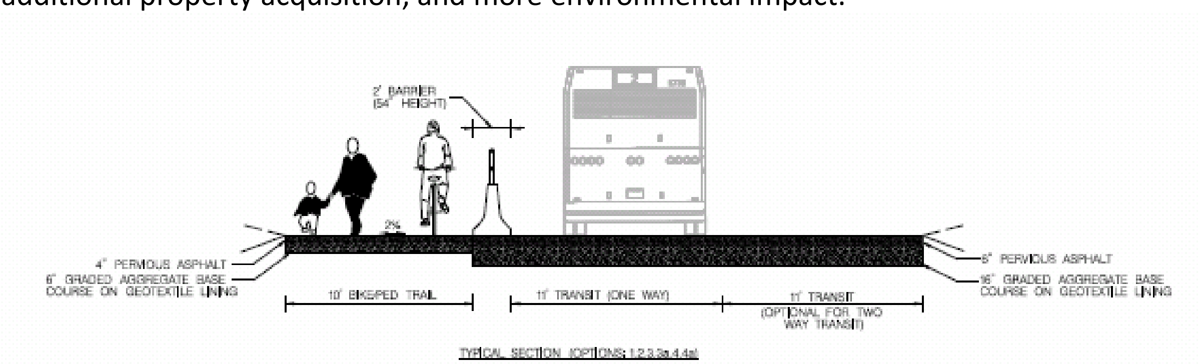


Figure 5: Connection of Dual-Lane Transit Bridge with Pedestrian/Bicycle Accommodations to Shared-Use Trail

8.3 Two-Level Bridge and Faux Cable-Stayed Bridge

The concept of a two-level (stacked) bridge was considered, with the first level providing a transit bridge and a second level providing a pedestrian and bicycle bridge. It was determined that providing approach ramps and steps with elevators to the second level would be problematic. Additional property acquisition would also be needed, and higher-cost, long-term maintenance issues would be anticipated. Securing approvals from SHA or funding agencies would be difficult, and it would be very difficult to justify this approach.

The concept of adding a faux tower and cable system attached to the existing structure was analyzed. A faux system would attempt to mimic the desired aesthetic and iconic treatments without providing any structural capabilities. This was dismissed because of wind loading and structural issues, along with concerns over anticipated difficulties with the approval process.

8.4 Widen Existing Bridge by Use of Cable-Stayed Structure

This creative alternative approach, with the concept provided by a local stakeholder, involves widening of the bridge by constructing a type of cable-stayed bridge allowing for a pedestrian path to be added to one side of the existing structure and a bicycle path on the other (See Figures 6 and 7). It should be noted that the existing superstructure is a single steel box beam, not three steel girders as depicted in Figure 6.

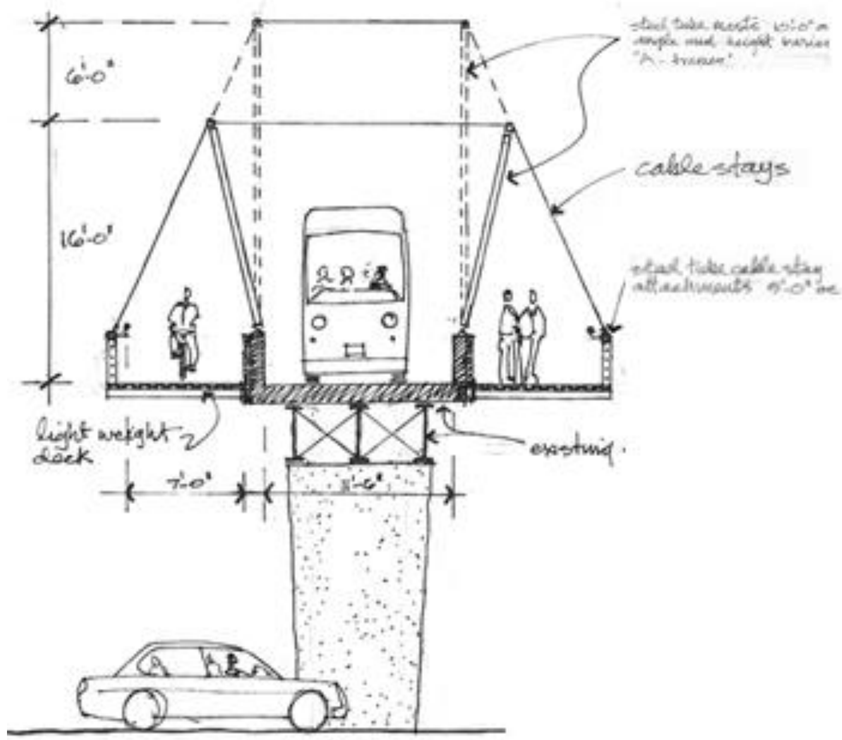


Figure 6: Typical Section, Widening Existing Bridge by Use of Cable-Stayed Structure

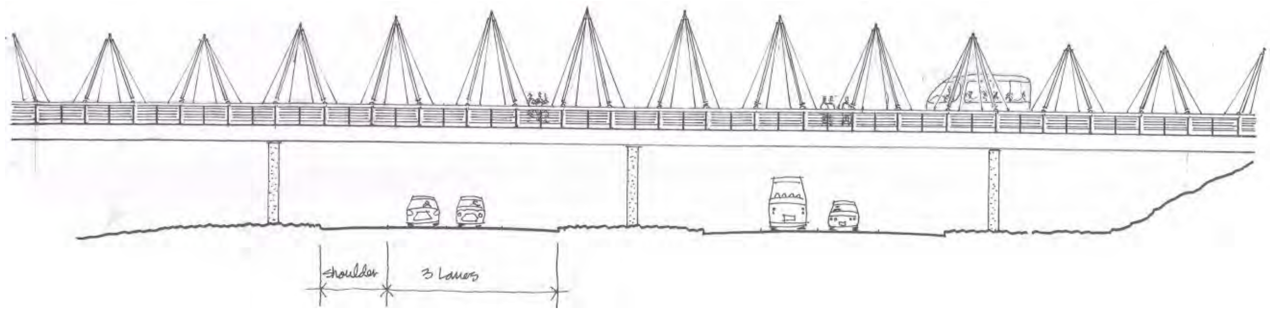


Figure 7: Elevation View, Widening Existing Bridge by Use of Cable-Stayed Structure

Preliminary analysis of the existing structure in its current configuration shows the bridge has adequate capacity to support transit vehicles, but a more in-depth analysis would be necessary to determine if the existing structure can support the additional weight of the pedestrian/bicyclist paths, the cable stays and attachments, and the additional loads due to greater bicycle and pedestrian traffic. The design must conform to AASHTO standards which would require simultaneous application of the transit vehicle load and a full pedestrian load to be applied to both paths. This would be a significantly heavier load than the existing structure carries. The existing structure can accommodate pedestrian load or transit load separately with pedestrian only loading governing. Torsional and overturning issues can develop if only one side of the overhang is loaded. Issues may also arise in the pier column and foundation due to unbalanced loading. The existing structure is near capacity as-is with a full pedestrian load applied, therefore without an in-depth analysis, it is believed that the existing structure does not have the adequate capacity to support the additional dead load of the cable structure and the full pedestrian load on both sides of the existing deck. In addition to structural concerns, the time required to inspect the structure would increase due to the additional cable stays and connections. Further, the long-term maintenance requirements will also increase.

As noted earlier in this report, the clear distance between the parapets of the bridge is 10.0 ft. Though it appears that an H-10 vehicle will fit, this tight squeeze over a relatively long distance could cause both drivers and riders of the transit vehicle to feel uneasy. The narrow clearance between the sides of the transit vehicle and the barrier fence could also pose a risk to passengers putting their hands or other objects out the transit vehicle windows.

The study team ultimately determined that this option should not be retained for further study because the governing load case (pedestrian loading on the full deck) approaches the capacity of the steel box girder. The additional load due to adding sidewalks on either side of the existing deck, and considering pedestrian loading simultaneously with transit vehicle loads would likely overload the structure. Additionally, the 10-foot clear width between the parapets is too narrow to comfortably accommodate transit vehicles.

8.5 Gondola System

A link was provided during the study for Brooklyn, New York's East River Skyway proposal for a multi-phase urban gondola to connect the growing residential and commercial corridors in the city's waterfront areas.

Otherwise known as an aerial transit or "rope" system, such a system would consist of multiple gondola cars riding on a cable strung high above the trees on each side of US 29. The cost of a gondola system is roughly estimated at $10 million to $12 million per mile.

A gondola system would likely have fewer environmental impacts than typical road construction, could be continuously monitored via computer and equipped with backup generators in case of power outages, could be implemented in a phased fashion as project funds become available, and has the potential to increase tourism.

However, the team determined this option should not be retained for further study for several reasons. Safety considerations are a key consideration, and it could be difficult to reach gondola passengers in the event of an emergency, and high winds or icy conditions could hinder the ability to operate the system. Elevators may also be required to provide accessibility in compliance with the Americans With Disabilities Act, which would increase the project cost. Gondola systems are typically used in mountainous terrain for recreational use, so this would be a non-standard application of the technology. Claustrophobia and acrophobia would be a real concern for some users, which would require them to seek alternate transit options, and the visual impacts of the system may be a concern to residents, preservationists and neighbors. Finally, there are very few gondola systems operating in the United States, and the project would require a specialty firm for the design which would likely increase project costs.

9. SUMMARY OF OPTIONS AND NEXT STEPS

Tables 1 and **2** below summarize the characteristics of each of the bridge and shared-use trail options discussed in this report. While this study does not provide any recommendations, it should be clear that there are two primary choices that can be made: renovate the existing bridge to improve the pedestrian and bicycle experience within a relatively short period of time or construct a second bridge (or Personal Rapid Transit) that will provide transit connectivity between Downtown Columbia and Oakland Mills that could take a decade or more to complete.

Table 1: Summary of Bridge Options

	BRIDGE OPTIONS								
	Option 1: Retrofit Existing Bridge	**Option 2: Retrofit w/Single Lane Transit**	**Option 3A: Cable-Stayed Bridge w/1 Transit Lane**	**Option 3B: Cable-Stayed Bridge w/2 Transit Lanes**	**Option 4A: Iconic Bridge w/1 Transit Lane**	**Option 4B: Iconic Bridge w/2 Transit Lanes**	**Option 5A: Lake Bridge w/Ped, Bike & 2 Transit Lanes**	**Option 5B: Lake Bridge w/2 Transit Lanes (no ped or bike)**	**Option 6: PRT**
Environmental Impacts									
Right-of-Way	0	0	0	0	0	0	0	0	0
Forest	0	238,200 SF / 5.5 AC.	250,000 SF / 5.7 AC.	325,000 SF / 7.4 AC.	238,200 SF / 5.5 AC.	309,660 SF / 7.1 AC	92,970 SF / 2.1 AC.	120,861 SF / 2.8 AC	108,420 SF / 2.5 AC.
Floodplain	0	88,200 SF / 2 AC.	92,000 SF / 2.1 AC.	119,600 SF / 2.7 AC.	88,200 SF / 2.1 AC.	114,660 SF / 2.6 AC.	77,330 SF/ 1.8 AC.	100,529	43,640 SF / 1.0 AC.
Parkland	0	0	0	0	0	0	0	0	0
Properties Affected	0	51,500 SF/ 1.2 AC.	55,000 SF 1.3 AC.	71,500 SF / 1.6 AC.	51,500 SF / 1.2 AC.	66,950 SF / 1.5 AC.	46,470 SF / 1.1 AC.	0	5,890 SF / .2 AC.
Wetlands	0	0.5 AC.	0.75	0.8	0.5 AC.	0.7 AC.	1.0 AC.	1.2 AC.	0.25 AC.
Streams	0	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Specimen Trees	0	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Implementation Timeline	2.5 years	7.5 years	9-10 years	9-10 years	9-10 years	9-10 years	9-10 years	9-10 years	9-10 years
Total Cost	$2.1 Million	$17.4 Million	$34.1 Million	$38.4 Million	$36.5 Million	$47.5 Million	$161.6 Million	$122.2 Million	$97.2 Million

Table 2: Summary of Shared-Use Trail Options

	EAST SIDE				WEST SIDE		
	Upgrade Existing with new HHC pathway	**Boardwalk**	**Single Lane Transit (with site work/ no bridge)**	**Double Lane Transit (with site work/ no bridge)**	**Upgrade Existing with new HHC pathway**	**Single Lane Transit (with site work / no bridge)**	**Double Lane Transit (with site work/ no bridge)**
Environmental Impacts	Currently in review process				Currently In review process		
Right-of-Way		0	TBD	TBD		TBD	TBD
Forest		5.5 AC.	3.5 AC.	5.0 AC.		2.5 AC.	2.0 AC
Floodplain		2 AC.	TBD	TBD		2.0 AC.	TBD
Parkland		0	TBD	TBD		TBD	TBD
Properties Affected		1.2 AC.	TBD	TBD		TBD	TBD
Wetlands		0.5 AC.	0.25 AC	0.3 AC		0.25 AC.	0.5 AC
Streams		TBD	TBD	TBD		TBD	TBD
Specimen Trees		TBD	TBD	TBD		TBD	TBD
Implementation Timeline		2.5 years	TBD	TBD		TBD	TBD
Total Cost		$1.7 million	$14.5 million	$10.4 million		$1.5 million	$2.1 million

Appendix A
Cost Estimates

Option Number / Description
1 - Retrofit Existing Bridge
2 - Complementary Bridge w/Single Transit
3a - Cable Stayed w/Single Transit
3b - Cable Stayed w/Dual Transit
4a - Iconic Bridge w/Single Transit
4b - Iconic Bridge w/Dual Transit
5a - Lake Bridge w/Ped-Bike-Dual Transit
5b - Lake Bridge with Dual Transit
6 - Personal Rapid Transit

DOWNTOWN COLUMBIA BRIDGE FEASIBILITY STUDY
Cost Estimate

November 14, 2014

Option 1 - Retrofit Existing Bridge ***3,629 LF from LPP to SFR***	**OPTION 1** **RETROFIT EXISTING BRIDGE**			
Length of bridge: 679 LF	Units	Quantity	Unit Cost	Cost
Category 1: Preliminary				
Preliminary (40% of Categories 2, 4, 5 and 6) Includes Mobilization, Maintenance of Traffic (including vehicular and pedestrian)	LS	1	$229,912	$229,912
TOTAL				**$229,912**
Category 2: Grading				
TOTAL				**$0**
Category 3: Drainage				
Drainage and Stormwater Management				$0
TOTAL				**$0**
Category 4: Structures				
Retrofit existing bridge with fabricated steel cage	LF	679	$600	$407,400
Paint steel box beam (includes cleaning and painting outside parapet)	LF	679	$100	$67,900
Deck Artistic Treatment	SF	6790	$12	$81,480
Demolition of Existing Barrier Fencing	LS	1	$18,000	$18,000
TOTAL				**$574,780**
Category 5: Paving				
				$0
TOTAL				**$0**
Category 6: Shoulders				
				$0
TOTAL				**$0**
Category 7: Landscaping				
Selective vegetative clearing and tree pruning along trail connections east and west sides	LS	1	$30,000	$30,000
TOTAL				**$30,000**
Category 8: Traffic				
				$0
TOTAL				**$0**
Category 9: Utilities				$0
Lighting for steel cage (no trail lighting)	LS	1	$80,000	$80,000
TOTAL				**$80,000**
TOTAL NEAT CONSTRUCTION COST			**SUBTOTAL**	**$914,692**
Engineering (20%)				$182,938.40
HOCO Construction Administrative Costs (20%)				$182,938.40
TOTAL ENGINEERING AND ADMINISTRATIVE COSTS			**SUBTOTAL**	**$365,876.80**
Right-of-Way (not included)				$0
			TOTAL	**$1,280,569**
15% INFLATION FOR 2017				$192,085.32
40% CONTINGENCY				$589,061.65
			TOTAL COST	**$2,061,716**

DOWNTOWN COLUMBIA BRIDGE FEASIBILITY STUDY

Cost Estimate

November 14, 2014

3,629 LF - Length of trail from LPP to SFR

	OPTION 2								
	RETROFIT EXISTING BRIDGE				**COMPLEMENTARY SINGLE LANE MULTI-SPAN STEEL GIRDER BRIDGE**				**TOTAL OPTION 2**
Length of existing / new bridge: 679 LF	Units	Quantity	Unit Cost	Cost	Units	Quantity	Unit Cost	Cost	Cost
Category 1: Preliminary									
Preliminary (40% of Categories 2, 4, 5 and 6) Includes Mobilization, Maintenance of Traffic (including vehicular and pedestrian)	LS	1	$222,712	$222,712	LS	1	$1,630,450	$1,630,450	$1,853,162
TOTAL				**$222,712**				**$1,630,450**	**$1,853,162**
									$0
Category 2: Grading									$0
Class 1 Excavation				$0	CY	5,000	$50	$250,000	$250,000
Borrow				$0	CY	2,500	$65	$162,500	$162,500
TOTAL				**$0**				**$412,500**	**$412,500**
									$0
Category 3: Drainage									$0
Drainage				$0	LS	1	$35,000	$35,000	$35,000
Stormwater Management (BMP's)				$0	LM	1	$50,000	$50,000	$50,000
Erosion and Sediment Control				$0	LS	1	$163,045	$163,045	$163,045
TOTAL				**$0**				**$248,045**	**$248,045**
									$0
Category 4: Structures									$0
Existing Bridge: retrofit with fabricated steel cage from Option 1	LF	679	$600	$407,400					$407,400
Existing bridge: Paint steel box beam (includes cleaning and painting outside parapet)	LF	679	$100	$67,900				$0	$67,900
Existing Bridge: Deck Artistic Treatment	SF	6,790	$12	$81,480				$0	$81,480
New complementary single lane transit bridge 679 LF bridge. 14' width, including parapet.					SF	9,506	$275	$2,614,150	$2,614,150
Retaining Walls				$0	LF	1000	$450	$450,000	$450,000
TOTAL				**$556,780**				**$3,064,150**	**$3,620,930**
Category 5: Paving									
Single Transit Lane -use HOCO Std. Paving Section P-3									
HMA Superpave Final Surface 9.5 mm - 1.5"					TON	400	$107	$42,800	$42,800
HMA Superpave Intermediate Surface 9.5 mm - 1.0"					TON	300	$107	$32,100	$32,100
HMA Superpave Base 19.0 mm- 3.0"					TON	775	$95	$73,625	$73,625
Graded Aggregate Base - 10"					SY	5100	$12	$61,200	$61,200
TOTAL								**$209,725**	**$209,725**
									$0
Category 6: Shoulders									**$0**
Curb and Gutter				$0	LF	250	$25	$6,250	$6,250
34" Concrete Traffic Barrier F shape, single face, Conc. Footing					LF	2,950	$130	$383,500	$383,500
TOTAL				**$0**			$5,000	**$389,750**	**$409,750**
Category 7: Landscaping									**$20,000**
Selective vegetative clearing and tree pruning along trail connections east and west sides	LS	1	$20,000	$20,000	LS	1	$50,000	$50,000	$70,000
Forest Mitigation					AC	5.5	$33,000	$181,500	$181,500
Wetland Mitigation					AC	0.5	$55,000	$27,500	$27,500
TOTAL				**$20,000**				**$259,000**	**$259,000**
Category 8: Traffic									
Local Roadway Marking				$0	MILE				$0
TOTAL				**$0**				**$0**	**$0**
Category 9: Utilities									
Existing Bridge: Lighting for steel cage	LS	1	$80,000	$80,000					$80,000
Lighting for new bridge					LS	1	$125,000	$125,000	$125,000
Trail Lighting to Supplement Existing Lighting by Others					LS	1	$275,000	$275,000	$275,000
TOTAL				**$80,000**				**$400,000**	**$480,000**
TOTAL NEAT CONSTRUCTION COST								**NEAT TOTAL**	**$7,513,112**
Engineering (20%)									$1,502,622.40
HOCO Construction Administrative Costs (20%)									$1,502,622.40
TOTAL ENGINEERING AND ADMINISTRATIVE COSTS								**SUBTOTAL**	**$10,518,357**
Right-of-Way (not included)									$0
								TOTAL	**$10,518,357**
18% INFLATION FOR 2021									$1,893,304.22
40% CONTINGENCY									$4,964,664.41
								TOTAL COST	**$17,376,325**

DOWNTOWN COLUMBIA BRIDGE FEASIBILITY STUDY

Cost Estimate

November 13, 2014

	OPTION 3A CABLE-STAYED BRIDGE WITH <u>SINGLE</u> TRANSIT LANE PRECAST CONCRETE, 110' HT. TOWER				OPTION 3B CABLE-STAYED BRIDGE WITH <u>DUAL</u> TRANSIT LANE PRECAST CONCRETE, 110' HT. TOWER			
	Units	Quantity	Unit Cost	Cost	Units	Quantity	Unit Cost	Cost
Category 1: Preliminary								
Preliminary (40% of Categories 2, 4, 5 and 6) Includes Mobilization, Maintenance of Traffic (including vehicular and pedestrian)	LS	1	$3,202,904	$3,202,904	LS	1	$400,000	$400,000
Demolition of existing bridge	LS	1	$450,000	$450,000	LS	1	$450,000	$450,000
TOTAL				**$3,652,904**				**$850,000**
Category 2: Grading								
Class 1 Excavation	CY	5,000	$48	$240,000	CY	7,500	$48	$360,000
Borrow	CY	1,000	$63	$63,000	CY	2,500	$63	$157,500
TOTAL				**$303,000**				**$517,500**
Category 3: Drainage								
Drainage	LS	1	$12,000	$12,000	LS	1	$25,000	$25,000
Traditional SWM (BMP's)	LM	0.50	$50,000	$25,000	LM	0.50	$90,000	$45,000
Erosion and Sediment Control	LS	1.00	$320,290	$320,290	LS	1	$484,090.72	$484,091
TOTAL				**$357,290**				**$554,091**
Category 4: Structures								
OPTION 3A CABLE-STAYED BRIDGE WITH SINGLE TRANSIT LANE PRECAST CONCRETE, 32' WIDTH DECK; 110' HT. TOWER	SF	21730	$350	$6,840,925				
OPTION 3B CABLE-STAYED BRIDGE WITH DUAL TRANSIT LANE PRECAST CONCRETE; 44' WIDTH DECK; 110' HT. TOWER					SF	29876	$350	$10,456,600
Retaining Walls	LF	800	$400	$320,000	LF	920	$400	$368,000
TOTAL				**$7,160,925**				**$10,824,600**
Category 5: Paving								
Transit Lane(s) -use HOCO Std. Paving Section P-3								
HMA Superpave Final Surface 9.5 mm - 1.5"	TON	382	$107	$40,874	TON	764	$107	$81,748
HMA Superpave Intermediate Surface 9.5 mm - 1.0"	TON	255	$107	$27,285	TON	510	$107	$54,570
HMA Superpave Base 19.0 mm- 3.0"	TON	765	$95	$72,675	TON	1530	$95	$145,350
Graded Aggregate Base - 10"	SY	5000	$12	$60,000	SY	10000	$12	$120,000
TOTAL				**$200,834**				**$401,668**
Category 6: Shoulders								
Curb and Gutter	LF	200	$25	$5,000	LF	300	$25	$7,500
Concrete Traffic Separation Barrier	LF	2,500	$135	$337,500	LF	2,600	$135	$351,000
TOTAL				**$342,500**				**$358,500**
Category 7: Landscaping								
Landscaping	LS	1	$20,000	$20,000	LS	1	$30,000	$30,000
Forest Mitigation	AC	5.7	$33,000	$188,100	AC	7.4	$33,000	$244,200
Wetland Mitigation	AC	0.70	$55,000	$38,500	AC	0.80	$55,000	$44,000
TOTAL				**$246,600**				**$318,200**
Category 8: Traffic								
Local Roadway Marking	MILE	0.00		$0	MILE	0.00		$0
TOTAL				**$0**				**$0**
Category 9: Utilities								
Lighting (bridge and trail lighting)	LS	1	$410,000	$410,000	LS	1	$450,000	$450,000
TOTAL				**$410,000**				**$450,000**
TOTAL NEAT CONSTRUCTION COST			**SUBTOTAL**	**$12,674,053**			**SUBTOTAL**	**$14,274,559**
Engineering (30%)				$3,802,215.89				$4,282,367.62
HOCO Construction Administrative Costs (30%)				$3,802,215.89				$4,282,367.62
TOTAL ENGINEERING AND ADMINISTRATIVE COSTS			**SUBTOTAL**	**$7,604,432**			**SUBTOTAL**	**$8,564,735**
Right-of-Way (not included)				$0				$0
			TOTAL	**$20,278,485**			**TOTAL**	**$22,839,294**
20% INFLATION FOR 2024				$4,055,696.95				$4,567,858.79
40% CONTINGENCY				$9,733,673				$10,962,861
			TOTAL COST 3A	**$34,067,854**			**TOTAL COST 3B**	**$38,370,014**

DOWNTOWN COLUMBIA BRIDGE FEASIBILITY STUDY
Cost Estimate

November 14, 2014

	OPTION 4A ICONIC BRIDGE WITH SINGLE TRANSIT LANE PRECAST CONCRETE				**OPTION 4B** ICONIC BRIDGE WITH DUAL TRANSIT LANE PRECAST CONCRETE			
	Units	Quantity	Unit Cost	Cost	Units	Quantity	Unit Cost	Cost
Category 1: Preliminary								
Preliminary (40% of Categories 2, 4, 5 and 6) Includes Mobilization, Maintenance of Traffic (including vehicular and pedestrian)	LS	1	$3,309,200	$3,309,200	LS	1	$4,286,400	$4,286,400
Demolition of existing bridge	LS	1	$450,000	$450,000	LS	1	$450,000	$450,000
TOTAL				**$3,759,200**				**$4,736,400**
Category 2: Grading								
Class 1 Excavation	CY	5,000	$48	$240,000	CY	7,500	$48	$360,000
Borrow	CY	1,000	$63	$63,000	CY	2,500	$63	$157,500
TOTAL				**$303,000**				**$517,500**
Category 3: Drainage								
Drainage	LS	1	$12,000	$12,000	LS	1	$25,000	$25,000
Traditional SWM (BMP's)	LM	0.50	$50,000	$25,000	LM	0.50	$90,000	$45,000
Erosion and Sediment Control	LS	1.00	$350,873.36	$350,873	LS	1	$465,106.72	$465,107
TOTAL				**$387,873**				**$535,107**
Category 4: Structures								
Option 4A: ICONIC EXTRADOSED PRECAST BRIDGE 32' width precast concrete	SF	21730	$350	$7,605,500				
Option 4A: ICONIC EXTRADOSED PRECAST BRIDGE 42' width precast concrete					SF	28520	$350	$9,982,000
Retaining Walls w/ concrete footing	LF	800	$400	$320,000	LF	920	$400	$368,000
TOTAL				**$7,925,500**				**$10,350,000**
Category 5: Paving								
Transit Lane(s) -use HOCO Std. Paving Section P-3								
HMA Superpave Final Surface 9.5 mm - 1.5"	TON	382	$107	$40,874	TON	764	$107	$81,748
HMA Superpave Intermediate Surface 9.5 mm - 1.0"	TON	255	$107	$27,285	TON	510	$107	$54,570
HMA Superpave Base 19.0 mm- 3.0"	TON	765	$95	$72,675	TON	1530	$95	$145,350
Graded Aggregate Base - 10"	SY	5000	$12	$60,000	SY	10000	$12	$120,000
TOTAL				**$200,834**				**$401,668**
Category 6: Shoulders								
Curb and Gutter	LF	200	$25	$5,000	LF	300	$25	$7,500
Concrete Traffic Separation Barrier	LF	2,500	$135	$337,500	LF	2,600	$135	$351,000
TOTAL				**$342,500**				**$358,500**
Category 7: Landscaping								
Landscaping	LS	1	$20,000	$20,000	LS	1	$30,000	$30,000
Forest Mitigation	AC	5.5	$33,000	$181,500	AC	7.1	$33,000	$234,300
Wetland Mitigation	AC	0.5	$55,000	$27,500	AC	0.7	$55,000	$38,500
TOTAL				**$229,000**				**$302,800**
Category 8: Traffic								
Local Roadway Marking	MILE	0.00		$0	MILE	0.00		$0
TOTAL				**$0**				**$0**
Category 9: Utilities		0		$0				$0
Lighting (bridge and trail lighting)	LS	1	$410,000	$410,000	LS	1	$450,000	$450,000
TOTAL				**$410,000**				**$450,000**
TOTAL NEAT CONSTRUCTION COST			**SUBTOTAL**	**$13,557,907**			**SUBTOTAL**	**$17,651,975**
Engineering (30%)				$4,067,372.21				$5,295,592.42
HOCO Construction Administrative Costs (30%)				$4,067,372.21				$5,295,592.42
TOTAL ENGINEERING AND ADMINISTRATIVE COSTS			**SUBTOTAL**	**$8,134,744**			**SUBTOTAL**	**$10,591,185**
Right-of-Way (not included)				$0				$0
			TOTAL	**$21,692,652**			**TOTAL**	**$28,243,160**
20% INFLATION FOR 2024				$4,338,530.36				$5,648,631.91
40% CONTINGENCY				$10,412,472.85				$13,556,717
			TOTAL COST 4A	**$36,443,655**			**TOTAL COST 4B**	**$47,448,508**

DOWNTOWN COLUMBIA BRIDGE FEASIBILITY STUDY
Cost Estimate

November 14, 2014

Length from LPP to SFR across lake *2,400*	OPTION 5A LAKE BRIDGE AND US 29 BRIDGE WITH BIKE/PED AND DUAL TRANSIT LANE PRECAST CONCRETE				OPTION 5B LAKE BRIDGE AND US 29 BRIDGE WITH DUAL TRANSIT LANE AND RETROFIT EXISTING BRIDGE PRECAST CONCRETE			
	Units	Quantity	Unit Cost	Cost	Units	Quantity	Unit Cost	Cost
Category 1: Preliminary								
Preliminary (40% of Categories 2, 4, 5 and 6) Includes Mobilization, Maintenance of Traffic (including vehicular and pedestrian)	LS	1	$16,865,337	$16,865,336.64	LS	1	$12,757,549	$12,757,549
Demolition of existing bridge	LS	1	$425,000	$425,000				
TOTAL				**$17,290,337**				**$12,757,549**
Category 2: Grading								
Class 1 Excavation	CY	1,000	$48	$48,000	CY	1,500	$48	$72,000
Borrow	CY	1,000	$63	$63,000	CY	2,500	$63	$157,500
TOTAL				**$111,000**				**$229,500**
Category 3: Drainage								
Drainage	LS	1	$50,000	$50,000	LS	1	$100,000	$100,000
Traditional SWM (BMP's)	LM	0.50	$75,000	$37,500	LM	0.50	$100,000	$50,000
Erosion and Sediment Control	LS	1	$1,618,301.60	$1,618,302	LS	1	$1,220,918.20	$1,220,918
TOTAL				**$1,705,802**				**$1,370,918**
Category 4: Structures								
Option 5A: ICONIC LAKE BRIDGE AND STEEL GIRDER BRIDGES **44'** width precast concrete	SF	106,000	$375	$39,750,000				
Option 5B: ICONIC CABLE-STAYED BRIDGE AND STEEL GIRDER SPANS **32'** width precast concrete (no bike / ped)					SF	77,000	$375	$28,875,000
Existing Bridge: Retrofit with fabricated steel cage from Option 1					LF	679	$600	$407,400
Existing bridge: Paint steel box beam (includes cleaning and painting outside parapet)					LF	679	$100	$67,900
Existing Bridge: Deck Artistic Treatment					SF	6,790	$12	$81,480
Retaining Walls w/ concrete footing	LF	1,200	$400	$480,000	LF	1600	$400	$640,000
TOTAL				**$40,230,000**				**$30,071,780**
Category 5: Paving								
Transit Lane(s) -use HOCO Std. Paving Section P-3								
HMA Superpave Final Surface 9.5 mm - 1.5"	TON	115	$107	$12,305	TON	400	$107	$42,800
HMA Superpave Intermediate Surface 9.5 mm - 1.0"	TON	80	$107	$8,560	TON	275	$107	$29,425
HMA Superpave Base 19.0 mm- 3.0"	TON	765	$95	$72,675	TON	850	$95	$80,750
Graded Aggregate Base - 10"	SY	1500	$12	$18,000	SY	5100	$12	$61,200
TOTAL				**$111,540**				**$214,175**
Category 6: Shoulders								
Curb and Gutter	LF	200	$25	$5,000	LF	300	$25	$7,500
TOTAL				**$5,000**				**$7,500**
Category 7: Landscaping								
Landscaping	LS	1	$20,000	$20,000	LS	1	$30,000	$30,000
Forest Mitigation	AC	2	$33,000	$69,300	AC	2.8	$33,000	$92,400
Wetland Mitigation	AC	1	$55,000	$55,000	AC	1.2	$55,000	$66,000
TOTAL				**$144,300**				**$188,400**
Category 8: Traffic								
Local Roadway Marking	MILE	0.00		$0	MILE	0.00		$0
TOTAL				**$0**				**$0**
Category 9: Utilities		0		$0				$0
Lighting (bridge lighting)	LS	1	$500,000	$500,000	LS	1	$600,000	$600,000
TOTAL				**$500,000**				**$600,000**
TOTAL NEAT CONSTRUCTION COST			**SUBTOTAL**	**$60,097,978**			**SUBTOTAL**	**$45,439,822**
Engineering (30%)				$18,029,393.47				$13,631,946.74
HOCO Construction Administrative Costs (30%)				$18,029,393.47				$13,631,946.74
TOTAL ENGINEERING AND ADMINISTRATIVE COSTS			**SUBTOTAL**	**$36,058,787**			**SUBTOTAL**	**$27,263,893**
Right-of-Way (not included)				$0				$0
			TOTAL	**$96,156,765**			**TOTAL**	**$72,703,716**
20% INFLATION FOR 2024				$19,231,353.04				$14,540,743.19
40% CONTINGENCY				$46,155,247.29				$34,897,783.66
			TOTAL COST 5A	**$161,543,366**			**TOTAL COST 5B**	**$122,142,243**

DOWNTOWN COLUMBIA BRIDGE FEASIBILITY STUDY

Cost Estimate

November 14, 2014

Length of PRT *3,300 LF* *0.6 miles*	OPTION 6 PRT - PERSONAL RAPID TRANSIT			
	Units	Quantity	Unit Cost	Cost
Category 1: Preliminary				
Preliminary (40% of Categories 2, 4, 5 and 6) Includes Mobilization, Maintenance of Traffic (including vehicular and pedestrian)	LS	1	$10,402,300	10,402,300
TOTAL				**10,402,300**
Category 2: Grading				
Class 1 Excavation	CY	750	$50	37,500
Borrow	CY	0	$65	0
TOTAL				**37,500**
Category 3: Drainage				
Drainage	LS	1	$12,000	12,000
Traditional SWM (BMP's)	LM	0.50	$100,000	50,000
Erosion and Sediment Control	LS	1.00	$780,173	780,173
TOTAL				**842,173**
Category 4: Structures				
PRT / MONORAIL (OR TRACK)	LF	3300	$7,500	24,750,000
PRT Stations	EA	2	$600,000	1,200,000
TOTAL				**25,950,000**
Category 5: Paving				
4" Total Depth of Asphalt	SY	350	$25	8,750
6" Total Depth of Graded Aggregate Base	SY	375	$12	4,500
TOTAL				**13,250**
Category 6: Shoulders				
Curb and Gutter	LF	200	$25	5,000
TOTAL				**5,000**
Category 7: Landscaping				
Landscaping	LS	1	$5,000	5,000
Forest Mitigation	AC	3	$33,000	82,500
Wetland Mitigation	AC	0	$55,000	13,750
TOTAL				**$101,250**
Category 8: Traffic				
Local Roadway Marking	MILE	0.00		0
TOTAL				**0**
Category 9: Utilities				
No Lighting				0
TOTAL				**0**
TOTAL NEAT CONSTRUCTION COST			**SUBTOTAL**	**$37,332,723**
Engineering (30%)				$11,199,816.75
HOCO Construction Administrative Costs (25%)				$9,333,180.63
TOTAL ENGINEERING AND ADMINISTRATIVE COSTS			**SUBTOTAL**	**$20,532,997.38**
Right-of-Way (not included)				$0
			TOTAL	**$57,865,720**
20% INFLATION FOR 2024				$11,573,143.98
40% CONTINGENCY				$27,775,545.54
			TOTAL COST	**$97,214,409**

DOWNTOWN COLUMBIA BRIDGE FEASIBILITY STUDY
Cost Estimate

November 14, 2014

1500 LF of boardwalk	**OPTION 7 RAISED BOARDWALK**			
	Units	Quantity	Unit Cost	Cost
Category 1: Preliminary				
Preliminary (40% of Categories 2, 4, 5 and 6) Includes Mobilization, Maintenance of Traffic (including vehicular and pedestrian)	LS	1	$200,000	$200,000
TOTAL				**$200,000**
Category 2: Grading				
Class 1 Excavation	CY	250	$50	$12,500
Borrow	CY	0	$65	$0
TOTAL				**$12,500**
Category 3: Drainage				
Drainage	LS	1	$0	$0
Traditional SWM (BMP's)	LM	0.25	$50,000	$12,500
Erosion and Sediment Control	LS	1.00	$20,000	20,000
TOTAL				**$32,500**
Category 4: Structures				
Raised Boardwalk (east side only)	LF	1500	$325	$487,500
TOTAL				**$487,500**
Category 5: Paving				
Trail - 4" Total Depth of Asphalt	SY	0	$23	$0
Trail Base - 6" Total Depth of Graded Aggregate Base	SY	0	$10	$0
TOTAL				**$0**
Category 6: Shoulders				
Curb and Gutter	LF	0		$0
TOTAL				**$0**
Category 7: Landscaping				
Landscaping	LS	0	$0	$0
Forest Mitigation	AC	0.6	$33,000	19,800
Wetland Mitigation	AC	0.3	$55,000	13,750
TOTAL				**$33,550**
Category 8: Traffic				
Local Roadway Marking	MILE	0.00		$0
TOTAL				**$0**
Category 9: Utilities				$0
Lighting (to supplement HHC lighting)	LS	1	$150,000	$150,000
TOTAL				**$150,000**
TOTAL NEAT CONSTRUCTION COST			**SUBTOTAL**	**$766,050**
Engineering (20%)				$153,210.00
HOCO Construction Administrative Costs (20%)				$153,210.00
TOTAL ENGINEERING AND ADMINISTRATIVE COSTS			**SUBTOTAL**	**$306,420.00**
Right-of-Way (not included)				$0
			TOTAL	**$1,072,470**
15% INFLATION FOR 2017				$160,870.50
40% CONTINGENCY				$493,336.20
			TOTAL COST	**$1,726,677**

Appendix B
Detailed Time Estimates

Estimated Timelines for Duration of Design and Construction *	**OPTION 1:** RETROFIT EXISTING BRIDGE		**OPTION 2:** RETROFIT W/ COMPLEMENTARY SINGLE TRANSIT LANE		**OPTIONS 3 THRU 6:** MAJOR BRIDGE PROJECTS	
Milestones or Tasks	Anticipated Time Frame	Running Total Time – **Months / Years**	Anticipated Time Frame	Running Total Time – **Months / Years**	Anticipated Time Frame	Running Total Time - **Months / Years**
1. Downtown Columbia Bridge Feasibility Study	November 2014	---	November 2014	---	November 2014	---
2. Decision by HOCO on Alternative Selections	.75 months	.75	3 months	3	5 months	5
3. Decision by HOCO on Project Start for Selected Alternative (in coordination with SHA)	0.5 months	1.25	4 months	7	2 months	7
4. Funding Alternatives Analysis	0.5 month	1.75	2 months	9	2 months	9 / 1 yr
5. Prepare RFP for Design Consultant	1 month	2.75	3 months	12 / 1 yr	3 months	12
6. Consultant Selection Process	1 month	3.75	3 months	15	3 months	15
7. Consultant NTP	0.75 months	4.5	1 month	16	1 month	16
8. Surveying (topographic)	Use HHC trail	---	3 months	19	3 months	19
9. Initiate Property Acquisition Process	---	---	1 month	20	1 month	20
10. Environmental Documentation (NEPA) Field work	---	---	1 month	21	1 month	21
11. Preliminary Design 30% Design TS&L (Type, Size & Location)	1.5 months	6	3 months	24 / 2 yrs	11 months	32 / 2.7 yrs
12. 30% Review Meeting (P.I., or Preliminary Investigation) with HOCO / SHA	1 month	7	1 month	25	1 month	33
13. Funding Application(s) preparation and submittals	Assumes no federal or state funding		Using federal funding 4 mo.	29	Using federal funding 4 mo.	37
14. Secure HOCO Funding	---	---	---	---	---	---
15. Design Development 65% (Semi-Final) Bridge	2.5 months	9.5	8 months	37 / 3 yrs	13 months	50 / 4.2 yrs
16. 65% Design Review (Semi-Final) Meeting with HOCO and SHA (submittal & review period)	.75 month	10.25	2 months	39	2 months	52
17. Right-of-Way Process	---	---	1 month	40	1 month	53
18. Geotechnical Investigation	---	---	2 months	42	2 months	55
19. Permitting – start environmental permits	---	---	2 month	44	2 months	57
20. Stormwater management Concept design, review and approval	---	---	2.5 months	46.5	3 months	60 / 5 yrs
21. 65% Review Meeting (submittal & review period)	2 months	12.25 / 1 YR	2 months	47.5 / 4 yrs	2 months	62
22. Final Review 90% Plans, Specs and Estimate	2.25 months	14.5	5 months	52.5 / 4.3 yrs	6 months	68 / 5.7 yrs
23. Final Review 90% Meeting (submittal & review period for HOCO and SHA)	2 months	16.5	3 months	55.5	3 months	71
24. Right-of-Way Certification (boundary survey if needed)	---	---	2 months	57.5	2 months	73
25. 100% Plans, Specs and Estimate (PS&E)	1.5 months	18 / 1.5 YRS	2.5 months	60 / 5 yrs	3 months	76
26. FHWA Approvals (if federal funding used)	---	---	2 months	62	2 months	78
27. Final Permits / MOU / NEPA	1.5 months	19.5	2 months	64	2 months	80
28. Approval to Advertise	1.25 months	20.75	1 months	65	1 months	81
29. Advertisement	1.5 months	22.25	1 month	66	1 months	**82 / 6.8 yrs**
30. Bid Period, Addenda, Bid Opening	1.75months	24 / 2 YRS	2 months	68	2 months	84
31. NPDES Permit approval	----	---	1 month	69	1 month	85
32. Award of Construction Contract	1 months	25	1 month	70	1 month	86
33. NTP	1 months	26	1 month	71	1 month	87
34. Construction, redline and green line drawings, inspections	3.75 months	**29.75**	16 months	**87 / 7.25 yrs**	20 months	**107 / 9 yrs**
35. Construction Complete, punchlists	0.25 month	30	1 month	88	1 month	108
36. As-Builts	.5 month	30.5	1 month	89	1 month	109
37. Project Close-out and Ribbon Cutting	.5 month	31 / 2.5 YRS	1 month	90 / **7.5 years**	1 month	110/ **9.2 yrs**

* Note: Timelines above are estimated and modeled on a typical MDSHA bridge project. Durations will vary and are dependent on the complexity of design, permitting, right-of-way acquisition, etc. Some tasks, such as permitting and environmental investigations, may be concurrent if the design process, reviews and agencies allow.